Clinton Creek Remediation Project

Environmental Site Characterization Update
Clinton Creek, Yukon

Prepared for:

Government of Yukon
Whitehorse, Yukon

June 2019
VE52705D.100

Prepared for:

Government of Yukon
Assessment and Abandoned Mines
Energy, Mines and Resources
Whitehorse, Yukon

Prepared by:

Wood Environment & Infrastructure Solutions
#600 – 4445 Lougheed Highway
Burnaby, BC V5C 0E4

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Table of Contents

Table of Contents (cont'd)

Page

List of Tables

List of Figures

Figures and Analytical Data - Tailings, Waste Dump and Soil

Figures and Analytical Data - Water Quality

List of Appendices

List of Acronyms and Abbreviations

AACE	American Association of Cost Engineers
AAM	Assessment and Abandoned Mines
ABA	Acid-base accounting
CCME	Canadian Council of Ministers of the Environment
CCRP	Clinton Creek Remediation Project
CIRNAC	Crown-Indigenous Relations and Northern Affairs Canada
CoC	Contaminants of Concern
CPT	Cone Penetration Test
DOM	Detrital Organic Matter
DS	Drop Structure
FAL	Freshwater Aquatic Life
GY	Government of Yukon
HHERA	Human Health and Ecological Risk Assessment
IPRP	Independent Project Review Panel
LCCA	Life Cycle Cost Analysis
SWEP	Special Waste Extraction Procedure
TA	Task Authorization
TH	Tr’ondëk Hwëch’in
VWP	Vibrating Wire Piezometer
Wood	Wood Environment & Infrastructure Solutions, a Division of Wood Canada
YG	Yukon Government

1.0 INTRODUCTION

1.1 Site Description

The Clinton Creek Mine Site (the Site) is a former asbestos mine which was operated between 1968 and 1978. The site is located approximately 100 km northwest of Dawson City, Yukon, near the confluence of Fortymile River and the Yukon River (Figure 1.1), and the site is accessed from the Top of the World Highway (Yukon Highway 9) and the Clinton Creek Road. These routes are typically maintained between the months of June and September when the George Black River Ferry is running between East Dawson and West Dawson. During the fall and winter months the site is only accessible by helicopter or snowmobile.

Major elements of the site are shown on Figure 1.2. During mine operations, material was removed from three ore sources, the Porcupine Pit (the largest pit), Horseshoe Pit and the Creek Pit. Waste was placed in the following locations:

1. Clinton Creek Waste Dump, where waste was placed along the south valley wall of the Clinton Creek valley. It is estimated that 60 million tonnes of waste were placed in the Clinton Creek Waste Dump;
2. Porcupine Creek Waste Dump, where waste was placed into the Porcupine Creek valley (Porcupine Creek Waste Dump); and
3. Snowshoe Pit Waste Dump, where waste was placed on the north side of the Snowshoe Pit along the top of the south Clinton Creek valley wall.

During mining operations, ore was transported from the south side of the Clinton Creek valley to the Mill Site, located on high ground on the north side of Clinton Creek, at the top of the west valley wall of Wolverine Creek, via an aerial tramway. The ore, a serpentine rock containing chrysotile asbestos, was processed in the mill and the waste material, or tailings, were transported via conveyor to two piles along the steep west slope of Wolverine Creek, one pile located north of the other. Approximately 12 million tonnes of tailings were deposited in these two piles. It is understood from conversations with former mine workers that material was never dozed over the valley wall, and that the piles were gravity stacked.

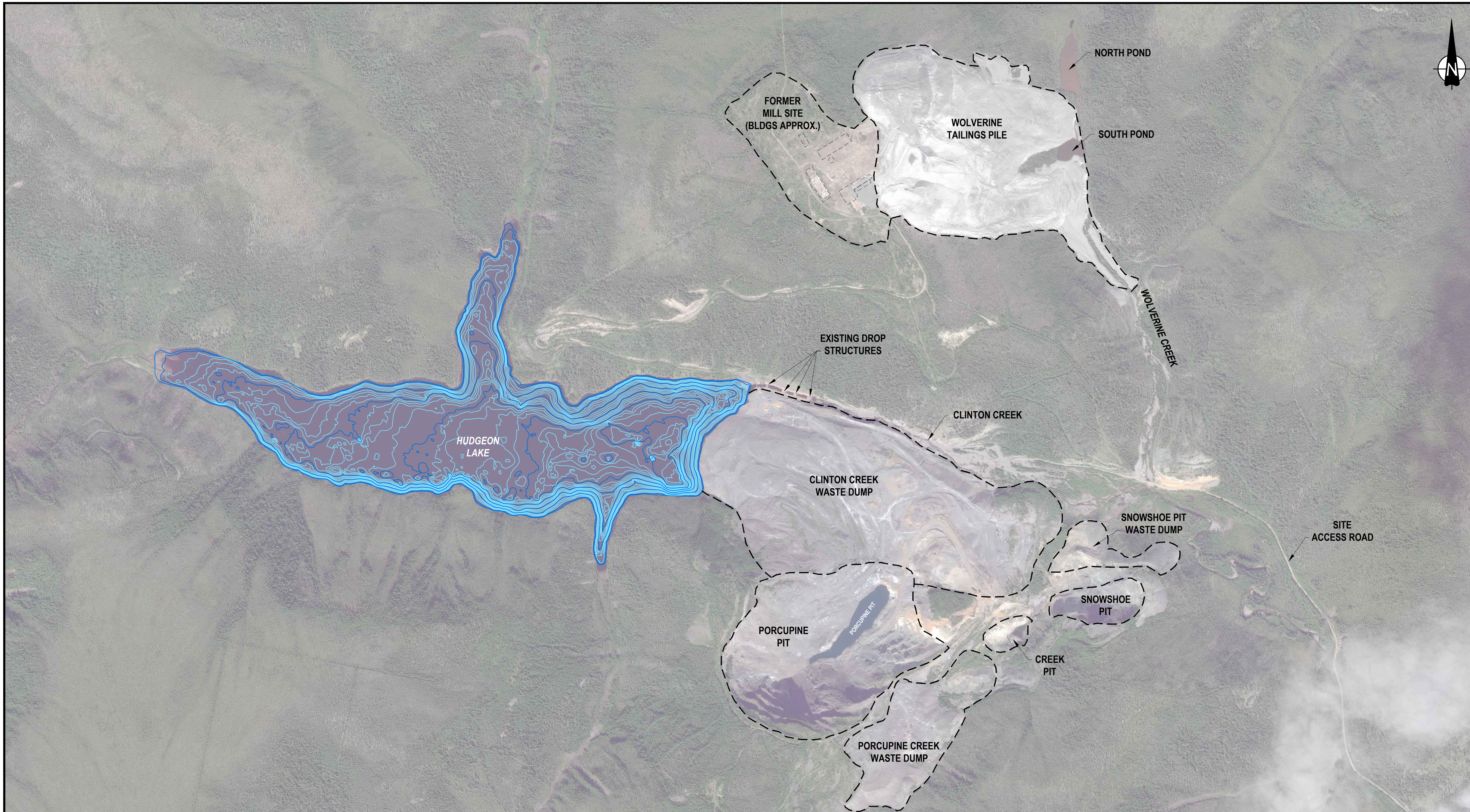
In 1974, waste placed on the south slope of the Clinton Creek valley, the Clinton Creek Waste Dump, is believed to have failed and blocked the Clinton Creek flow path. It should be noted that Clinton Creek was diverted north of the natural creek alignment, which originally flowed along the south toe of the Clinton Creek valley, prior to the failure of the Clinton Creek Waste Dump. The failure created a landslide dam, which impounded water upstream, producing what is now known as Hudgeon Lake. Additional information about the formation of Hudgeon Lake is provided in Amec Foster Wheeler (2018a). It is currently believed that only a portion of the Clinton Creek Waste Dump failed, and that efforts were made to stabilize the resulting landslide dam. Currently, water discharging from Hudgeon Lake travels southeast via Clinton Creek to Fortymile River, approximately 8 km downstream, through four gabion drop structures (DS1, DS2, DS3 and DS4), constructed between 2002 and 2004. DS4 was upgraded and repaired in 2015, following damage sustained in 2010. Damage to DS4 was noted in the field following the spring freshet in 2018, and additional damage was caused to the drop structure during a flood event in August 2018. Supplementary repairs were completed to DS4 in September 2018 (Tetra Tech 2018).

wood.

Environment & Infrastructure Solutions
a Division of Wood Canada Limited
#600 - 4445 Lougheed Highway
Burnaby, BC V5C 0E4
Tel. 604-294-3811 Fax 604-294-4664

DWN BY:	TH
CHK'D BY:	KH
DATUM:	NAD 83
PROJECTION:	UTM Zone 7
SCALE:	AS SHOWN
CLIENT / PROJECT:	CLINTON CREEK GEOTECHNICAL SITE CHARACTERISATION
TITLE:	SITE LOCATION PLAN
DATE:	JUNE 2019
PROJECT NO:	VE52705
REV. NO:	A
FIGURE NO:	1.1

P:\CAD\CIV\2018 Site Investigation PDF\Figure-1.1.dwg - FIG 1.1 - Jul. 02, 2019 3:01pm - Juliana.Matos



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Environment & Infrastructure Solutions
a Division of Wood Canada Limited
#600 - 4445 Lougheed Highway
Burnaby, BC V5C 0E4
Tel. 604-294-3811 Fax 604-294-4664

CLIENT: Yukon

DWN BY:	TH
CHK'D BY:	KH
DATUM:	NAD 83
PROJECTION:	UTM Zone 7
SCALE:	AS SHOWN

PROJECT: CLINTON CREEK MINE GEOTECHNICAL SITE CHARACTERISATION

TITLE: SITE LAYOUT

DATE:	JUNE 2019
PROJECT NO:	VE52705C.100.2
REV. NO:	A
FIGURE NO:	1.2

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The south tailings lobe also failed in 1974, blocking Wolverine Creek. It is understood that the initial failure of the tailings was relatively rapid, and there was considerable mobility of the initially steep tailings cone down the slope, blocking Wolverine Creek, and then down the Wolverine Creek valley following the breach of the temporary landslide dam. Per Amec Foster Wheeler (2018b), there is some evidence that suggests liquefaction may have been a factor in the failure of the tailings pile. At some time post mine-closure, the north tailings pile also blocked Wolverine Creek. At present, there are two ponds which have formed along Wolverine Creek, one upstream of the north tailings lobe and one between the two tailings lobes, referred to as North and South Ponds, respectively. The North Pond discharges into the South Pond and flows from the South Pond is conveyed south via Wolverine Creek, finally discharging into Clinton Creek near the site gate.

1.2 Scope Development

In 2016, the Project Parties (Government of Yukon (the *Owner*), Indigenous and Northern Affairs Canada (INAC), and of Tr'ondëk Hwëch'in (TH)) sought the development of a 10% design and an AACE Class 4 LCCA for three closure concepts on the Clinton Creek side, three closure concepts on the Wolverine Creek side, and common elements, as described below.

<u>Clinton Creek Side Closure Concepts</u>

a) **Water Passage and Catastrophic Failure Mitigation (LCCA Option D3, I2)** – Conduct sufficient work on the waste rock pile to mitigate a catastrophic failure of the pile and construct a water conveyance channel to provide water passage from Hudgeon Lake to Clinton Creek.

b) **Water Passage, Catastrophic Failure Mitigation and Lowering Lake (LCCA Option E3)** – Conduct sufficient work on the waste rock pile to mitigate a catastrophic failure, construct a water conveyance channel to provide water passage from Hudgeon Lake to Clinton Creek, and lower Hudgeon Lake as part of that concept.

c) **Water Passage with Reduction of the Lake Level, Eliminating the Dam, and Mitigating Catastrophic Failure (LCCA Option F)** – Conduct sufficient work on the waste rock pile to prevent it from acting as a Dam (i.e. as defined by the Canadian Dam Association) on Clinton Creek and to mitigate a catastrophic failure of the waste rock pile. Construct a water conveyance channel to provide water passage through the site.

<u>Wolverine Creek Side Closure Concepts</u>

a) **Sediment Control Only (Not in the LCCA)** – Construct a sediment control structure downstream of the rock-lined channel in Wolverine Creek – no work on the tailings pile or the channel is required.

b) **Water Passage and Stability Improvement (LCCA Option B, C, D, D2 – note that Option B does not have a remediation measure for the tailings)** – Conduct sufficient work at the base of the tailings pile to minimize the tailings movement and provide a semi-stable surface to construct a water conveyance channel.

c) **Isolate the Asbestos (LCCA Option E, E2)** – Stabilize tailings pile to allow a cover to be placed or relocate the tailings pile.

Common Elements Closure Concepts

a) Porcupine Creek Waste Rock Pile

b) Snowshoe Pit Waste Rock Pile

c) Porcupine Creek and Snowshoe Pits

d) Hudgeon Lake Outlet Abutments and Log boom

e) Former Mill Site

f) Air Strip

g) Miscellaneous Borrow Areas

h) Miscellaneous Waste

i) Two Large Pieces of Equipment

j) Ore Piles

k) Clinton Creek Access and Site Roads

l) Other Roads

m) Clinton Creek Crossings

n) Miscellaneous Infrastructure

Wood was retained in 2016 by the Yukon Government to complete a Site Investigation (SI), a Human Health and Ecological Risk Assessment (HHERA) and to progress design development activity. Following review of Wood field data collected and initial design concepts, the Project Parties elected in the spring of 2017 to halt the development of the geotechnical aspects of the 10% remediation designs until an agreed upon conceptual site model was established.

The current Assessment and Abandoned Mines (AAM), Government of Yukon (YG) Scope of Work was developed in October 2017 and addressed the continuation of engineering services related to the Clinton Creek Remediation Project. This revised scope involved updating the reports drafted by Amec Foster Wheeler, additional document and data reviews, analyses, data gap assessments, field investigation planning and execution, and the continued development of remedial designs for the property. The execution plan responding to the YG scope of work was described in Wood (2018c).

1.3 Environmental/Contaminants Site Characterization Report

The initial site characterization report that this document updates (Amec Foster Wheeler 2018c) focused on the status of characterization data that would be relevant to those site remediation and/or management issues apart from those relating to the management or mitigation of movements in the waste dump and tailings piles (i.e., the "non-geotechnical" components of closure planning). It was a synopsis of what was known about conditions on the property; what was understood, or could be inferred about the key drivers for selection of remediation/management options and what remained to be understood before these selections could be made.

The document provided summary observations relating to conditions on the property that were evident prior to the 2018 site investigation. Key characterization issues identified by the document were as follows:

- From a contaminants perspective, the predominant issues were the elevated metals and asbestos materials at, or near grade on waste dumps and tailings piles or accumulations.
- The waste and tailings sources were not acid generating, and this limited the areal and vertical reach of downstream influences.
- The physical redistribution of fine grained materials from the rock and tails had influenced the quality of downstream creek sediments, but over limited distances.
- Generally, downstream creek water qualities exhibited influences from the rock and tails, but these influences did not appear to be significant enough, or sustained enough to produce clearly intolerable water qualities at any distance from the site.
- Lake and ponded water qualities, and the ecosystems that they can support, had clearly been influenced by, or were a direct consequence of, the presence of waste dumps and tailings piles. However, for the most part, these influences were limited to the waterbodies themselves, and the physical constraints that were a consequence of their presence (e.g., barriers to fish passage).
- Similarly, while various studies had identified changes in local downstream ecologies (e.g., benthic communities) that could be attributed to the rock and tailings sources, it seemed unlikely that these changes would rise above consequence thresholds that would drive dedicated and incrementally significant remedial efforts on the property.

1.4 Document Purpose

This document provides an update to those environmental attributes and/or conditions of the Clinton Creek site that derive largely from the outcomes of the 2018 field investigation on the site, that will influence the selection of a closure concept for the property and the nature and scope of that concept.

In making the interpretations and trade-offs that will ultimately be required to define remediation and reclamation requirements, Wood has applied judgements to the interpretations of available characterization data, and in the identification of key drivers for the selection of alternatives. While Wood believes available data are sufficient to assess alternatives, there remain some characterization data gaps that may require additional consideration prior to execution of a closure plan. Wood's view is that these gaps are not of a significance that will influence selection of a concept and are therefore best addressed during design development and/or permitting of a preferred option.

1.5 Document Scope

This characterization update addresses the environmental components of the broader closure scope, which also includes measures for the physical stabilization of various site features, the waste dump and tailings accumulations in particular. The geotechnical characterizations that support these stabilization efforts are described in a separate, companion document (Wood 2019).

1.6 Document Development

This document updates and expands upon the characterization summary (Amec Foster Wheeler 2018c) that focused on the identification of data gaps to be addressed by the 2018 site investigation. The final scope for that program was described in an Investigation Execution Plan (IEP) (Wood 2018a) and the resulting outcomes in an investigative report (Wood 2019a). These investigative outcomes also supported an update to the 2017 Human Health and Ecological Risk Assessment (Amec Foster Wheeler 2017) that is described in a separate, companion document (Wood 2019b).

2.0 DATA SOURCES

The data sources that have contributed to this characterization update are described in the following sections. These sources combine the large dataset that predated Wood's current involvement in the project, with the information compiled during the 2018 site investigation and the ongoing site monitoring programs managed separately by AAM.

2.1 Soil, Waste Material and Tailings Data Tables

Environmental analytical data for soils, tails and waste material generated by all Clinton site investigations (2018 and prior) are presented in the following tables that are included in the separate Figures and Analytical Data (Tailings, Waste Material and Soil) section of this document:

- Table S1 - asbestos and metals data for waste dump material ;
- Table S2 - asbestos and metals data for tailings;
- Table S3 - asbestos and metals data for soils and sediments in the Porcupine Creek area;
- Table S4 - asbestos and metals data for soils in the mill area;
- Table S5 - hydrocarbons and PCB data for soils in the mill area; and
- Table S6 - background soil conditions.

These tables combine the 2018 site investigation results with the data compiled during the previous programs described in the 2017 HHERA (Amec Foster Wheeler 2017). The locations referenced in these tables are shown on the figures at the front end of the separate section referenced above.

2.2 Water Quality

Various water quality characterization and monitoring activities have been undertaken at the Clinton Creek property dating back to the immediate post closure period. Systematic monitoring efforts at prescribed locations have been undertaken since 2009. These monitoring activities and outcomes are described in Minnow (2010), Laberge (2012), ELR (2014), Hemmera (2015, 2016, 2016a, 2016b), and EDI (2018).

The Yukon Government currently undertakes monthly water quality monitoring at the Clinton property. This program involves surface water quality sampling, groundwater seep sampling, hydrometric measurements, snow surveys, and meteorological data management. Monitoring activities have been completed monthly since September 2017. The work is undertaken by EDI Environmental Dynamics Inc. (EDI) under contract to Yukon. The conduct and findings of the current program are described in EDI (2018).

EDI maintains an Access database for recent water quality monitoring events (i.e., since 2017). Excerpts from this database and from the previous monitoring events referenced above are included in the characterization updates by site component that are presented in Section 3 and in the separate Figures and Analytical Tables (Water Quality) section of this document. These excerpts (the W series tables in the separate section) are intended to focus on those key parameters of concern that are of particular interest for individual site elements. Monitoring locations are shown on the figure included at the front of the separate water quality section (note that location E4 (not included on the figure)) is downstream of the site on Clinton Creek, just upgradient of the confluence with Eagle Creek).

Parameter excursions are identified in the W series tables relative to CCME's Freshwater Aquatic Life (FAL) criteria (CCME 2019) and Health Canada's Guidelines for Canadian Drinking Water Quality (Health Canada 2017). The latter criteria are not directly relevant given that the Clinton Creek waters are not currently a potable water source, and are unlikely to be used as such in the future. However, these drinking water guidelines provide useful context in that they broadly characterize the likelihood that actionable risks might be associated with any exceedances of aquatic life criteria. For example, areally limited exceedances between FAL and drinking water criteria are considered unlikely to generate materially incremental requirements to the closure concept scope.

2.3 Sediment Quality

There were no additional creek sediment data assembled during the 2018 investigative program. The available table is compiled as Table B.6 of Amec Foster Wheeler (2017).

2.4 Asbestos Air Monitoring Program

The air monitoring program conducted during the 2018 investigation program at the Clinton Creek property provided an expanded dataset on asbestos in air levels. This expanded dataset was a key input to the HHERA update described in Section 2.7. A report describing the conduct and findings of the Air Quality and Occupational Exposure Monitoring Program is provided in Wood (2019a).

In summary, air monitoring identified elevated concentrations of asbestos fibres (relative to conservative assessment criteria) in several locations, within and outside of restricted areas. Elevated asbestos fibre concentrations were also associated with several personnel performing tasks within the restricted areas of the site. While none of the elevated concentrations reached the site specific Action Level of 0.05 f/cc or the applicable Yukon OEL, the results indicate that intrusive site activities have the potential to generate airborne asbestos fibres in the waste dumps and tailings areas of site. Furthermore, elevated concentrations of asbestos fibres present in non-restricted areas indicated that asbestos contamination may be transported from restricted areas either through wind transport or through cross-contamination.

2.5 Small Mammals Survey

The 2018 field investigation also included the conduct of a small mammals sampling and assessment program to assess the potential contamination and histological effects of asbestos and metals in small mammals on and near the tailings area. Again, the purpose of this survey was to provide additional data input to the HHERA update described in Section 2.7. Methods and results are reported in Wood (2019a) and summarized below.

2.5.1 Capture

Two species of small mammals were captured in the Clinton Creek Asbestos Mine area: red-backed vole (n = 32) and meadow vole (n = 4), both herbivores. Similar numbers of red-backed voles were captured in the Mill and Control areas (n = 13 and 19, respectively). No voles were captured adjacent to the tailings area during 281 trap nights.

2.5.2 Metal Analyses

Chromium and nickel are the two primary metals of concern at Clinton Creek. The small mammal sampling at Clinton Creek did not indicate increased levels of those metals in any of the voles sampled. The results of the metals analyses are used in the HHRA and ERA updates (Section 2.7 and Wood (2019b)).

2.5.3 Histology

The only substantive histological difference between voles captured in the Mill and Control areas was the presence of erythrocytes (indicating blood) in lung tissue of voles captured in the Mill area. That condition may be an artifact of euthanasia; however, because animals were handled similarly in both areas, there may be environmental factors involved. There were no other indications that the animals were affected by exposure to contaminants. Histology examinations are used in the updated ERA (Section 2.7 and Wood (2019b)).

2.6 Operational History Update

2.6.1 Purpose

The characterization assessments completed over the years provided varying and generally limited descriptions of the facility's processing operations. A systematic operational history for the property had not been developed prior to the 2018 investigative program. Much of this could be inferred or was self evident from the range of investigations and assessments completed for the site, but a more complete operational history was undertaken as part of Wood's current scope to identify any large volume processing inputs that should be considered (i.e., beyond the incidental fuels, solvents and other chemical inventories that would be associated with any industrial operation of this scale).

This operational history provides data input for the general characterization of the Clinton property and updates a preliminary history provided in Amec Foster Wheeler (2018c). The operational history provides:

- an overview of typical asbestos milling operations;
- a presentation of historical information/references that describe the operation at the Clinton Creek property in particular;
- an outline of the information that could be derived from a review of available historical aerial photographs; and
- a discussion of the significant contaminant sources that were likely associated with the Clinton Creek operation.

2.6.2 Asbestos Milling Operations

2.6.2.1 Asbestos Source Material

There are six types of asbestos: actinolite, amosite, anthophyllite, crocidolite, tremolite, and chrysolite. The first five types are known as amphiboles and are characterized by having very strong and stiff fibres, which makes them a serious health hazard. Amphibolic asbestos fibres can penetrate body tissue, especially in the lungs, and eventually cause tumours to develop. The sixth type of asbestos, chrysotile, exhibits serpentine fibres that are much softer and more flexible than amphibolic asbestos, and they do less damage to body tissue. All six types of asbestos are composed of long chains of silicon and oxygen atoms, locked together with various metals, such as magnesium and iron, to form the whisker-like crystalline fibres that characterize this mineral (Advameg 2018).

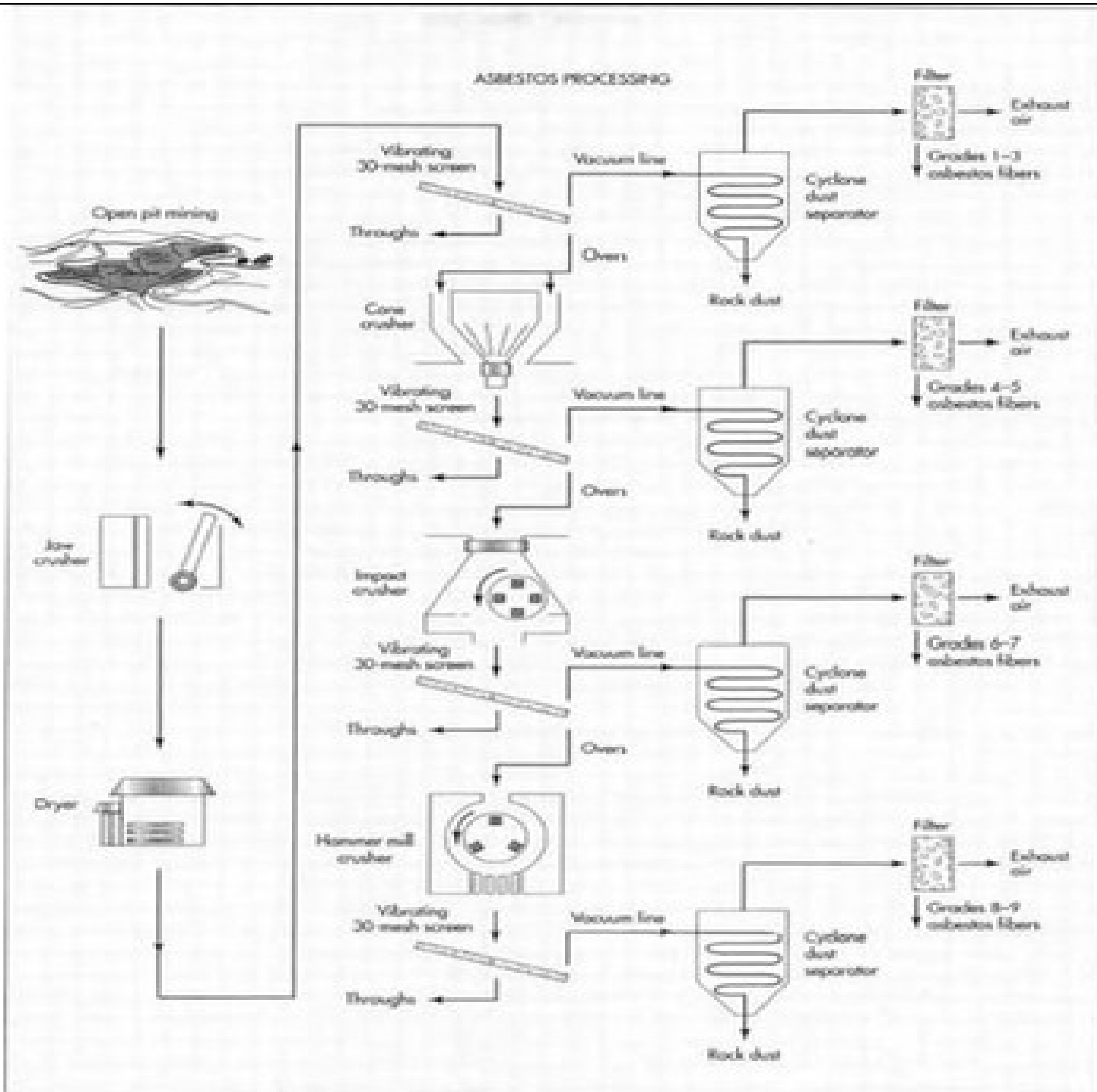
In its natural form, asbestos does not break down or degrade and is not considered to be mobile. It is through the milling or manufacturing processes that exposure to asbestos fibres tends to become a concern. Chrysotile is the predominant form of asbestos evident on the Clinton Creek property (Amec Foster Wheeler 2017).

2.6.3 Asbestos Milling Processes

Asbestos was typically processed in a dry milling operation. The primary separation process involved a series of crushing and vacuum aspiration operations in which the asbestos fibres were separated from, and drawn out of the ore. This was normally followed by a series of secondary separation operations to remove rock dust and other small debris.

A typical asbestos milling operation is illustrated on Figure 2.1. These typical operations incorporate the following process steps (Advameg 2018 and Inspect Media 2018):

- ore is directed to a jaw crusher and the crushed ore is then dried;
- the ore falls on a vibrating mesh screen and is vacuumed off;
- the fine silt and rock particles that fall through the vibrating screen constitute the tailings. The crushed ore pieces that remain on the screen are called overs and are moved to the next stage of processing;
- the crushed ore from the first screen is fed through a second crusher and vibrating screen combination, repeating the above process;
- the process of crushing and vacuum aspiration of the asbestos fibres is repeated as needed to meet recovery objectives (typically twice more). The longest fibres are broken free from the surrounding rock in the first crusher and are vacuumed off the first screen. Shorter length fibres are broken free and captured on each successive set of crushers and screens, until the shortest fibres are captured on the last screen;



wood.		**Clinton Creek Remediation Project**		
Yukon Government Depart of Mines & Resources	Yukon	**Operational History – Typical Asbestos Milling Process**		
Drawn: RBG	Scale: NTS	Date: June 2019	Project No.: VE52705D.100.1	**Figure: 2.1**

- the asbestos fibres and other material captured from each screen are carried suspended in a stream of air and run through cyclone separators. The heavier debris and rock dust particles fall to the centre of the whirling air stream and drop out the bottom of the separators; and
- the air then passes through sets of filters, which capture the different length asbestos fibres for packaging.

2.6.4 The Cassiar Mines Process at Clinton Creek

The milling process at the Clinton Creek property was designed to release the fibrous asbestos from the waste material . The product was used for products including cement asbestos shingles, flat sheets, brake linings, putties, and plastics. F.H. Stephens described the milling process as follows (Stephens (1969) as reported in Bottge (1975)):

> *"The treatment is a dry process consisting of five stages of fiberizing and screening for recovery of the desired quality and grade of fiber for packaging. Three 125,000 cfm fans provide suction lift for fiber released from the rock, and for the dust sent to the cyclone collectors".*
>
> *"The mill consists of a rock line and three fiber lines. The rock line has successive stages of screening, fiber-lifting, crushing, and fiberizing. Longer fiber is lifted during early stages and shorter fiber progressively thereafter. Longer elements are collected and discharged into the CP cleaning circuit of screens and cyclones; intermediate fiber is lifted from the 2nd, 3rd, 4th, and 5th stages of screening and collected for grading and cleaning in the CT fiber circuit of collectors, screens, specific-gravity separators, and opener fans; and short fiber from the 5th, 6th, and 7th stages of screening is collected in the CY circuit and directed through a further series of screens, collectors, specific-gravity separators, and opener fans to bin storage. Final fiber product is fed to pressure packers, bagged under 2,000 lbs. pressure into 100 lb. capacity jute bags, conveyed to the palletizing machine, and strapped in one ton units for temporary storage and truck transportation."*

2.6.5 Air Photo Reviews and Staff Interview

The information on the operation's configuration derived from historical reports was supplemented with a review of an air photo taken during the mine's peak operating period.

2.6.5.1 Air Photo Review

Figure 2.2 combines a 1970 aerial photograph of the former mill area and a recent Google Earth image of the same area. The following observations are derived from a review of these photographs:

- three large process buildings are evident, the Dry Rock Storage Building to the north, the Maintenance Building to the west and the Mill and Dryer Building to the south;
- there are two large storage tanks to the north and south of the Dry Rock Storage Building; and
- other smaller storage tanks are evident between these two buildings.

2.6.5.2 Staff Interviews

A telephone interview with Mr. Bruce Duffee was conducted on 14 January 2019. Mr. Duffee was Cassiar Mines Limited's Production Foreman from early 1972 until the operation closed. Mr. Duffee provided the following information about the Clinton Creek operation:

- Bruce Duffee was Cassiar's Production Foreman from early 1972 until closure.
- Mill Area Building descriptions are as follows (see Figure 2.2):
  - Maintenance Building: heavy mine equipment maintenance at north end.
  - Mill and Dryer Building: the mill is the rectangular building to the west; dryer to the east.
  - Dry Rock Storage Building.
- The drying operation was fuelled directly via diesel (i.e., diesel fired heaters; not electric dryers).
- Both of the two large storage tanks northeast and southwest of Building C were used for diesel storage.
- Site power requirements were serviced via generators at the Clinton Creek townsite (i.e., no large generators on-site).
- There were two large step-down transformers on the north side of the dryer building. Mr. Duffee was not aware of any spills and/or oil disposition efforts at decommissioning. He spoke (recently) to the former electrical supervisor for the operation who advised that they would not have spilled/disposed to ground (they were aware of PCB issues at the time).
- There was a significant diesel spill from the north tank (location of test hole BH18-21) caused by a front-end loader running into the tank base.
- The mine operation used significant electrical power for drills and shovels.
- There was a boneyard north of Building C that could have been used for small volume chemicals disposal (Mr. Duffee has no direct knowledge of inventories or disposition however).
- Domestic waste, rubble, industrial garbage (i.e., typical landfill inputs for this kind of operation) were tipped over the Wolverine Creek escarpment in the vicinity of the north tailings lobe. All materials were eventually covered by tailings.
- At decommissioning, the mill building was burned down and the remaining debris (including unsalvageable steel) was directed to the tailings escarpment dump described above.
- Most of Buildings A and C were sold off as scrap/salvage (i.e., taken off-site).
- There was no significant explosives storage in the mill area. Explosives were sent directly to mine on as needed basis. Any residuals at shutdown would have been sold or reused elsewhere.

1970 Image:

National Earth Observation Data Framework Catalogue
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Scale: 15000
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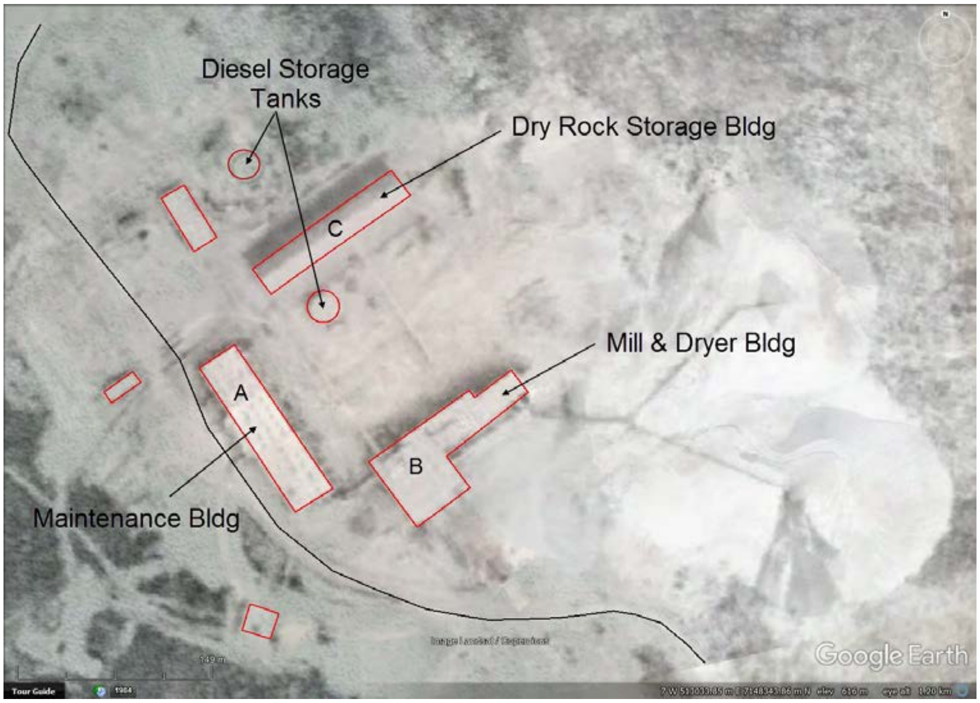
Overlap: 60
NTS Map: 116C07
Season: Spring



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Sensor: GeoEye-1
Geography: Clinton Creek
Resolution (m): 0.5
Cloud Cover (%): 15
Horizontal Accuracy (m): 0.5
Licensee: Yukon government

wood.		Clinton Creek Remediation Project		
Yukon Government Depart of Mines & Resources	Yukon	Operational History – 1970 Airphoto		
Drawn: ECW	Scale: NTS	Date: June 2019	Project No.: VE52705.100.1	**Figure: 2.2**

2.6.6 Potential Contaminant Source Areas

This section focuses on the potential contaminant sources of a significant scale that can be identified from the facility descriptions outlined in the above sections. The discussion does not consider the many low volume sources that would have been associated with an industrial operation of this scale (e.g., solvents, caustics and other cleaning and/or maintenance compounds), on the premise that the volumes involved would be unlikely to generate widespread impacts, and because of the lack of any evident deleterious ecological impacts some 40 years after closure.

The large scale sources that could have generated contamination having some potential for residual and continuing impacts include the following (note that the issues associated with these sources were considered during the scoping of the 2018 site investigation):

- Diesel and Gasoline Storage: these fuels were stored in some quantity on the Clinton Creek property. A release at depth was understood to be a possibility. For this reason, 2018 boreholes BH18-20 and 21 were completed in the vicinity of the tank locations north and south of Building C with appropriate hydrocarbon testing of selected samples per hole (see discussion of results in Mill Area commentary on Table 3.1).
- Transformer Oil: the scale of the power distribution system reportedly used on the Clinton property indicated a potential that PCBs could have been released on the property at some point. The appropriate management and disposition of PCB containing oils that was implied by Environment Canada correspondence from the late 1980s (RRU 1999) has not been validated by this operational history (the referenced documents are no longer available). However, the observations provided by Cassiar's Production Foreman (previous section) supplemented by the PCB analytical data from the 2018 mill area boreholes (see Table S5) suggest that the 1988 Environment Canada dispositions of the PCB issue can be relied upon.
- Explosives: the historical record indicates that ammonium nitrate fuel oil combinations were used on the property. There is no information in the limited record suggesting that quantities of significance were either released or retained on-site. Given its inherent economic value, it is unlikely that useable materials would have been left on-site at closure. In addition, large scale and persistent ammonium residuals could be expected to generate elevated concentrations of various nitrogen compounds in monitoring data for groundwater seepage and/or surface water. There is no evidence of elevated nitrogen compounds in recent water quality monitoring data (EDI 2018). All of this supports a conclusion that explosives can be discounted as a potential contaminant source that will influence closure requirements for the property.

2.7 HHERA Update

The update to the site's 2017 Human Health and Ecological Risk Assessment (HHERA) (Amec Foster Wheeler 2017) was an important input to refining the general characterization of the Clinton Creek property, and its known or potential impacts on local environments. The HHERA update (Wood 2019b) had the following general objectives:

- To consider outcomes from the soil, small mammal, and air (asbestos fibres) sampling programs completed at the site in 2018.

- To update the previous human health risk assessment using this new information to characterize and quantify the potential human health risks at the site.
- To update the previous ecological risk assessment using this new information to characterize and quantify the potential ecological risks at the site.

The conclusions of the human health component of the HHERA update were as follows:

- Unacceptable risks to campers due to direct exposure to nickel in tailings cannot be ruled out.
- Unacceptable risks due to direct exposure to metals are not predicted for all receptor groups assessed (campers, hunter/gatherers, and occasional visitors) in other site areas investigated (soil at the mine and mill areas and waste dump).
- Unacceptable risks are not predicted associated with hunting/gathering on the site.
- Unacceptable risks due to airborne asbestos exposure are predicted for the hunter/gatherer and camper receptor groups under current site conditions.
- Unacceptable risks due to airborne asbestos exposure are not predicted for occasional site visitors under current site conditions.
- For scenarios in which tailings remain accessible and could be disturbed, there are potential unacceptable risks to human health due to inhalation of airborne asbestos and/or direct exposure to nickel in tailings.
- For scenarios in which there is no access to and no disturbance of the tailings, unacceptable risks are not predicted.
- The tailings contain consistently higher metals and asbestos content than both the waste material and the soil samples from the remainder of the site. The tailings are the major source of asbestos on site.

The conclusions of the ecological component of the HHERA update were as follows:

- The soil and waste dump material chemistry results compared to the literature-based effects benchmarks for plants and soil invertebrates indicate that the waste dump and tailings pile areas have the potential for effects to plant and/or soil invertebrate communities. It should be noted that the tailings and waste dump are barren and largely devoid of vegetative cover. Should risk management plans include active revegetation of tailings or the waste dump, further investigations to validate these conclusions could be collected, such as:
  - Vegetation community surveys
  - Chemistry analysis of metals in vegetation
  - Invertebrate community investigations
  - Chemistry analysis of metals in invertebrates

- Livers of trapped voles were submitted for metals analysis. Based on the statistical evaluation conducted on the liver concentrations of contaminants of potential concern (COPCs) as well as a literature review to identify studies which used small mammal trapping to evaluate liver concentrations of metals, it is unlikely that the bioaccumulation of metals from soil at the site is affecting the populations of voles.
- Samples from the small mammals collected from both the mill site and control were submitted for histological examination for lesions and signs of disease. There was no appreciable difference in the prevalence of various lesions in the Mill Site vs. Control Site groups. Overall, the voles appear to be in good health with no significant signs of overt disease.
- Based on the results of food web modelling, combined with the results of the small mammal trapping study, it is concluded that the potential risk to small mammal populations at the mill site from current soil conditions is low.

3.0 CHARACTERIZATION UPDATE

3.1 Key Site Elements

3.1.1 Characterization Synopsis

The synopsis of data characterizing contaminant issues for the Clinton property (i.e., the "non-geotechnical" dataset) is outlined in Table 3.1. This characterization considers the historical dataset compiled for the property and the outcomes of the 2018 site investigation. Table 3.1 is constructed as follows:

- Column 1 - Site Feature: references the individual site components that will be included in the scope of an integrated Closure and Remediation (C&R) Plan for the property.
- Column 2 - Physical Overview: references the feature's location, its physical scale, a general description of the physical properties of the local materials and/or subsurface and its stability status.
- Column 3 - Contaminants Overview: provides a synopsis of the available characterization data identifying contaminants of concern (CoC) for the site feature in question. This column provides separate discussions for both the site feature as a potential contaminants source area, and for the downstream environmental components or features that may be influenced by the migration of CoCs from source areas.
- Column 4 - Primary HHERA Conclusions: this column combines the available characterization data with an interpretation of Amec Foster Wheeler's 2016 Human Health and Ecological Risk Assessment (HHERA) (Amec Foster Wheeler 2017) and the 2019 update to this HHERA (Wood 2019b) findings to make judgements about the known or likely significance of the CoCs associated with each site feature.
- Column 5 - Key Remediation Drivers: this column is a discussion of Wood's interpretation of those key issues that are likely to influence the selection of a remedial and/or management approach for the site feature in question. These comments do not address measures that are eventually identified as requirements for providing stable rock and tailings structures, and assume that these requirements will typically become boundary conditions in the selection of approaches for the site feature in question. This column includes interpretations that may not yet be fully supported by the available data, and/or that will be influenced by the requirements and perspectives of the project partners. The sometimes subjective interpretations included in this discussion are offered to facilitate partner inputs and in an attempt to focus efforts on most likely outcomes.

For most of the site features referenced in Table 3.1, the "Primary HHERA Conclusions" and/or "Key Remediation Drivers" suggest that specific mitigative action is not required. The table content should not be interpreted to mean that the lack of an environmental mitigation imperative supports maintenance of the status quo. It simply means that other factors (e.g., physical stability) are more likely to dominate the definition of closure requirements.

Table 3.1: General Site Characterization Assessment

Site Feature	Physical Overview	Contaminants Overview	Primary HHERA Conclusions	Key Remediation Drivers
1. Tailings	About 12 million tonnes of mill tailings were deposited over the west valley slope of the Wolverine Creek valley. The tailings are composed primarily of serpentine and asbestos fibres. The original tailings deposit, referred to as the south lobe, failed in 1974 resulting in displacement of tailings to the floor of the deeply incised valley where flow in Wolverine Creek became blocked. This initial landslide blockage was almost immediately breached dispersing tailings as far as 2 km downstream (Stepanek and McAlpine 1992, as reported in AECOM (2009)). Cassiar constructed a series of rock weirs in 1978 to convey water over the south lobe. Following the failure of the south lobe and until closure of the mill in 1976, the tailings were deposited in the north lobe. Downslope movement of the north lobe began in 1978 and by 1985, the toe of the north lobe had reached the valley bottom, forming another pond. In 1978, Cassiar unsuccessfully attempted to stabilize both tailings pile lobes by partial regrading and terracing (AECOM 2009). The pile currently covers some 40 ha and is underlain by fluvial silty sand and gravel deposits over weathered argillite bedrock (Tetra Tech 2016).	**1. Source Area** • Tailings samples exhibit elevated levels of antimony, arsenic, barium, boron, chromium, cobalt, iron, manganese, nickel, and selenium (see Table S2). • Of these, chromium, nickel and cobalt are regularly present at levels well above screening/remediation guidelines and/or background levels. Chromium and nickel are more significantly and consistently elevated than cobalt. • Asbestos is present at significant levels throughout the tailings matrix. Asbestos levels in the tailings are consistently and significantly higher than are evident in the waste material. • These elevated metal/asbestos levels are evident at both surface and depth and are not associated with a particular areal location or locations within the tailings footprint (see Figure 3.1 for the locations of chromium and nickel excursions). • The mean and median levels of metal excursions in the tailings are similar, suggesting a relatively homogeneous distribution of impact. • The average metal, and particularly chromium and nickel levels in the tailings are considerably higher than in the waste (some 300% to 400% higher in the case of chromium and nickel). • Evidence of other common industrial contaminants (e.g., hydrocarbons, salt) has not been encountered in the tailings materials, and the property's operational history suggests a low potential for encountering these materials in this area. **2. Impacted Environmental Features** • Contaminants in the tailings pile could impact a range of environmental receptors and/or media. The environmental components that have a particular relevance to the mobility of contaminants (i.e., and hence, the potential for the contaminant footprint of the property to expand over time) are as follows: – Wolverine Creek sediments downgradient of the tailings; – Wolverine Creek surface waters downgradient of the tailings; and – groundwaters downgradient of the tailings. • Wolverine Creek sediments exhibit levels of nickel and selenium that may be related to releases from the tailings pile (see Table B.6 in Amec Foster Wheeler 2017). Levels observed are above typical background levels, but moderately so (a statistically grounded characterization of background levels has not been developed). The nickel and selenium levels are above some recognized sediment criteria, but below CCME residential/ parkland standards. Other tailings metal contaminants (e.g., chromium) are evident in the sediments at levels of concern. In short, it appears that releases from the tailings have impacted creek sediment quality, but not to degrees that are likely to produce degradations in aquatic ecosystems material enough to justify remedial efforts incremental to those that may be applied at the tailings pile itself.	The HHERA update (Wood 2019b) conclusions that can be related to the tailings pile specifically are as follows: • unacceptable risks to campers due to direct exposure to nickel in tailings cannot be ruled out; • unacceptable risks due to airborne asbestos exposure are predicted for the hunter/gatherer and camper receptor groups under current site conditions; • unacceptable risks due to airborne asbestos exposure are not predicted for occasional site visitors under current site conditions; • for scenarios in which tailings remain accessible and could be disturbed, there are potential unacceptable risks to human health due to inhalation of airborne asbestos and/or direct exposure to nickel in tailings; • for scenarios in which there is no access to and no disturbance of the tailings, unacceptable risks are not predicted; and • the tailings contain consistently higher metals and asbestos content than both the waste and the soil samples from the remainder of the site.	• The key risk issues presented by the tailings are those hazards to human users of the site created by direct contact with metals (particularly nickel) and ingestion of airborne asbestos. • These key risk issues would likely be effectively mitigated by the application of access restrictions and/or by covering the surface of the tailings (via engineered covers, or relocation to a covered spoil structure). • It seems unlikely that the comparatively minor impacts to downstream environmental components observed to date (Wolverine Creek surface waters, sediments and aquatic ecosystems) would justify significant incremental remedial activities and expenditures or any supplemental access restrictions and/or exposure controls (i.e., beyond those required to address the direct contact risks addressed above) or to physically stabilize the tailings inventory, • It is useful to note that placement of a cover over tailings surfaces would likely have a positive mitigative impact on downstream environmental components via reductions in surface erosion and soluble contaminant transport via infiltrating precipitation.

Site Feature	Physical Overview	Contaminants Overview	Primary HHERA Conclusions	Key Remediation Drivers
		• Wolverine Creek sediments exhibit comparatively minor asbestos levels that are not clearly elevated above background (Table B.6 of Amec Foster Wheeler 2017). • Wolverine Creek surface waters about 700 m downstream of the tailings (sampling site E3 on Figure W1) occasionally exhibit hexavalent chromium levels above aquatic standards and routinely exhibit selenium excursions above those standards. Neither parameter exhibits levels approaching drinking water standards. It should be noted that background selenium levels occasionally exceed aquatic standards, but not as routinely as is observed at sampling site E3 (note: these summary comments are derived from the data excerpts presented herein in Table W2, and from the broader water quality database represented by Hemmera (2016, 2016a, 2016b), Laberge (2016), LER (2014) and EDI (2018)). • There are no obvious seasonal differences in key metal levels in the water qualities summarized in Table W2, nor any clearly evident changes in parameter levels over time (note however that statistical analyses that might identify more subtle parameter trends have not been attempted herein, or as part of the monitoring scopes referenced above). • In short, Wolverine Creek surface waters do not exhibit metal levels that are consistently and clearly elevated above background, or at levels that are likely to generate risks at significant distances downstream from the tailings source. The data suggest that some metal laden sediments are moving downstream from the tailings, a circumstance that would not be unexpected given the configuration and constituents of the pile. However, if these releases are occurring in significant quantities, they do not appear to be producing obvious, significant and/or mobile deleterious effects on local surface water quality. • There is no groundwater data available for areas downgradient of the tailings pile. While not confirmed hydrogeologically, it is assumed that any groundwater impacts would likely manifest themselves in Wolverine Creek waters. If they do not report to the creek (i.e., remain in local aquifers), they are less likely to be relevant from the perspective of environmental risk. • The above summary points suggest that the primary CoCs associated with the tailings pile have not had influences on the quality of downstream media that are likely to be materially relevant for the definition of remedial requirements for primary environmental components of concern. The phrase 'materially relevant' means that any evident impacts are unlikely to generate consequences significant enough to justify incremental remedial efforts targeted specifically at downstream media (e.g., removal of stream sediments). This judgment considers that any such action could produce secondary impacts greater than those associated with the original concern (e.g., release of sediments during in-creek remedial works).		

Site Feature	Physical Overview	Contaminants Overview	Primary HHERA Conclusions	Key Remediation Drivers
2. Waste Rock	From 1968 until depletion of economic reserves in 1978, the Cassiar Mining Corporation (Cassiar) extracted approximately 12 million tonnes of serpentine ore from the three open pits (AECOM 2009). Overburden and waste from the three open pits and crusher were deposited in either the Clinton Creek and Snowshoe Pit waste dumps on the south side of the Clinton Creek valley or the Porcupine Creek waste dump south in the Porcupine Creek valley. Waste material was disposed of by dumping on the slope of the respective valley walls. The total volume of waste is estimated to be 60 million tonnes (Roach 1998, as reported in AECOM (2009)). The waste material typically consists of argillite, phyllite, platey limestone and micaceous quartzite (Stepanek and McAlpine 1992, as reported in AECOM (2009)). Asbestos fibres are occasionally found within the waste material (RRU 1999, as reported in AECOM (2009)).	**1. Source Area** • Waste samples exhibit elevated levels of aluminum, arsenic, boron, chromium, cobalt, iron, lithium, manganese, molybdenum, nickel, selenium, vanadium, zinc, and zirconium (see Table S1). • Of these, chromium, nickel and cobalt are present over portions of the area at levels well above screening/remediation guidelines and/or background values. Chromium and nickel are more significantly and consistently elevated than cobalt. • The mean levels of chromium and nickel are significantly higher than median levels indicating the mean is influenced by peak excursions over a smaller number of samples. • Asbestos is present at significant levels over portions of the waste inventory. • The waste materials are generally less friable than the tailings materials and the associated asbestos levels are anticipated therefore to be less available to human receptors in particular. • Evidence of other common industrial contaminants (e.g., hydrocarbons, salts) has not been encountered in the waste material, and the property's operational history suggests a low potential for encountering these materials in this area. • Significantly elevated metal/asbestos levels are not present in all waste materials (i.e., they appear to be less homogeneous in this regard than the tailings). Metal/asbestos excursions cannot be reliably associated with either surface or deep materials, nor to a particular areal location or locations within the waste footprint (see Figure 3.2 for the locations of chromium and nickel excursions). • The relative proportions of the waste dump inventory that do and do not exhibit metal/asbestos excursions of significance have not been quantified. However, some general sense of these proportions can be derived by noting that 30% of the waste dump samples tested exhibit chromium and/or nickel above Residential/Parkland remediation criteria. The corresponding percentage for the tails is 92%. **2. Impacted Environmental Features** • Contaminants in the waste dump could impact a range of human and environmental receptors and/or media. The environmental components that are particularly relevant to the mobility of contaminants (and hence, the potential for the contaminant footprint of the property to expand over time) are as follows: – sediments in the waste dump drainage structures, and in Clinton Creek downgradient of the dump; – surface waters in the waste dump drainage structures and in the downstream portions of Clinton Creek; and – groundwaters associated with the waste dump pile. • There are significantly elevated levels of chromium and nickel in the waste dump drainage structure sediments and in Clinton Creek sediments immediately downstream of the pile. Metal levels in creek sediments just upstream of Eagle Creek are reduced, but still elevated (particularly nickel) (see Table B.6 in Amec Foster Wheeler 2017).	The HHERA update (Wood 2019b) conclusions that can be related to the waste dump specifically are as follows • unacceptable risks due to direct exposure to metals are not predicted for all receptor groups assessed (campers, hunter/ gatherers, and occasional visitors); • unacceptable risks are not predicted associated with hunting/ gathering on the waste dump ; and • unacceptable risks due to airborne asbestos exposure are not predicted for occasional site visitors under current site conditions.	• Similar to the tailings pile, the key environmental risk issues presented by the waste dump are those hazards to human users of the site created by direct contact with metals and exposure to airborne asbestos. • The waste dump differs from the tailings in the areal distribution of these risk areas across the footprint of the rock. The HHERA update supports a conclusion that elevated metal and/or airborne asbestos levels on the waste dump are not high enough and pervasive enough to require a mitigative response. • As part of detailed closure design and/or execution it would be prudent to undertake surficial sampling and analysis of final waste dump surfaces (post application of the selected closure concept) to confirm that the areal distribution of metal/asbestos excursions in the finished landscape is consistent with the HHERA assumptions. If departures from those assumptions are encountered, targeted and local adjustments to final slopes could be made (i.e., presumably by locally relocating/ reconfiguring hot spots, or via placement of local clean rock covers). • If the selected closure concept involves relocation and/or reconstruction of the existing spillway and downstream drainage channel, channels sediments exhibiting significant metal excursions should be segregated during execution and placed below more benign portions of the rock inventory in the finished closure landscape.

Site Feature	Physical Overview	Contaminants Overview	Primary HHERA Conclusions	Key Remediation Drivers
		• Clinton Creek surface waters adjacent the waste pile and immediately downstream from it (sampling sites E1 and E2 on Figure W1), have exhibited few excursions above CCME FAL in recent water quality monitoring (see summary data in Table W2 and the broader water quality database represented by Hemmera (2016a, 2016b), Laberge (2016), ELR (2014) and EDI (2018)). In particular, the hexavalent chromium that is occasionally evident in the tailings/Wolverine Creek waters are not significantly and persistently present in the waste Clinton Creek drainage. There are selenium excursions in the Clinton Creek waters, but these are not clearly and significantly distinguished from background levels. The arsenic levels that are present in Snowshoe Pit Lake waters (see Table W5) are not evident in the Clinton Creek surface waters. • There are no obvious seasonal differences in key metal levels in the water qualities summarized in Table W2, nor any clearly evident changes in parameter levels over time (note however that statistical analyses that might identify more subtle parameter trends have not been attempted herein, or as part of the monitoring scopes described above). • The data suggest that some metal laden sediments are moving downstream from the waste dump. However, these releases do not appear to be producing obvious and significant deleterious effects on local surface water quality. • Groundwater seepages from the waste dump consistently exhibit moderately elevated levels of hexavalent chromium (see Table W3). These levels do not consistently show up in surface waters downstream of the rock. Again, the arsenic levels evident in Snowshoe Pit Lake waters are not present in the waste dump groundwater seepages. • The above summary points suggest that the primary CoCs associated with the waste dump have not had influences on the quality of downstream media that are materially relevant for the primary environmental components of concern. The phrase 'materially relevant' means that any evident impacts are unlikely to generate consequences significant enough to justify incremental remedial efforts targeted specifically at downstream media. It is noted, for example, that efforts directed towards waste dump stabilization and/or reconfiguration (potentially driven by a variety of issues) could result in the removal of some sediments from existing conveyance structures/features. In addition, it is possible, indeed likely, in many specific locations, that stream bed removals could produce secondary impacts greater than those associated with the original concern (e.g., release of sediments during in-creek remedial works).		

Site Feature	Physical Overview	Contaminants Overview	Primary HHERA Conclusions	Key Remediation Drivers
3. Mill and Mine Site	AECOM (2009) reported that the Cassiar mining and processing operation included a crusher building located on the high ground between the Porcupine and Creek Pits. The mill site was located on a plateau along the west side of the Wolverine Creek valley about 150 m higher than the mine site area. An airstrip is located about 1.5 km north of the mill site. The mill buildings and Town Site buildings were auctioned off in 1978. Between 1979 and 1987, structures from the Town Site and most of the mill structures and equipment were removed as part of decommissioning activities. Continued decommissioning of the mine site was carried out from 1987 to 1989 during which time the primary and secondary crushing units from the crusher building complex at the mill were removed (1988), warning signs were posted and additional mine site cleanup was carried out (1989). There are no buildings currently remaining at the site; however, large, heavily reinforced concrete foundations remain at the former mill site, the crusher building, and Tram Tower #3.	**1. Source Area** • Analytical data available for the mill area suggest that at least some surficial soils exhibit significantly elevated, above background levels of chromium, cobalt and nickel (see Table S4). Chromium and nickel excursions in particular are similar to those observed in waste dump are evident in some surface soils in the mill and common areas, but not in the undisturbed soils at depth (supporting the supposition that rock and/or tails have been used or distributed on-site by design (road construction) or via environmental vectors) (see Figure 3.3 for locations of those samples exhibiting chromium and nickel excursions. Note that all of these excursions were for surficial samples; none of the samples tested at depth exhibited above criteria chromium or nickel levels). • There is some evidence of asbestos fibres in these areas, but not at levels well above background, and well below those evident at the tailings pile. • Hydrocarbon and PCB data for the two environment test holes completed (see Operational History update in Section 2.6) in the former mill area are provided in Table S4 . These test holes targeted the locations of two large storage tanks that were evident on the 1970 aerial photograph for the former mill area during the 2018 site investigation. • Table S4 identifies exceedances relative to CCME's Canadian Environmental Quality Guidelines (for PCBs; CCME 2019a) and Canada Wide Standards for Petroleum Hydrocarbons (PHC) in Soil (CCME 2019b). The following comments and observations can be made from the data in the table: – none of the samples tested exhibit evidence of PCB contamination; – one sample from Test Hole BH18-21 at a depth of 2.5 m exhibits clear evidence of hydrocarbon contamination (i.e., hydrocarbon parameter levels exceeding CCME criteria for Parkland); – this sample exhibits hydrocarbons primarily in the F1 (C6-C10) and F2 (C10-C16) ranges, consistent with what might be expected from weathered diesels; the materials reportedly stored in the tank at this location during mill operations; – surficial materials at Test Hole BH18-21 show no evidence of hydrocarbon contamination; – Test Hole BH18-21 samples show trace hydrocarbon impacts down to about 5 m (i.e., from the 2.5 m to 5 m depth increment); a sample collected at 7.5 m exhibits no evidence of hydrocarbon contamination; – trace levels (i.e., detectable but well below CCME criteria) of F2 or F3 hydrocarbons are evident in test hole BH18-20 (the location of the other large storage tank evident on the 1970 aerial photograph); and	The HHERA update (Wood 2019b) conclusions that can be related to the mill and mine sites are as follows: • unacceptable risks due to direct exposure to metals are not predicted for all receptor groups assessed (campers, hunter/ gatherers, and occasional visitors); • unacceptable risks are not predicted associated with hunting/ gathering on the site; • unacceptable risks due to airborne asbestos exposure are not predicted for occasional site visitors under current site conditions; • for scenarios in which tailings remain accessible and could be disturbed, there are potential unacceptable risks to human health due to inhalation of airborne asbestos and/or direct exposure to nickel in tailings; and • for scenarios in which there is no access to and no disturbance of the tailings, unacceptable risks are not predicted.	• The HHERA outcomes suggest that the risks posed by elevated metal levels in some surficial soils in the mill and general mine site areas are likely below prescribed hazard quotients and, therefore, that specific controls and/or remedial measures for limiting exposures are unlikely to be necessary in these areas. • The potential influences of mill area hydrocarbon impacts will be influenced by pending monitoring outcomes and associated considerations of the range of impacts this hydrocarbon source could have. In the interim, the operative assumption is that this source is unlikely to generate material risks that would require incremental, intrusive remedial activity (i.e., the most likely outcome is continued monitoring of a form of natural attenuation).

Site Feature	Physical Overview	Contaminants Overview	Primary HHERA Conclusions	Key Remediation Drivers
		– none of the indicators of hydrocarbon impact extend to the maximum depth of test holes 20 and 21 (i.e., suggesting any source areas may be limited to the vadose zone (above groundwater) in the area). **2. Impacted Environmental Features** • Contaminants in the mill and general mine area soils could impact the range of human and environmental receptors and/or media identified on Figures 8-1 and 9-1 of the HHERA (Amec Foster Wheeler 2017). Apart from the hydrocarbon impacts referenced above, the downstream influences that these contaminants might have are generally captured by the assessments of sediment, groundwater and stream water quality that have been described for the tailings and waste material in Table Entries 1 and 2. The configuration of the site and the resolution provided by available data are such that it is difficult to ascribe any specific downstream influences to particular features in the mill and/or general mine area. • With respect to hydrocarbons in particular, a recommendation has been offered to add a suite of hydrocarbons to the current surface water monitoring program at Clinton Creek. The proposed testing would be done for the Wolverine Creek monitoring point downgradient of the mill site. The outcomes of this monitoring will support determinations of the incremental risks that might be associated with the mill area hydrocarbon sources, and/or whether additional source delineation efforts will be required prior to, or potentially during, execution of a remediation and reclamation concept.		

Site Feature	Physical Overview	Contaminants Overview	Primary HHERA Conclusions	Key Remediation Drivers
4. Hudgeon Lake	Hudgeon Lake was formed in the mid 1970s when the Clinton Creek waste dump failed resulting in a blockage of the valley. Continued movements of the waste dump resulted in the current configuration. The lake is approximately 2,100 m long, with a width of up to 600 m. Bathymetry data generated in 2010 showed a maximum lake depth of approximately 29 metres and a lake volume estimated at 10 million cubic metres. The lake area at the time of the survey was 72 ha, at a water surface elevation of 411.6 m. The depth of the lake increases from west to east with the original valley slope and the deepest part of the lake is directly west of the Clinton Creek waste dump (AECOM 2011). Clinton Creek enters Fortymile River approximately 10 km downstream from Hudgeon Lake and another 5 km downstream where the Fortymile enters the Yukon River (UMA/AECOM 2008). The lake is ice covered for about six months of the year, typically from late October to early May. There appears to be little or no surface flow from the lake during the winter (AvF R&D 2016).	**1. Lake Waters** Most of the following descriptions have been excerpted from AvF R&D 2016). • During some or most winters, the waters of the lake are entirely anoxic, and cannot support fish (UMA/AECOM 2008). The primary cause of the anoxic conditions is decomposition of organic material on the lake bottom, and a contributing factor is naturally high concentrations of sulphate in waters entering the lake (UMA/AECOM 2008; Liebau 2010). The decomposition also results in the formation of sulphides which tend to be concentrated in the lower levels of the lake. Anoxic surface water conditions are likely partly caused by oxidation of methane, which bubbles up from the lake bottom throughout the year and can be trapped below the ice in the winter. • The annual rate of aeration of Hudgeon Lake has not been investigated. However, by summer, the surface waters have sufficient oxygen to be able to support fish and other aquatic life (RRU 1999). Dissolved oxygen levels are generally highest in the upper 2 metres of the lake and then decline with depth. Levels measured at 5 metres have been depressed, but remained sufficient to sustain aquatic life (Liebau 2010). The chemical characteristics of the water change quickly below 5 metres (see Table W4). • From a geochemical perspective, the sulphide production that occurs in Hudgeon Lake is influenced by the following (UMA/ AECOM 2008): 1. A large supply of detrital organic matter, with a sufficient annual flux to stimulate relatively high decomposition rates in lakebed sediments. 2. A limited seasonal oxygen supply to lake bottom waters. 3. Depletion of oxygen for cellular respiration during decomposition, so that much of the organic matter is broken down by bacteria that utilize other substances to biochemically decompose the detrital organic matter (DOM). 4. Dominance of microbial sulphate reduction as the major process of organic matter decomposition in the Hudgeon Lake bed and waters. • UMA/AECOM (2008) noted that the DOM in the lake exhibited both relatively rapidly degradable pool of organic carbon, as well as a more recalcitrant pool, for which microbial decomposition rates would be much slower. Assuming that the major mass of DOM was introduced over a brief time period during the creation of Hudgeon Lake, it is expected that the overall DOM decomposition rates would decrease over time. The situation is expected to be somewhat analogous to organic matter breakdown and methane production rates in landfills, which have been documented to decrease slowly over decades. • AECOM (2009) noted that there are levels of asbestos in Hudgeon Lake waters and sediment that suggest a potential for release of asbestos fibres from the waste material into Hudgeon Lake.	• The HHERA (Amec Foster Wheeler 2017) noted that while Hudgeon Lake is an anthropogenic feature that does not support life in anything but its uppermost waters, the lake as a potential contaminants source area has not generated downstream human or ecological risks of material significance. The HHERA also noted that this conclusion could change depending on the specific remediation, closure and/or reclamation options adopted for the site. Options that involve lowering the lake level could expose sediments exhibiting elevated CoC levels that could, in turn, generate incremental risks that are currently unquantified. An assessment of the significance of contaminant excursions in newly exposed surfaces could likely be derived from HHERA update conclusions relating to metal and asbestos levels in the rock and tails.	• The nature and downstream influences of Hudgeon Lake itself (as it is currently constituted) are such that no risk issues of significance have been identified that would, in themselves, generate a clear need for dedicated and specific remedial measures apart from those needed to mitigate potentials for what may be determined to be catastrophic lake releases. • UMA/AECOM (2008) noted that attempts to enhance the fish habitat in the Clinton Creek watershed by infilling or lowering Hudgeon Lake may not be effective (infilling) and/or feasible (lowering). The latter conclusion related mainly to the geotechnical challenges associated with constructing and maintaining the required water conveyance structures. AvF R&D (2016), in commenting on the potential impacts of remedial alternatives on the fishery, concluded that lowering the lake level to 398 masl would represent the first step in restoring Clinton Creek to a naturally functioning aquatic environment in a non-glaciated area. • The key remediation issues applicable to the lake then will likely be: – the environmental impacts of the lowered lake level that may be a feature of the preferred waste dump stabilization concept; – key impacts are likely to be: o the associated influence on the ecological viability of any remaining lake (the current technical consensus is that a lowered lake level will likely improve this ecological health and viability); and o the remediation and reclamation liability associated with newly exposed rock and valley wall surfaces. – the technical and logistical issues that will be associated with removing substantial proportions of the lake water inventory (i.e., the physical concepts required to move this volume of water, any treatment requirements during removal and/or the time required to affect removal).

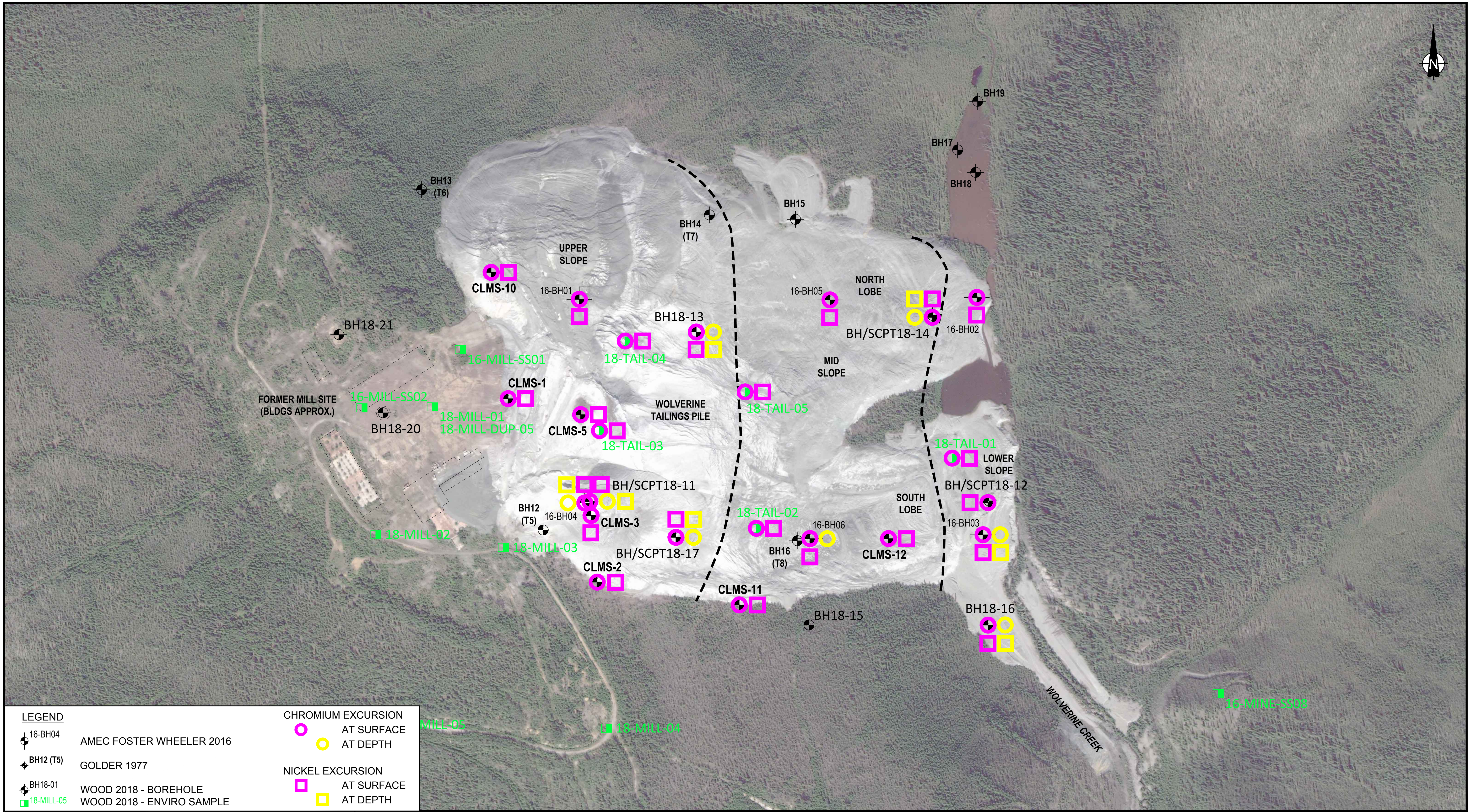
Site Feature	Physical Overview	Contaminants Overview	Primary HHERA Conclusions	Key Remediation Drivers
		2. Surface Water Discharges • UMA/AECOM noted that sulphide levels in areas downstream of Hudgeon Lake have been reported to be acceptably low and oxygen levels sufficiently high (DFO 2007). Re-oxygenation occurs at, and immediately beyond, the outlet of Hudgeon Lake to reconvert S^{2-} to SO_4^{2-}, and to off-gas any residual H_2S. The four gabion drop structures likely contribute to the re-oxygenation of water leaving Hudgeon Lake. • The following observations relating to metal levels in Hudgeon Lake waters are derived from the data excerpts provided in Table W4: – There are some arsenic levels between aquatic life and drinking water standards in the lower levels of the lake. Shallow and mid depth waters exhibit no arsenic levels above aquatic standards. – Apart from selenium, there are no other metal excursions in the lake water. The below aquatic criteria chromium levels evident are comprised fully of Cr(III) (i.e., there is no detectable hexavalent chromium in the lake waters). – The selenium levels in the lake are between aquatic and drinking water standards and are consistent with those found entering the lake (see results for monitoring site R1 in Table W1). – In short, the metal levels in lake water are not, in themselves, likely to generate risks of consequence to downstream media. • AvF R&D (2016) noted that the primary effect of the lake on water quality in downstream waters has been to increase nutrients in surface outflows and the seeps that result at least in part from lake water entering the waste material and discharging downstream. The source of the nutrients is the decomposing organic matter in the lake. Invertebrate abundance downstream is high, and supports large numbers of fish. The lake also captures significant thermal energy, which is subsequently exported to Clinton Creek downstream from the lake outlet. • Various studies of the lake itself suggest no capability for sustaining fish populations of significance. AvF R&D (2016) noted that because fish cannot ascend the existing gabion drop structures, the lake is barren of fish. • With respect to water bodies downstream of the lake, Minnow (2010) reported that no external abnormalities were observed among any of the fish caught in 2009. In addition, there were no obvious differences in the condition of slimy sculpin in Clinton Creek compared to those in other tributaries to the Fortymile River. Clinton Creek appears to have a stable and healthy fish population relative to other creeks of its size in the Yukon drainage and has been recognized as an important rearing habitat for juvenile salmon (WMEC 2009). The 2009 fish survey confirmed that populations of arctic grayling, Chinook salmon, and slimy sculpin utilize Clinton Creek.		

Site Feature	Physical Overview	Contaminants Overview	Primary HHERA Conclusions	Key Remediation Drivers
		• AvF R&D (2016) noted that the same fish species use Clinton Creek today as would have used Clinton and Wolverine Creeks prior to mine development, and in much the same manner. The limit of upstream migration by fish in the main creek and tributaries would have varied annually and would have been related to environmental factors such as streamflow and gradient. • AvF R&D (2016) noted that a study (Marty, MacKenzie-Grieve and Guilbeault 2014) into the effects of asbestos exposure on slimy sculpin (selected because they are the only year round resident fish in Clinton Creek) found that their health was comparable to other populations in the Yukon. • In short, the studies conducted over the years suggest that while the lake may have influences on the characters of local aquatic ecosystems, there have not been negative impacts on local downstream fish populations of material significance.		

Site Feature	Physical Overview	Contaminants Overview	Primary HHERA Conclusions	Key Remediation Drivers
5. Porcupine Pit	The Porcupine Pit was the primary source of ore for the Cassiar mining operation. In addition to the roughly 60 million tonnes of waste and overburden deposited over the south slope of the Clinton Creek valley (i.e., the Clinton Creek waste dump), approximately 3 million tonnes of rock and overburden were placed southeast of the pit in what is now referenced as the Porcupine Pit waste dump (Advisian 2016). Waste material was placed across the Porcupine Creek valley slope. The most northerly section of the dump was placed at least partially up the east valley slope and this area has remained relatively stable. Sections near the centre of the dump which were placed farther away from the east valley toe, however, experienced slumping that created blockages to creek flow at two locations. Both blockages behave as permeable dams with creek flow through or beneath the rock fill. Impounded water upstream of the waste dump continues to flow either below or through the waste or along the east valley slope in subterranean channels. The majority of flow occurs via a drainage channel incised through the slide debris from the southern portion of the waste dump where it enters the dump. Water is subsequently conveyed along a drainage channel incised along the south edge of the road where it eventually spills into the Creek Pit. Creek flow is also occurring via subterranean flow along the toe of the waste and east valley slope where flowing water is visible below the organic mat on the valley slope. Discharge from the subterranean flow system occurs as a small spring near the northwest corner of the waste dump (AECOM 2003). Instabilities of the pit walls and waste dump slopes have been evident in the past, although more recent monitoring suggests movement rates around the pit are generally low (Advisian 2016). In 2006, trenching and berming work and the installation of warning signs were completed to limit access to the edge of the pit.	• In many respects, the Porcupine Pit and its waste dump are an extension of the Clinton Creek waste dump and the two dumps have a combined influence on downstream receptors and environs. • The Porcupine waste dump is similar to the Clinton Creek dump in that it contains asbestos fibres and elevated levels of various metals, particularly chromium, nickel, cobalt and zirconium (see Table S3). • The Porcupine Creek sediments just upstream of Clinton Creek exhibit metal excursions (i.e., elevated chromium, nickel and selenium), similar to those observed in Clinton Creek sediments (see Table B.6 of Amec Foster Wheeler 2017 and Laberge 2016). • Porcupine Creek surface waters do not exhibit significant and persistent metal excursions, similar to data for Clinton Creek waters downstream of Porcupine Creek. • Analytical data for the Porcupine Pit waters is limited, largely because ongoing concerns about pit wall stability has constrained access. Data for a monitoring event in 2013 is provided in Table W5 . These data indicate levels of arsenic and boron above aquatic guidelines and in the case of arsenic, above drinking water guidelines. These excursions are not evident in the receiving environments downstream of the pit lakes (see results for E series monitoring locations in Table W2). There were no obvious excursions of chromium or nickel levels in this one monitoring event.	• The Clinton Creek waste dump discussion outlined in Table Entry 2 would apply generally to the collective influences of the Clinton Creek, Porcupine Creek and Snowshoe Pit rock sources.	• The key remediation drivers related to the Porcupine Pit and waste dump would be the same as those outlined in Table Entry 2 for the Clinton Creek waste pile. • There are physical hazards associated with the Porcupine Pit walls that are unique to this site element. To date, these have been mitigated largely via attempts to limit access to the area. Any more robust efforts to mitigate these risks over the long term will be integrated with the final materials management plan developed for the property (i.e., there remains the possibility that the pit could be a spoil area for any materials removed as part of rock and/or tailings stabilization efforts). • Data on any fishery in the pit lake is limited. Apart from questions about the presence and nature post remediation, the lack of access suggests that incremental efforts to support a fishery are unlikely.

Site Feature	Physical Overview	Contaminants Overview	Primary HHERA Conclusions	Key Remediation Drivers
6. Snowshoe and Creek Pits	The Snowshoe and Creek Pits were the smaller of the three ore sources for the Cassiar operation and are located east and north of the Porcupine Pit. The Snowshoe Pit is located along a hillside on the south side of Clinton Creek, while the Creek Pit is located along the original alignment of Porcupine Creek. A comparatively small waste dump is located north of the Snowshoe Pit. Both the Snowshoe and Creek Pits typically retain ponded water (AECOM 2009).	• In general terms, the Snowshoe and Creek Pits are part of the broader contaminants source area southeast of Hudgeon Lake that exhibits elevated metal levels, particularly chromium, nickel and cobalt, as well as pockets of potential asbestos fibre source areas that are present sporadically in the larger waste mass. • The general comments relating to waste dump contaminant issues described for the Clinton and Porcupine waste piles therefore apply to the Snowshoe and Creek Pit areas. • Recent data for the Snowshoe Pit ponded water (Table W5) indicates a pattern of metal excursions similar to that outlined above for the Porcupine Pit Lake (with the exception of boron levels which are not elevated above aquatic criteria). Arsenic is elevated in all of the sampling results; however, these excursions do not appear in sampling sites downstream (see results for E2 in Table W2).	• The Clinton Creek waste dump discussion outlined in Table Entry 2 would apply to the collective influences of the Clinton Creek, Porcupine Creek and Snowshoe Pit rock sources.	• The discussion provided in Table Entry 5 for the Porcupine Pit applies largely for the Snowshoe and Creek Pits.

Site Feature	Physical Overview	Contaminants Overview	Primary HHERA Conclusions	Key Remediation Drivers
7. Wolverine Creek Ponds	The Wolverine Creek ponds are the small bodies of impounded water created by the movement of the north and south tailings lakes into the Wolverine Creek Valley. The valley stream channel is now perched above the original valley bottom. The tailings deposits impound water and interrupt normal sediment transport from the upper watershed. The valley bottom below the downstream end of the tailings deposit is entirely transformed (AvF R&D 2016). Wolverine Creek flows into Clinton Creek approximately 1.5 km downstream of Hudgeon Lake and enters the creek immediately after crossing the mine access road through a culvert. The culvert outlet is perched, has a drop of over 1.5 metres and does not provide opportunities for fish passage (WMEC 2009).	• There is no recent monitoring data relating specifically to the quality of the Wolverine Creek pond waters. Given their proximity to the tailings lobes, particularly the south pond, it would be reasonable to assume these waters exhibit the metal excursions evident in creek waters immediately downstream of the tailings and waste material (Sections 1 and 2 above).	• The Tailings discussion under Feature 1 would apply to the collective influences of the tailings and Wolverine Creek ponds and sediments. • The periphyton and benthic communities in the Wolverine Creek aquatic ecosystem are likely altered by the presence of the tailings. • The fishery in Wolverine Creek downstream of the tailings does not exhibit significant adverse impacts that can be related to the presence of the tailings (see AvF R&D (2016)).	• The key remediation drivers for the Wolverine Creek ponds would be similar to those outlined in Feature 1 for the larger tailings area source.



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Environment & Infrastructure Solutions
a Division of Wood Canada Limited
#600 - 4445 Lougheed Highway
Burnaby, BC V5C 0E4
Tel. 604-294-3811 Fax 604-294-4664

CLIENT:

Yukon

DWN BY:	TH
CHK'D BY:	BG
DATUM:	NAD 83
PROJECTION:	UTM Zone 7
SCALE:	AS SHOWN

PROJECT:
CLINTON CREEK REMEDIATION PROJECT
ENVIRONMENTAL CHARACTERIZATION UPDATE

TITLE:
Locations of Chromium and Nickel Excursions
Above CCME Residential Parkland Criteria
TAILINGS

DATE:	JUNE 2019
PROJECT NO:	VE52705D.100.1
REV. NO:	A
FIGURE NO:	3.1

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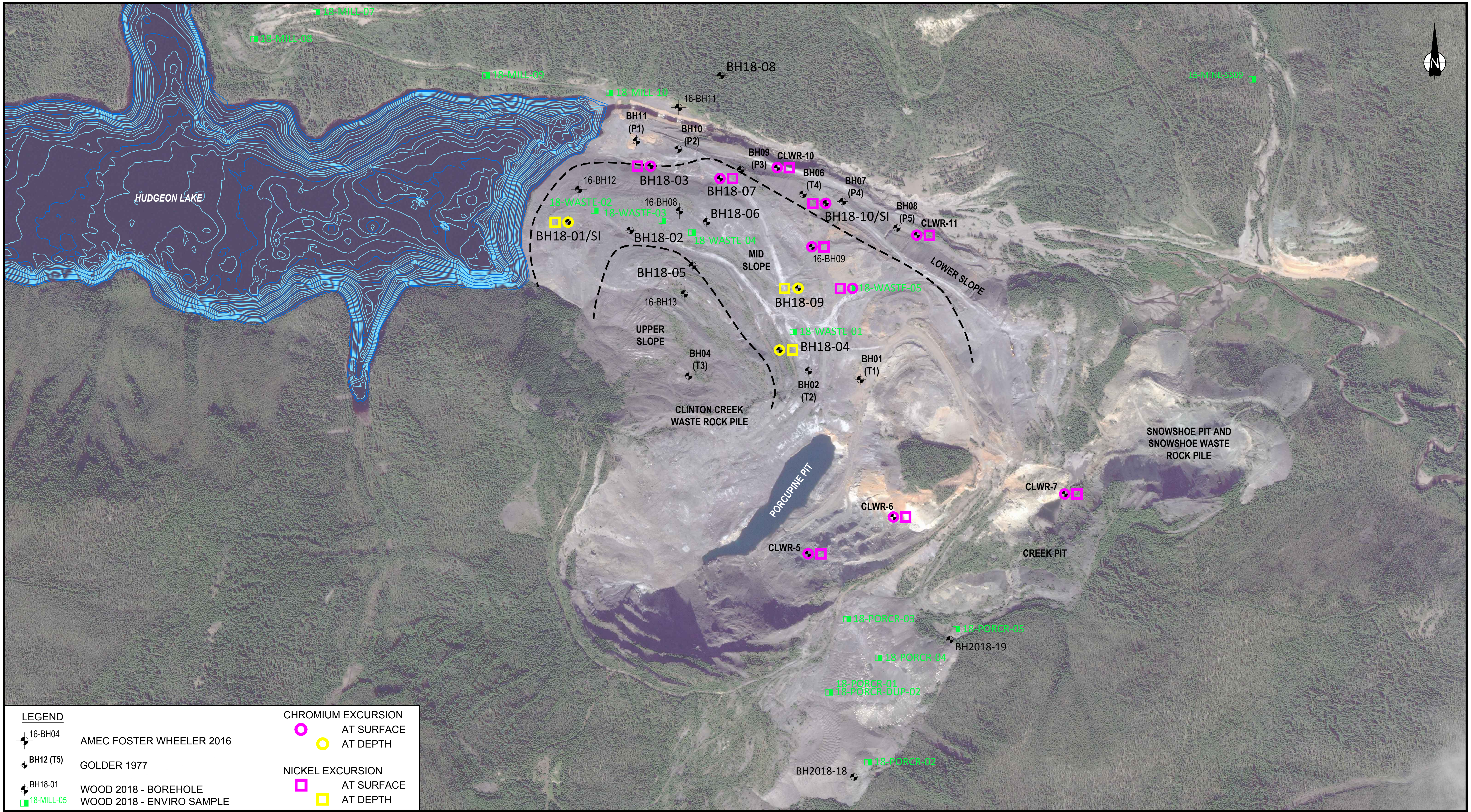

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Environment & Infrastructure Solutions
a Division of Wood Canada Limited
#600 - 4445 Lougheed Highway
Burnaby, BC V5C 0E4
Tel. 604-294-3811 Fax 604-294-4664

CLIENT:

Yukon

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CHK'D BY:	BG
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PROJECTION:	UTM Zone 7
SCALE:	AS SHOWN

PROJECT:
CLINTON CREEK REMEDIATION PROJECT
ENVIRONMENTAL CHARACTERIZATION UPDATE

TITLE:
Locations of Chromium and Nickel Excursions Above CCME Residential Parkland Criteria
WASTE DUMP

DATE:	JUNE 2019
PROJECT NO:	VE52705D.100.1
REV. NO:	A
FIGURE NO:	3.2

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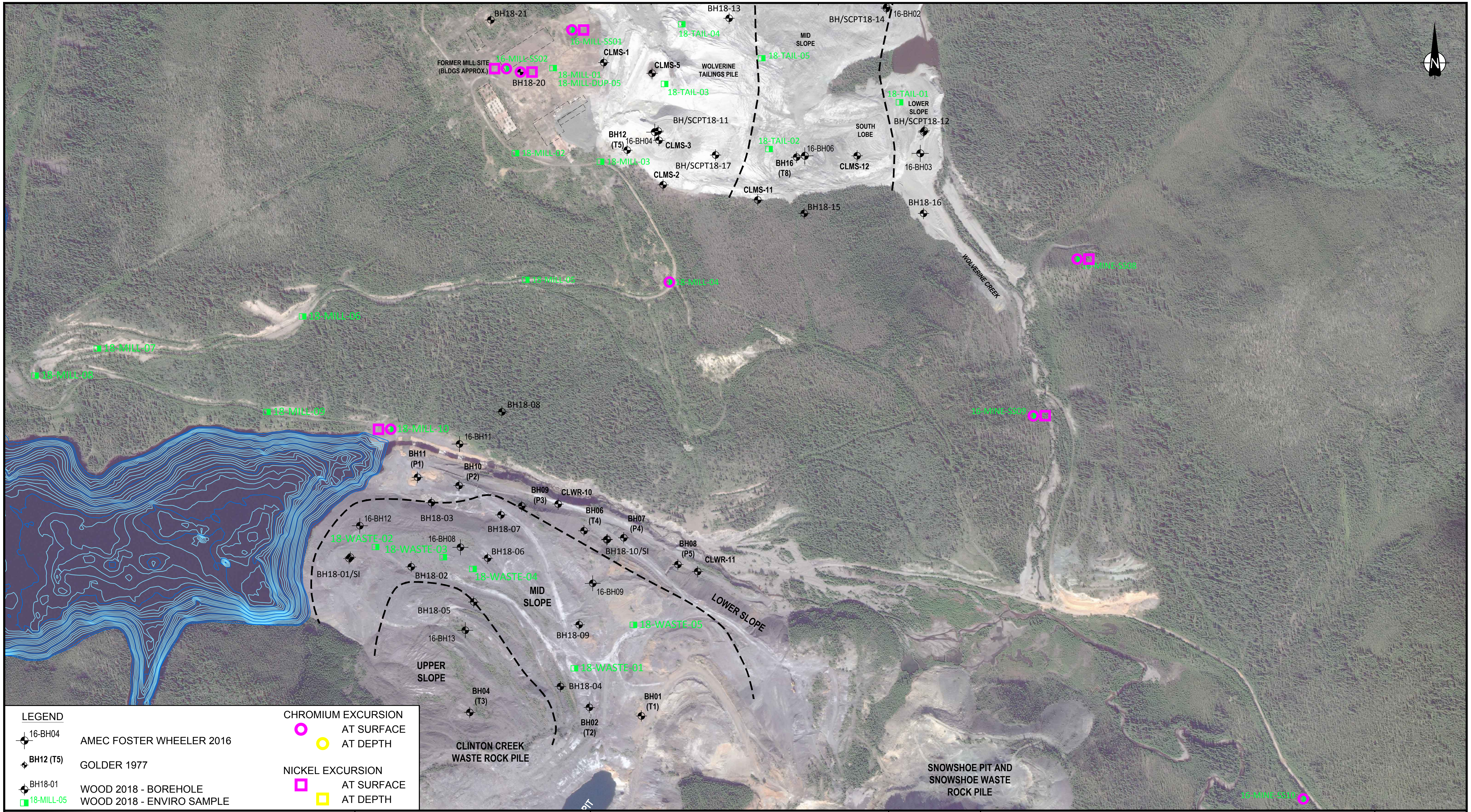

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wood.

Environment & Infrastructure Solutions
a Division of Wood Canada Limited
#600 - 4445 Lougheed Highway
Burnaby, BC V5C 0E4
Tel. 604-294-3811 Fax 604-294-4664

CLIENT:

Yukon

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DATUM:	NAD 83
PROJECTION:	UTM Zone 7
SCALE:	AS SHOWN

PROJECT:
CLINTON CREEK REMEDIATION PROJECT
ENVIRONMENTAL CHARACTERIZATION UPDATE

TITLE:
Locations of Chromium and Nickel Excursions
Above CCME Residential Parkland Criteria
MILL SITE AND COMMON AREAS

DATE:	JUNE 2019
PROJECT NO:	VE52705D.100.1
REV. NO:	A
FIGURE NO:	3.3

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3.1.2 Source Rock Characteristics

The contaminant characterizations of the Clinton property that are summarized in Table 3.1 are influenced by some of the key characteristics of the ores that serviced the operation, specifically the mobility of the metals that are present in these source materials and the form of particular metals of concern that are present on the site.

3.1.2.1 Metals Mobility

The leachability of metals, and particularly the acid generating capacity of the ores, have significant influences on potential contaminant mobility. This has been assessed in previous investigations, most specifically as described in AECOM (2009) and as reproduced below.

> *The leachability of different minerals/waste materials at the Clinton Creek Mine site was evaluated based on collection of seven representative samples collected by Government of Yukon staff in the vicinity of Hudgeon Lake, the channel stabilization works in Clinton Creek and the tailings pile. These mineral/waste material samples were analyzed for 36 elements by digestion followed leachability testing based on the modified Special Waste Extraction Procedure (SWEP), and acid-base accounting (ABA) analysis. The SWEP is designed to assess mobilization into water under conditions similar to or worse than might be encountered in the environment (based on pH). As expected, the quartz-carbonate altered serpentinite exhibited naturally elevated levels of arsenic, antimony, barium, boron, chromium, cobalt, mercury, nickel, and magnesium. Cadmium was not detected in the serpentinite samples, but was detected in two samples of argillite. One of the tailings samples had a very high concentration of boron relative to the other samples. Overall, the SWEP results confirmed that the Clinton Creek waste rock materials (i.e. argillite) have very limited leachability. Serpentinite soils exhibited a higher concentration of leachable arsenic and antimony than argillite samples. Cadmium was not leached from either the argillite or serpentinite samples under the extraction conditions used. This further suggested that the cadmium in Hudgeon Lake surface waters is released from argillite-type minerals, but only under reduced conditions. The results of acid-base-accounting (ABA) trials indicated that the host rock (i.e. serpentinite) and waste rock (i.e. argillite) contains only small amounts of sulfide minerals (related to acid generating potential) and sulfate relative to the large neutralization potential. As expected, there was no potential for acidic rock drainage from the argillite material forming the waste rock dumps.*

3.1.2.2 Chromium Speciation

The other key feature of the source materials that influence the risks posed by contaminants on the property is the proportion of the chromium compounds that is comprised of hexavalent chromium, versus the more common trivalent form. The HHERA update document (Wood 2019b) prepared for the property addresses the assumed presence of hexavalent chromium and its influence on risks in some detail. Briefly, while the HHERA noted that soils at Clinton Creek are not expected to contain anthropogenic sources of Cr (VI), six soil samples were submitted for laboratory analysis of chromium speciation to test this assumption. The results of the speciation suggested that most of the total chromium measured at the site is trivalent chromium (Cr III) with trace amounts of hexavalent chromium (Cr VI) (up to 2.3% in the samples tested).

It is worth noting that the industrial processes applied on the Clinton property are not those that would be typically associated with the production and/or occurrence of hexavalent chromium. NIOSH (2013) notes that processes involving extremely high temperatures capable of oxidizing metallic forms of chromium to the hexavalent state are those most likely to be of concern. This would include industrial processes like welding, painting, electroplating, iron/steel foundry, wood preservation and chromium metal production. NIOSH (2013) makes no reference to asbestos mining and processing, or similar low temperature mining processes as typically associated with the significant occurrence of hexavalent chromium.

3.2 Other Common Elements

There are various common or ancillary elements of the Clinton property not captured in the Table 3.1 discussion, specifically:

- Porcupine Creek and Snowshoe Pit waste and ore piles;
- Hudgeon Lake outlet abutments and log boom;
- air strip;
- miscellaneous borrow areas;
- two large pieces of equipment and miscellaneous waste;
- Clinton Creek access site roads and creek crossings; and
- miscellaneous infrastructure.

Broadly, these other elements can be categorized as follows:

- the air strip;
- roads/crossings; and
- rock/ore piles and debris/redundant infrastructure.

There has been some work post shutdown directed to these elements, the most recent description of which is provided in AECOM (2009) (Appendix A of that document lists locations/features and mitigation measures undertaken). Generally speaking, work to date has involved demolition of structures, regrading to restrict access to select areas and to cover areas with significant asbestos fibre accumulations and the on-site burial of demolition debris.

The following sections provide an overview of the likely disposition of the above common element categories during closure design development and execution.

3.2.1 Air Strip

There is no characterization data available for the air strip. However, neither is there any indication that potential contaminant levels departing from background, or at worst, from those evident in waste dump accumulations, would be present in this area. This means that all options ranging from no action (i.e., spontaneous, long term reversion to indigenous vegetation) to active surface reclamation could be contemplated. The decision taken would depend on Partner determinations of the air strip's place in the post closure landscape and land utilization expectations. The actions taken would likely be influenced by the nature of the closure concept selected for key site elements (i.e., options with a large materials management component would place equipment on-site that would lower the incremental costs of active surface reclamation at the air strip if the Partners determined that to be a requirement). In any case, the incremental costs and efforts associated with a closure approach for the air strip are not likely to rise to a level that would influence distinctions made amongst and between the candidate closure options considered during this 10% design phase.

3.2.2 Roads/Crossings

The disposition of roads and creek crossings on the property would be similar to the air strip in that it will be influenced by the Partners' objectives for post closure land use. It should be noted that the features in this category would include haul roads and crossings that might be upgraded to execute the preferred closure concept. For some post closure scenarios, there may be a need or desire to maintain access, either for monitoring/maintenance and/or to facilitate public access, or conversely, to limit access as part of risk management efforts. Given that contaminant issues are not likely to be significant on, or near, roads and crossings, a range of options from spontaneous revegetation to active grading and surface reclamation would be viable. Similar to the air strip, the costs and efforts related to any of these approaches is unlikely to materially influence the concept select activity that is the focus of the 10% design phase.

3.2.3 Rock/Ore Piles and Debris/Redundant Infrastructure

This comment element category includes materials and/or features that are not likely to be retained in their current form in the post closure landscape. Again, the specific methods and details relating to their disposition will be heavily influenced by the general closure concept selected. Options involving large materials movements and the development of Porcupine Pit as a spoil structure could easily integrate the movement of rock and ore piles and the disposal of debris within the pit at relatively low incremental costs. Less intensive closure options might require more dedicated and incrementally expensive efforts directed towards the disposition of these materials. However, even these more incrementally significant costs are unlikely to influence the concept select activities that are the focus of this 10% design phase.

Wood has included the Hudgeon Lake outlet abutments and log boom disposition in this category. There are no closure options that would see these items retained in their current form. Presumably, they would be dismantled as needed to eliminate operational conflicts with closure flow conveyance designs, and the associated debris handled with the larger inventory of site waste and debris.

4.0 SUMMARY OBSERVATIONS

Wood offers the following summary comments and observations derived from the content of Table 3.1 and Sections 2 and 3.

4.1 General Site Characterizations

- From a contaminants perspective, the predominant issues on the Clinton Creek property are the elevated metals and asbestos materials at, or near grade on waste dump and tailings piles or accumulations. These two source categories are large in volume and areal coverage, and influence, to at least some degree, media and receptors both on the property itself and areas downstream.
- The waste dump and tailings sources are not acid generating, and this has limited the areal and vertical reach of downstream influences.
- The physical redistribution of fine grained materials from the waste and tails has influenced the quality of downstream creek sediments, but over limited distances.
- Ongoing water quality monitoring programs have identified impacts associated with individual elements of the property (e.g., elevated hexavalent chromium in waste dump groundwater seepage; elevated arsenic, hexavalent chromium and/or baron in Snowshoe and Porcupine Pit lake waters; elevated arsenic in the lower depths of Hudgeon Lake). However, these excursions (above aquatic standards) typically do not approach or exceed drinking water guidelines (relevant only as a surrogate measure of potential impact), and do not manifest themselves in surface waters at any distance away from the individual source areas. Generally then, while water qualities occasionally exhibit influences from the waste and tails, these influences do not appear to be significant enough, or sustained enough, to produce clearly intolerable water qualities at any distance from the site.
- With the exception of hydrocarbons in the mill area (weathered diesels; see Section 4.2), there is little evidence of other contaminants potentially associated with a mining operation (e.g., PCBs, explosive compounds). While investigative efforts have not focused on these parameters, and there is some potential for their presence on-site, the lack of evident impacts some 40 years after closure suggest a limited probability for issues of significance.
- Hydrogeologic investigations for the site have been limited and there is no comprehensive information on groundwater conditions and qualities. However, from what is known about the limited mobility of source materials, and surface water/rock seepage qualities, it seems unlikely that any currently unidentified groundwater impacts would add incrementally to what is already understood about the downstream influences of the site.
- Lake and ponded water qualities, and the ecosystems that they can support, have clearly been influenced by, or are a direct consequence of, the presence of waste and tailings piles. However, for the most part, these influences are limited to the waterbodies themselves, and the physical constraints that are a consequence of their presence (e.g., barriers to fish passage). The secondary and potentially negative influences of these waterbodies on the broader ecology would appear to be limited.

- Similarly, while various studies have identified changes in local downstream ecologies (e.g., benthic communities) that can be attributed to the waste dump and tailings sources, it seems unlikely that these changes would rise above consequence thresholds that would drive dedicated and incrementally significant remedial efforts on the property.

4.2 Outcomes of 2018 Investigations

- The asbestos and metals data compiled in 2018 are generally consistent with that from previous investigations and do not alter the general perspectives and site characterizations summarized above.
- Significant asbestos levels are present at surface and at depth in the tailings pile.
- While asbestos can be found in the waste dump and Porcupine Creek waste materials at levels comparable to those in the tails, these excursions are not as pervasive as is evident in and on the tails.
- Elevated asbestos levels consistent with those evident in the waste dump can be found at surface in the mill and common areas; however, asbestos levels at depth in these areas are consistent with background.
- The analytical data in the Tables section highlight the following attributes relating to the presence of chromium and nickel, two of the key metals of concern highlighted in the HHERA for the property (Amec Foster Wheeler (2017) and Wood (2019b)):
  - both chromium and nickel are present at significant levels throughout the tailings matrix (i.e., at surface and depth);
  - similar to the asbestos profile, maximum chromium and nickel levels at surface and depth in the waste dump and Porcupine Creek waste materials are similar to those evident in the tails; however, the median levels are much lower in the waste dump and Porcupine Creek (i.e., suggesting a lower potential for receptor exposures in the dump/Porcupine Creek); and
  - chromium and nickel excursions similar to those observed in waste dump are evident in some surface soils in the mill and common areas, but not in the undisturbed soils at depth (supporting the supposition that rock and/or tails have been used or distributed on-site by design (road construction) or via environmental vectors).
- The 2018 data provide lower detection limits for some parameters (e.g., Zr) that suggest some potential additions to the list of potential contaminants of concern. That said, these new parameter excursions are typically (or always) co-located with other metal excursions and are unlikely to materially impact closure requirements.
- The hydrocarbons (weathered diesels) identified at depth in 2018 near former storage tanks have not generated constraints on likely at-grade land uses, or obvious impacts on downstream media (additional information of downstream impacts will be provided via adding hydrocarbon testing to the monitoring regime for Wolverine Creek downstream of the mill site). It is reasonable to assume that it will be possible to manage these hydrocarbons in the closure plan for the property via natural attenuation monitored over limited timelines.

4.3 Environmental Risk Profile

The conclusions of the HHERA update completed for the property were outlined in Section 2.7. In summary, these conclusions were as follows:

- The risk assessments completed for the property suggest that the elevated metal levels evident in and on the waste dump, and more sporadically over other areas of the property, are not likely to generate intolerable risks for human receptors under the more plausible post closure land use scenarios.
- The risks posed by asbestos, particularly for the tailings, are more significant, but still do not clearly suggest the need for targeted, remedial efforts that go beyond aerially limited, and source specific actions (a cover over the tailings, for example).
- Similarly, the risks posed by chromium and nickel on the tailings suggest the need for targeted remedial efforts for exposed tailings surfaces (e.g., access restrictions or a cover).

The ecological risk assessment completed for the property suggests that the maintenance of viable local ecosystems post closure is not likely to require significant mitigative actions beyond those needed to physically stabilize site features and address risks posed by any exposed tailings. At the least, no ecological risks have been identified that are likely to have a determining influence on the selection of a preferred closure concept following this 10% design development phase. There may however be some additional re-examination of select ecological pathways and/or receptors required to validate current judgements regarding post closure impacts in light of the particular characteristics of the selected closure concept. In Wood’s view, any such additional and/or supplemental assessments are best integrated with the regulatory approvals and permitting effort that will be part of closure activity following concept select.

5.0 CLOSURE

This report has been prepared for the exclusive use of Government of Yukon for specific application to the area within this report. Any use which a third party makes of this report, or any reliance on or decisions made based on it, are the responsibility of such third parties. Wood accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report. It has been prepared in accordance with generally accepted soil and foundation engineering practices. No other warranty, expressed or implied, is made. This Report is also subject to the limitations contained in Appendix A.

With appreciation,

Wood Environment & Infrastructure Solutions
a Division of Wood Canada Limited

PROFESSIONAL
YUKON
ROBERT BRIAN GEDDES
TERRITORY
30 JUNE 2019
ENGINEER

Reviewed by:

R. Brian Geddes, P.Eng.
Principal Engineer

Yaming Chen, M.Sc., Ph.D., P.Geo.
Senior Associate Hydrogeologist

RBG/YC/jm

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Association of Professional
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6.0 REFERENCES

Advameg, Inc. 2018. *Asbestos; How products are made*. Retrieved from http://www.madehow.com/Volume-4/asbestos.html. 21 March 2018.

Advisian. 2016. *Clinton Creek Long Term Performance Monitoring Program, 2016 Survey Results*. Prepared for Government of Yukon, Department of Energy, Mines and Resources, Assessment and Abandoned Mines Branch.

AECOM Canada Ltd. (AECOM). 2009. *Former Clinton Creek Asbestos Mine Overview Report*. Prepared for Government of Yukon.

AECOM Canada Ltd. (AECOM). 2011. *Clinton Creek Technical Options Assessment.* Prepared for Government of Yukon. July 2011.

Amec Foster Wheeler Environment & Infrastructure (Amec Foster Wheeler). 2017. *Human Health and Ecological Risk Assessment Report for Task Authorization (TA) #5: Develop 10% Designs and Cost Estimates, Clinton Creek Remediation Preliminary Design (10%) (DRAFT)*. Submitted to Government of Yukon, Department of Energy, Mines and Resources, Assessment and Abandoned Mines Branch. March 2017.

Amec Foster Wheeler Environment & Infrastructure (Amec Foster Wheeler). 2018a. *Clinton Creek Mine Geotechnical Data Gaps*. Project #VE52695. 29 March 2018.

Amec Foster Wheeler Environment & Infrastructure (Amec Foster Wheeler). 2018b. *Clinton Creek Mine Geotechnical Design Gaps.* Project VE52695. 29 March 2018.

Amec Environment & Infrastructure (Amec Foster Wheeler). 2018c. *Clinton Creek Remediation Project General Site Characterization and Data Gap Assessment.* Project VE52695.100.05. March 2018.

AvF R&D. 2016. *Clinton Creek Site: Fish Utilization and Passage, March 2016*. Prepared for Yukon Government, Energy, Mines and Resources, Assessment and Abandoned Mines.

Bottge, R.G. 1975. *Comparative Asbestos Mining and Processing Costs - Alaska Versus Yukon Territory*. United States Department of the Interior, Bureau of Mines Information Circular, IC 8672.

Department of Fisheries and Oceans (DFO). 2007. *Memorandum from Al Von Finster, RRB OHEB: Clinton Creek, tributary to the Fortymile River, Yukon River North Mainstem sub-basin - record of 2007 activities*. 12 pages.

Canadian Council of Ministers of the Environment (CCME). 2019. *Guideline Summary Tables*. Downloaded from: http://st-ts.ccme.ca/en/index.html. 27 February 2019.

Canadian Council of Ministers of the Environment (CCME). 2019a. *Canadian Environmental Quality Guidelines; Soil Quality Guidelines for the Protection of Environmental and Human Health; PCBs*. Downloaded from: www.ccme.ca/en/resources/canadian.environmental_quality_guidelines. January 2019.

Canadian Council of Ministers of the Environment (CCME). 2019b. *Canada-Wide Standards for Petroleum Hydrocarbons (PHC) in Soil.*

Ecological Logistics & Research Ltd. (ELR). 2014. *Clinton Creek Surface Water Quality and Hydrological Monitoring Program - 2013*. Prepared for Yukon Government, Assessment and Abandoned Mines. March 2014.

EDI Environmental Dynamics Inc. (EDI). 2018. *Clinton Creek Surface Water Quality and Hydrological Investigations 2018/19: Methodology*. Prepared for Government of Yukon, Department of Energy, Mines and Resources, Assessment and Abandoned Mines Branch. July 2018.

Health Canada. 2017. *Guidelines for Canadian Drinking Water Quality Summary Table.* Prepared by the Federal-Provincial-Territorial Committee on Drinking Water of the Federal-Provincial-Territorial Committee on Health and the Environment. February 2017.

Hemmera Envirochem Inc. (Hemmera). 2015. *July 2015 Clinton Creek Surface Water Quality and Hydrological Monitoring Program Report.* Prepared for Government of Yukon, Department of Energy, Mines and Resources, Assessment and Abandoned Mines Branch. November 2015.

Hemmera Envirochem Inc. (Hemmera). 2016. *Fall 2015 Clinton Creek Water Quality and Hydrological Monitoring Program Report*. Prepared for Government of Yukon, Assessment and Abandoned Mines. January 2016.

Hemmera Envirochem Inc. (Hemmera). 2016a. *Winter 2016 Clinton Creek Water Quality and Hydrological Monitoring Program Report*. Prepared for Government of Yukon, Assessment and Abandoned Mines. March 2016.

Hemmera Envirochem Inc. (Hemmera). 2016b. *Summer 2016 Clinton Creek Water Quality and Hydrological Monitoring Program Report*. Prepared for Government of Yukon, Assessment and Abandoned Mines. December 2016.

Laberge Environmental Services (Laberge). 2012. *Summary of Environmental Monitoring Activities at the Abandoned Clinton Creek Asbestos Mine, 2011*. Prepared for Government of Yukon, Department of Energy, Mines and Resources, Assessment and Abandoned Mines Branch. March 2012.

Laberge Environmental Services (Laberge). 2016. *DRAFT Aquatics Existing Conditions Investigations at Clinton Creek Mine Site, 2016*. Prepared for Yukon Government - Energy, Mines and Resources, Assessment and Abandoned Mines.

Liebau, W.H.O. 2010. *Hydrogen Sulfide in Hudgeon Lake, Yukon: Evaluation and Remediation Options*. A thesis submitted in partial fulfillment of the requirements for the degree of M.Sc., Royal Roads University. April 2010.

Marty, G.D., J. Mackenzie-Grieve, J. Miller, and M. Guilbeault. 2014. *Health Assessment of Slimy Sculpin in Three Yukon Streams*. 67 pp.

Minnow Environmental Inc. (Minnow). 2010. *Assessment of 2009 Aquatic Data for Clinton Creek Mine, Yukon*. Submitted to Yukon Government, Energy, Mines and Resources, Assessment and Abandoned Mines. July 2010.

National Institute for Occupational Safety and Health (NIOSH). 2013. *Criteria for a Recommended Standard, Occupational Exposure to Hexavalent Chromium.* Department of Health and Human Services. Centers for Disease Control and Prevention.

Royal Roads University - Applied Research Division (RRU). 1999. *An Environmental Review of The Clinton Creek Abandoned Asbestos Mines, Yukon, Canada*. 180 pp.

Stephens, F.H. 1969. *Cassiar Asbestos Corporation Limited, The Clinton Mine Western Miner, September 1969*. p. 39.

Tetra Tech EBA (Tetra Tech). 2016. *Existing Geotechnical Subsurface and Monitoring Data Summary Report, Abandoned Clinton Creek Asbestos Mine Site, Yukon*. Submitted to Yuko Government, Assessment and Abandoned Mines. February 2016.

Tetra Tech EBA (Tetra Tech). 2018. *Clinton Creek DS4 Emergency Repairs*. Construction Memorandum to J. Ojierenem, Government of Yukon, Assessment and Abandoned Mines. 19 October 2018.

UMA Engineering Ltd./AECOM. 2008. *Former Clinton Creek Asbestos Mine - Review of Suggested Improvements to Hudgeon Lake*. UMA Project No. 6029 009 00 (4.61), 30 pp.

White Mountain Environmental Consulting (WMEC). 2009. *Clinton Creek, Fish Community* Survey. September 2009, November 2009.

Wood Environment & Infrastructure Solutions (Wood). 2018a. *Investigation Execution Plan, Clinton Creek Property, Yukon.* Project VE52705.100.03. August 2018.

Wood Environment & Infrastructure Solutions (Wood). 2018b. *Clinton Creek Remediation Project, 2018 Site Investigation Site Specific Health and Safety Plan – Rev. 2, Clinton Creek, Yukon.* Project VE52705.100.03. Prepared for Government of Yukon, Whitehorse, YT, September 2018.

Wood Environment & Infrastructure Solutions (Wood). 2018c. *Clinton Creek Remediation Project*. Proposal for 2018 Site Investigation and 10% Design Phase Development Services – Rev. 1. Prepared for Government of Yukon, Whitehorse, YT, May 2018.

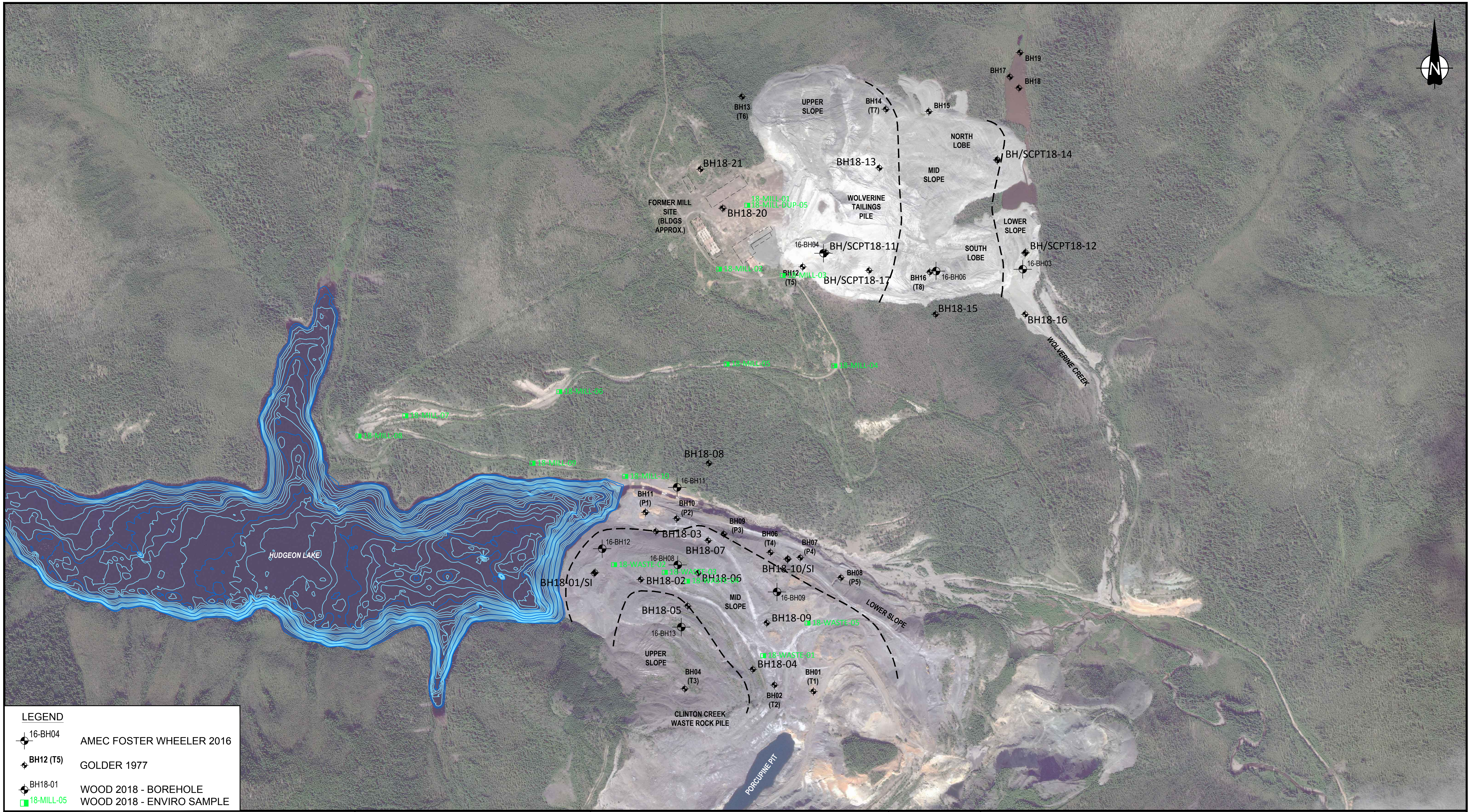
Wood Environment & Infrastructure Solutions. 2019. *Geological and Geotechnical Site Characterization and Model - Clinton Creek Remediation Project*. Prepared for Government of Yukon, Department of Energy, Mines and Resources, Assessment and Abandoned Mines Branch . July 2019.

Wood Environment & Infrastructure Solutions. 2019a. *Clinton Creek Remediation Project 2018 Site Investigation Report*. Prepared for Government of Yukon, Department of Energy, Mines and Resources, Assessment and Abandoned Mines Branch. July 2019.

Wood Environment & Infrastructure Solutions. 2019b. *Clinton Creek Remediation Project Human Health and Ecological Risk Assessment Update*. Prepared for Government of Yukon, Department of Energy, Mines and Resources, Assessment and Abandoned Mines Branch. July 2019.

Figures and Analytical Data

Tailings, Waste Dump and Soil



NOTE:
THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH THE WOOD ENVIRONMENT AND INFRASTRUCTURE SOLUTIONS REPORT DATED JUNE 2019

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wood.

Environment & Infrastructure Solutions
a Division of Wood Canada Limited
#600 - 4445 Lougheed Highway
Burnaby, BC V5C 0E4
Tel. 604-294-3811 Fax 604-294-4664

CLIENT:

Yukon

DWN BY:	TH
CHK'D BY:	BG
DATUM:	NAD 83
PROJECTION:	UTM Zone 7
SCALE:	AS SHOWN

PROJECT:
CLINTON CREEK REMEDIATION PROJECT
ENVIRONMENTAL CHARACTERIZATION UPDATE

TITLE:
SITE LOCATION
PLAN NORTH

DATE:	JUNE 2019
PROJECT NO:	VE52705D.100.1
REV. NO:	A
FIGURE NO:	S1

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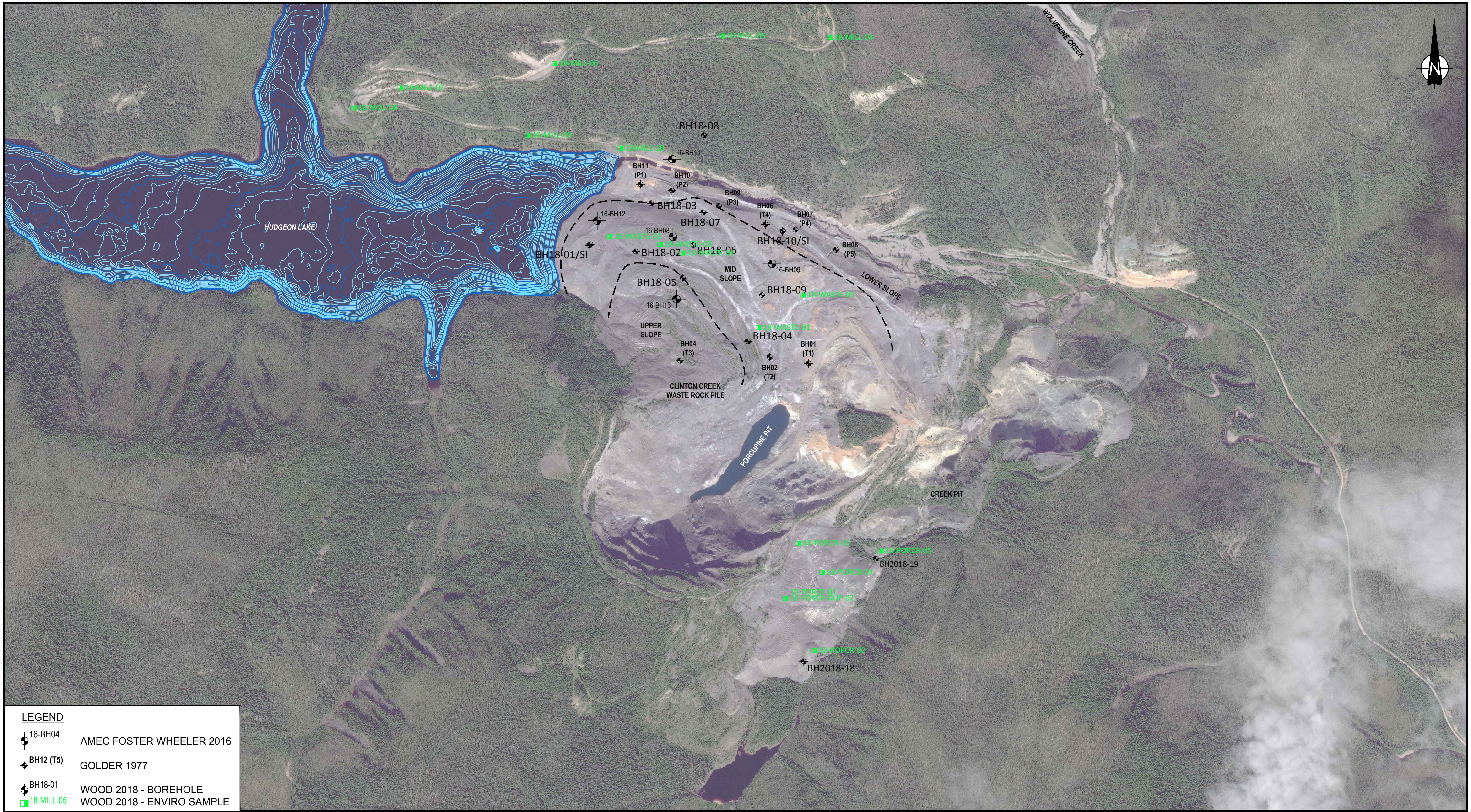

NOTE:
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a Division of Wood Canada Limited
#600 - 4445 Lougheed Highway
Burnaby, BC V5C 0E4
Tel. 604-294-3811 Fax 604-294-4664

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Yukon

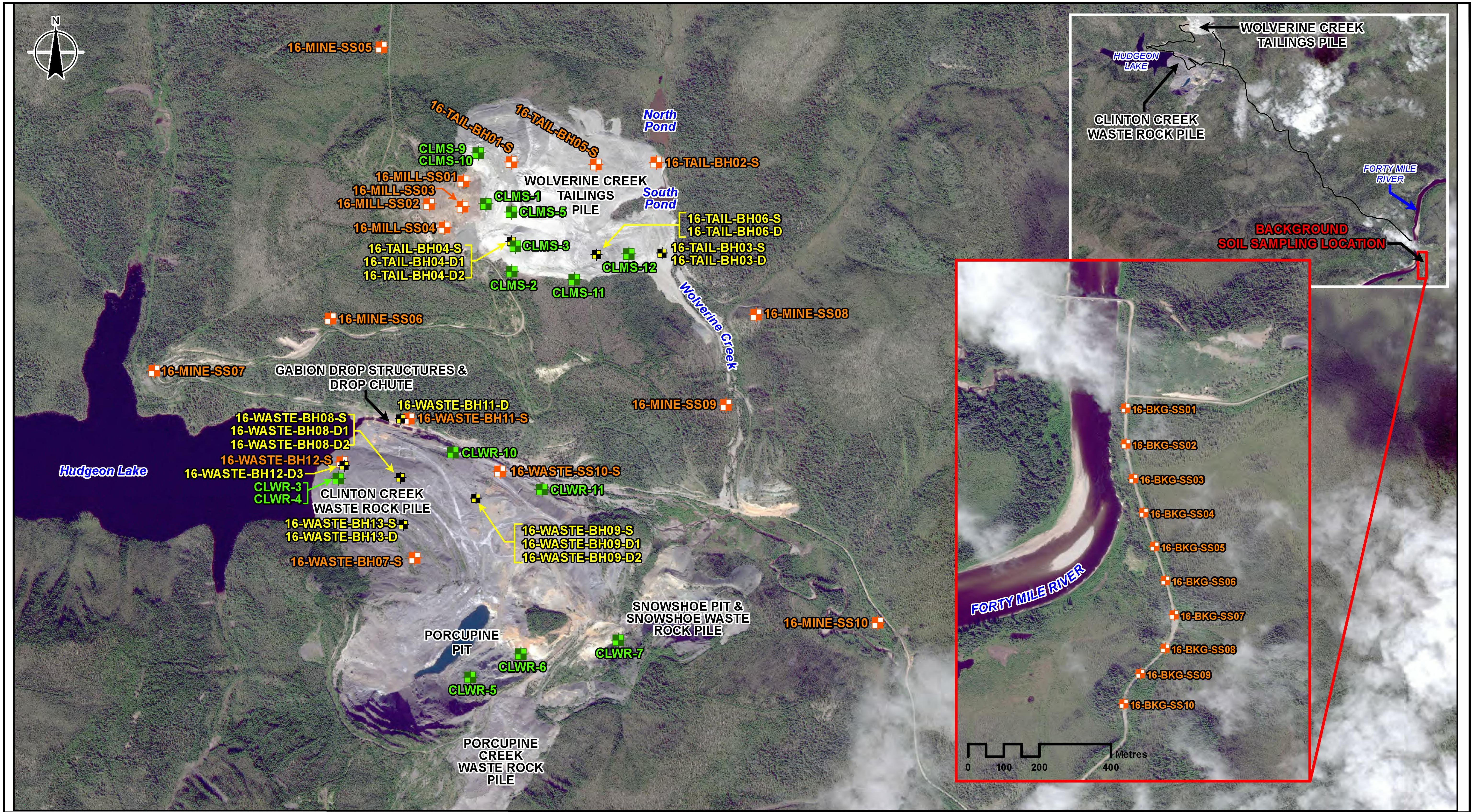
DWN BY:	TH
CHK'D BY:	BG
DATUM:	NAD 83
PROJECTION:	UTM Zone 7
SCALE:	AS SHOWN

PROJECT:
CLINTON CREEK REMEDIATION PROJECT
ENVIRONMENTAL CHARACTERIZATION UPDATE

TITLE:
SITE LOCATION
PLAN SOUTH

DATE:	JUNE 2019
PROJECT NO:	VE52705D.100.1
REV. NO:	A
FIGURE NO:	S2

P:\CAD\CIV\2018 Site Investigation PDF\VE52705D.100.01-ENV-Character-S1-S2-S3.dwg – FIG S2 – Jul. 02, 2019 2:32pm – Juliana.Matos



NOTE:
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0m 100 200 300 400 500

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wood.

Environment & Infrastructure Solutions
a Division of Wood Canada Limited
#600 - 4445 Lougheed Highway
Burnaby, BC V5C 0E4
Tel. 604-294-3811 Fax 604-294-4664

CLIENT:

Yukon

DWN BY:	TH
CHK'D BY:	BG
DATUM:	NAD 83
PROJECTION:	UTM Zone 7
SCALE:	AS SHOWN

PROJECT:
CLINTON CREEK REMEDIATION PROJECT
ENVIRONMENTAL CHARACTERIZATION UPDATE

TITLE:
PRE 2018
ENVIRONMENTAL SAMPLING LOCATIONS

DATE:	JUNE 2019
PROJECT NO:	VE52705D.100.1
REV. NO:	A
FIGURE NO:	S3

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Table S1 - Waste Dump - Asbestos & Metals

wood.

Legend

- Result exceeds agricultural guideline: (light yellow shading)
- Result exceeds residential/parkland guideline: (dark orange shading)
- Surface sample: (green shading)
- Sampled at depth: (grey shading)

Sample ID	Date	Year	Depth (m)	Depth Category	Area	Aluminum (Al)	Antimony (Sb)	Arsenic (As)	Barium (Ba)	Beryllium (Be)	Bismuth (Bi)	Boron (B)	Cadmium (Cd)	Calcium (Ca)	Chromium (Cr)	Cobalt (Co)	Copper (Cu)	Iron (Fe)	Lead (Pb)	Lithium (Li)	Magnesium (Mg)	Manganese (Mn)	Mercury (Hg)	Molybdenum (Mo)	Nickel (Ni)	Phosphorus (P)	Potassium (K)	Selenium (Se)	Silver (Ag)	Sodium (Na)	Strontium (Sr)	Sulpher (S)	Thallium (Tl)	Tin (Sn)	Titanium (Ti)	Tungsten (W)	Uranium (U)	Vanadium (V)	Zinc (Zn)	Zirconium (Zr)	Asbestos By Point Count	Other Fibres: Cellulose	Asbestos: Chrysotile	Mica	Other Fibres	Other Fibres: Synthetic
Environmental Health Guidelines (Agricultural)						---	20 [3]	25 [1]	390 [3]	4 [3]	---	120 [3]	9 [1]	---	50 [1]	180 [3]	150 [1]	---	350 [1]	---	---	---	0.6 [2]	6.9 [3]	45 [2]	---	---	1 [2]	20 [3]	---	---		1 [2]	---	---		33 [2]	130 [2]	200 [1]	---						
Human Health Guidelines (Residential/Parkland)						15600 [0]	7.5 [3]	100 [1]	6800 [2]	38 [1]	---	4300 [3]	3 [1]	---	100 [1]	22 [3]	15000 [1]	11000 [0]	500 [1]	32 [0]	---	380 [0]	6.6 [2]	110 [3]	200 [2]	---	---	80 [2]	77 [3]	---	9400 [0]		1 [2]	9400 [0]	---		23 [2]	39 [3]	5600 [3]	1.3 [0]	%	%	%	%		
Reported Detection Limit						50	0.1	0.1	0.5	0.1	0.2	5	0.02	50	0.5	0.1	0.5	50	0.5	2	100	1	0.05	0.1	2.5	50	100	0.2	0.1	50	0.5		0.05	2	1.0		0	0	2	1	0.1	1	0.1	1		
						Results (mg/kg)																																			Results (%)					
16-WASTE-BH07-S	2-Sep-16	2016	0 - 0.15	Surface	Waste Rock	17123	2.3	13.4	36	0.6	0.4	3	2.63	12261	30	20	66	43337	22.2	27	10285	552	0.21	15.5	65	720	455	5.7	0.4	96	96.1		0.178	1	4		1.25	29	174	5.6	-	Trace <1	0.6	Trace <1		
16-WASTE-BH08-S	2-Sep-16	2016	0 - 0.15	Surface	Waste Rock	21271	2.2	19.7	95	0.7	0.4	3	2.74	5620	30	23	73	51822	34.2	31	11261	580	0.23	22.5	79	727	396	4.3	0.4	66	40.9		0.181	1	3		1.66	33	261	4.1	-	Trace <1	0.3	Trace <1		
16-DUP-4 (DUPLICATE OF 16-WASTE-SS08-S)	2-Sep-16	2016	0 - 0.15	Surface	Waste Rock	20972	2.1	16.8	125	0.7	0.4	3	1.82	6852	31	20	61	47446	28.8	40	11420	510	0.24	15.3	64	642	363	4.1	0.4	75	63.5		0.175	1	3		1.40	31	173	4.6	-	-	0.1	Trace <1		
16-WASTE-SS08-D1 (SHOWN AS"16-WASTE-BH08-D1" ON SAMPLE)	27-Sep-16	2016	10.4 - 11.0	Depth	Waste Rock	6941	3.1	15.7	131	0.4	0.3	3	0.61	34595	56	15	23	28607	13.6	14	13306	860	0.19	6.0	171	412	266	2.2	0.2	95	184.1		0.298	1	3		1.01	15	80	5.8	-	-	0.2	Trace <1		
16-WASTE-SS08-D2 (SHOWN AS"16-WASTE-BH08-D2" ON SAMPLE)	30-Sep-16	2016	50.0 - 50.6	Depth	Waste Rock	3830	1.0	6.8	50	0.2	0.1	3	2.83	77236	10	6	22	16260	7.0	7	7884	310	0.22	5.1	29	950	321	4.2	0.4	25	269.6		0.058	1	3		1.06	10	82	4.4	-	-	1-5	Trace <1		
16-WASTE-BH09-5	3-Sep-16	2016	0 - 0.15	Surface	Waste Rock	3691	6.2	47	57	0.2	0.1	75	0.46	12973	745	65	20	48833	6.8	1	140275	672	0.10	3.8	2647	308	200	1.5	0.1	25	62.2		0.062	1	21		0.67	24	51	1.3	-	-	50-75	-		
16-WASTE-BH10-5	4-Sep-16	2016	0 - 0.15	Surface	Waste Rock	3463	4.6	14.4	77	0.2	0.1	99	0.30	10463	1133	105	17	66372	4.0	3	135737	788	0.08	2.0	1924	167	171	0.7	0.1	25	48.8		0.090	1	33		0.53	22	42	0.5	-	-	50-75	-		
16-WASTE-BH11-5	2-Sep-16	2016	0 - 0.15	Surface	Waste Rock	11162	1.0	10.1	353	0.4	0.1	3	0.53	9574	27	10	28	23753	10.5	9	5647	401	0.03	1.9	33	711	1054	1.2	0.2	227	50.7		0.084	1	502		1.02	45	76	2.5	-	5-10	0.3	Trace <1		
16-WASTE-SS11-D(SHOWN AS "16-WASTE-BH11-D" ON SAMPLE LABEL	4-Oct-16	2016	15.8	Depth	Waste Rock	1819	1.6	9.2	112	0.3	0.3	3	2.45	35462	10	11	51	27912	13.7	1	7470	478	0.34	8.0	44	1167	378	9.4	0.8	25	128.1		0.176	1	2		1.96	16	121	5.7	-	Trace <1	0.1	Trace <1		
16-WASTE-BH12-5	0-Jan-00	2016	0	Unknown	Waste Rock	7430	2.4	14.1	65	0.5	0.3	3	2.28	19800	21	17	61	41600	16.9	10	9280	442	0.20	12.0	66	794	530	5.7	0.5	25	99.5		0.162	1	3		1.61	25	181	5.5	-	Trace <1	0.4	Trace <1		
16-WASTE-SS12-D3(SHOWN AS "16-WASTE-BH12-D3" ON SAMPLE	19-Sep-16	2016	34.7 - 35.4	Depth	Waste Rock	15177	2.2	13.0	57	0.7	0.4	3	0.97	1108	27	11	59	51369	21.8	24	5872	198	0.20	9.2	57	713	432	5.5	0.4	113	20.1		0.146	1	8		2.09	30	186	4.6	-	-	0.1	Trace <1		
16-WASTE-BH13-5	25-Sep-16	2016	0 - 0.15	Surface	Waste Rock	4082	3.0	15.5	111	0.4	0.3	3	1.43	11507	29	18	59	36368	19.4	4	9933	597	0.26	14.1	74	740	727	5.0	0.5	73	88.5		0.249	1	8		1.43	23	145	4.1	-	1-5	0.3	Trace <1		
16-WASTE-SS13-D(SHOWN AS "16-WASTE-BH13-D" ON SAMPLE LABEL	19-Sep-16	2016	19.5 - 20.1	Depth	Waste Rock	3141	1.6	8.8	68	0.4	0.3	3	2.12	50777	8	11	37	28823	14.0	3	9660	329	0.32	8.8	42	763	743	8.8	0.6	25	222.9		0.105	1	3		1.51	15	136	6.3	-	-	0.1	Trace <1		
16-DUP 5 (DUPLICATE SAMPLE OF 16-WASTE-SS13-D)	19-Sep-16	2016	19.5 - 20.1	Depth	Waste Rock	2189	1.8	8.3	65	0.4	0.2	3	2.15	85690	7	11	32	31900	13.1	1	12760	640	0.26	7.2	40	724	495	9.7	0.5	25	359.7		0.130	1	3		1.56	13	125	9.2	0.05	-		Trace <1		
18BH01-01	28-Aug-18	2018	0.0-0.15	Surface	Waste Rock	1798	2.8	25	91	0.4	0.3	3	5.67	46583	19	14	62	36172	16.3	1	15773	634	0.72	24.9	76	993	473	8.2	0.9	25	222.9	13775	0.298	1	4	0.25	3.87	34	366	17.1			5-10	Trace <1		
18BH01-02	28-Aug-18	2018	30	Depth	Waste Rock	16059	3.5	49	154	0.3	0.1	29	0.20	8531	623	46	32	31435	6.3	23	72437	476	0.03	1.8	726	284	364	0.6	0.1	25	30.1	1139	0.025	1	322	0.25	0.59	29	42	2.5			10-25	Trace <1		
18-BH02-01	3-Sep-18	2018	0.0-0.15	Surface	Waste Rock	7262	3.1	12.9	50	0.6	0.3	3	2.42	34607	21	15	49	34607	23.0	16	8822	385	0.26	20.7	70	556	362	7.0	0.8	25	177.7	7851	0.247	1	3	0.25	1.95	23	205	12.2			0.6	1-5		
18-BH02-DUP-07 (BH02-01)	3-Sep-18	2018	0.0-0.15	Surface	Waste Rock	9721	2.7	15.1	61	0.5	0.3	3	3.93	27273	23	17	52	38740	21.0	16	9959	431	0.03	21.3	78	683	465	6.4	0.7	25	157.0	7231	0.277	1	3	0.25	2.41	27	251	8.8			0.2	Trace <1		
BH2018-02-02/156'	17-Sep-18	2018	48	Depth	Waste Rock	8940	3.2	17.8	52	0.5	0.3	3	0.85	18300	18	14	57	33300	42.3	14	2960	244	0.32	23.1	38	651	930	7.5	0.8	304	99.1	16000	0.207	1	35	0.25	1.37	22	109	16.6	0.05		Trace <1			
18-BH03-01	3-Sep-18	2018	0.0-0.15	Surface	Waste Rock	6161	9.0	38	238	0.3	0.4	37	1.01	16989	732	58	34	41398	7.6	14	92043	565	0.23	4.0	1086	642	312	2.2	0.4	25	110.8	500	0.280	1	36	0.25	1.58	27	81	4.2			25-50	Trace <1		
18-BH03-02/82' (25M)	6-Sep-18	2018	25	Depth	Waste Rock	2970	2.0	11.0	93	0.2	0.1	3	5.29	92900	14	8	34	20900	8.9	1	4870	363	0.42	5.9	42	2040	1120	17.6	1.0	25	317.0	11100	0.120	1	22	0.57	2.83	18	153	1.7	0.05		Trace <1			
18-BH04-01	3-Sep-18	2018	0.0-0.15	Surface	Waste Rock	11398	2.5	15.2	61	0.5	0.4	3	2.03	18925	24	17	59	38387	23.5	22	8634	410	0.22	17.1	71	654	387	6.5	0.6	25	103.7	1828	0.229	1	3	0.25	1.72	26	187	8.6			0.7	1-5		
18-BH04/38'	13-Sep-18	2018	11.5	Depth	Waste Rock	3972	3.7	14.1	71	0.2	0.1	31	2.92	58235	595	42	47	28848	8.1	6	82777	456	0.26	5.0	740	868	592	5.6	0.4	25	232.5	3875	0.056	1	25	0.25	1.58	20	87	6.1			5-10	Trace <1		
18-BH05-01	3-Sep-18	2018	0.0-0.15	Surface	Waste Rock	14400	4.0	21.3	57	0.7	0.4	3	3.24	47100	25	19	68	48100	29.4	24	12700	574	0.25	29.1	88	999	590	8.9	0.8	78	204.0	10700	0.275	1	5	0.25	2.51	40	283	16.5	0.05			1-5		
BH2018-05-02/151'	17-Sep-18	2018	46	Depth	Waste Rock	19700	1.4	7.7	79	0.6	0.3	3	0.74	18100	25	15	42	36600	17.3	38	9980	558	0.15	6.2	44	603	1010	2.8	0.4	208	111.0	4700	0.106	1	57	0.25	1.06	25	117	12.0	0.05		Trace <1			
18-BH06-01	3-Sep-18	2018	0.0-0.15	Surface	Waste Rock	15269	1.2	8.8	48	0.5	0.3	3	0.70	7269	38	14	36	31935	18.5	27	10301	333	0.11	7.0	57	519	312	1.8	0.3	60	39.0	2366	0.100	1	6	0.25	1.09	19	112	7.0			1-5	1-5	N.R	
18-BH06-02	31-Aug-18	2018	35	Depth	Waste Rock	3154	1.6	10.7	173	0.3	0.1	3	3.10	93319	9	9	33	20811	11.3	2	8434	370	0.03	8.2	41	1078	832	8.2	0.6	64	339.5	10077	0.118	1	5	0.25	2.07	15	125	10.7	0.05	Trace <1		1-5		
18-BH07-01	3-Sep-18	2018	0.0-0.15	Surface	Waste Rock	6805	2.1	13.0	52	0.2	0.1	25	3.29	14857	380	25	26	27948	7.3	8	68571	417	0.07	3.0	415	423	249	0.9	0.1	25	59.0	500	0.025	1	24	0.25	0.89	28	47	4.7			25-50	1-5		
18-BH07-02	3-Sep-18	2018	25	Depth	Waste Rock	4130	1.6	10.2	77	0.7	0.4	3	1.05	18800	12	19	56	52200	16.9	1	8800	516	0.22	7.2	61	749	750	3.7	0.4	62	85.6	9100	0.144	1	4	0.25	2.05	22	181	11.8	0.05			1-5		
18-BH08-01	3-Sep-18	2018	0.0-0.15	Surface	Waste Rock	10100	2.6	16.4	467	0.6	0.5	3	2.23	10900	20	23	62	51700	34.6	11	5350	610	0.23	15.3	72	755	770	4.7	0.5	135	70.0	500	0.308	1	15	0.25	1.40	34	211	7.9	0.05			1-5		
18-BH08-DUP-08 (BH08-01)	3-Sep-18	2018	0.0-0.15	Surface	Waste Rock	8860	2.6	16.2	147	0.6	0.4	3	2.47	11900	18	20	58	47500	33.3	9	4910	550	0.23	14.0	67	778	680	4.5	0.5	116	64.8	500	0.267	1	10	0.25	1.48	30	211	7.1	0.05			Trace <1		
18BH09-01	28-Aug-18	2018	0.0-0.15	Surface	Waste Rock	8611	1.8	11.3	58	0.4	0.4	3	0.95	12019	22	17	46	39090	20.0	21	8320	422	0.07	8.9	63	734	420	1.6	0.2	25	67.7	6184	0.095	1	12	0.25	1.58	16	109	11.1			50-75	Trace <1		
18BH09-02	28-Aug-18	2018	48.8	Depth	Waste Rock	9562	2.8	61	204	0.3	0.1	36	0.31	21124	1074	80	119	36292	2.6	25	117978	485	0.03	1.8	924	340	135	0.7	0.3	25	84.0	500	0.025	1	519	0.25	0.44	30	36	2.7			10-25	Trace <1		
18-BH10-01	28-Aug-18	2018	0.0-0.15	Surface	Waste Rock	5357	6.5	23.6	189	0.3	0.1	50	0.80	21734	524	53	26	47420	10.8	8	77387	551	0.14	5.0	955	531	417	2.0	0.2	25	91.3	1317	0.190	1	38	0.25	1.20	25	85	5.6			10-25	Trace <1		
18-BH10-02	27-Aug-18	2018	19.8	Depth	Waste Rock	4363	1.5	9.9	115	0.5	0.4	3	1.19	36044	16	16	40	35714	16.3	4	10549	526	0.20	5.1	55	792	813	4.3	0.4	80	167.0	4615	0.109	1	13	0.25	1.87	18	108	11.3			0.2	Trace <1		

Table S1 - Waste Dump - Asbestos & Metals

wood.

Legend

- Result exceeds agricultural guideline: (yellow)
- Result exceeds residential/parkland guideline: (orange)
- Surface sample: (green)
- Sampled at depth: (grey)

Results (mg/kg); Asbestos Results (%)

Sample ID	Date	Year	Depth (m)	Depth Category	Area	Aluminum (Al)	Antimony (Sb)	Arsenic (As)	Barium (Ba)	Beryllium (Be)	Bismuth (Bi)	Boron (B)	Cadmium (Cd)	Calcium (Ca)	Chromium (Cr)	Cobalt (Co)	Copper (Cu)	Iron (Fe)	Lead (Pb)	Lithium (Li)	Magnesium (Mg)
Environmental Health Guidelines (Agricultural)						---	20 [3]	25 [1]	390 [3]	4 [3]	---	120 [3]	9 [1]	---	50 [1]	180 [3]	150 [1]	---	350 [1]	---	---
Human Health Guidelines (Residential/Parkland)						15600 [o]	7.5 [3]	100 [1]	6800 [2]	38 [3]	---	4300 [3]	3 [3]	---	100 [1]	22 [3]	15000 [1]	11000 [o]	500 [1]	32 [o]	---
Reported Detection Limit						50	0.1	0.1	0.5	0.1	0.2	5	0.02	50	0.5	0.1	0.5	50	0.5	2	100
18-WASTE-01	28-Aug-18	2018	0.0-0.15	Surface	Waste Rock	1713	2.3	12.4	51	0.4	0.2	3	2.02	30819	14	14	45	39224	14.7	1	10884
18-WASTE-02	28-Aug-18	2018	0.0-0.15	Surface	Waste Rock	14978	2.1	11.0	34	0.5	0.3	3	2.74	6563	23	21	46	41703	22.3	23	9278
18-WASTE-03	28-Aug-18	2018	0.0-0.15	Surface	Waste Rock	7274	2.6	12.2	61	0.6	0.3	3	2.56	29095	20	18	48	34375	17.9	12	11315
18-WASTE-04	28-Aug-18	2018	0.0-0.15	Surface	Waste Rock	7963	3.3	15.6	32	0.6	0.2	3	2.72	16703	26	18	53	39763	21.9	14	8405
18-WASTE-05	28-Aug-18	2018	0.0-0.15	Surface	Waste Rock	2823	6.6	108	137	0.4	0.1	55	0.67	16487	554	54	41	40086	6.3	3	101293
CLWR-3	August 1998	1998	0 - 0.10	Surface	Waste Rock		10.0	13.0	84	0.5			2.30		19	15	58		25.0		
CLWR-4	August 1998	1998	0 - 0.10	Surface	Waste Rock		10.0	14.0	103	0.7			2.50		22	15	62		25.0		
CLWR-5	August 1998	1998	0 - 0.10	Surface	Waste Rock		40	28	65	1.0			0.20		1110	55	25		100		
CLWR-6	August 1998	1998	0 - 0.10	Surface	Waste Rock		50	13	397	1.5			0.05		1810	105	10		150		
CLWR-7	August 1998	1998	0 - 0.10	Surface	Waste Rock		50	17	1060	1.5			0.50		625	46	21		150		
CLWR-10	August 1998	1998	0 - 0.10	Surface	Waste Rock		40	15	10	1.0			0.05		1180	76	14		100		
CLWR-11	August 1998	1998	0 - 0.10	Surface	Waste Rock		10	18	296	0.8			1.60		486	49	48		25		

Sample ID	Manganese (Mn)	Mercury (Hg)	Molybdenum (Mo)	Nickel (Ni)	Phosphorus (P)	Potassium (K)	Selenium (Se)	Silver (Ag)	Sodium (Na)	Strontium (Sr)	Sulpher (S)	Thallium (Tl)	Tin (Sn)	Titanium (Ti)	Tungsten (W)	Uranium (U)	Vanadium (V)	Zinc (Zn)	Zirconium (Zr)	Asbestos By Point Count	Other Fibres: Cellulose	Asbestos: Chrysotile	Mica	Other Fibres	Other Fibres: Synthetic
Environmental Health Guidelines (Agricultural)	---	0.6 [2]	6.9 [3]	45 [2]	---	---	1 [2]	20 [3]	---	---		1 [2]	---	---		33 [2]	130 [2]	200 [1]	---						
Human Health Guidelines (Residential/Parkland)	380 [o]	6.6 [2]	110 [3]	200 [2]	---	---	80 [2]	77 [3]	---	9400 [o]		1 [2]	9400 [o]	---		23 [2]	39 [3]	5600 [3]	1.3 [o]	%	%	%	%		
Reported Detection Limit	1	0.05	0.1	2.5	50	100	0.2	0.1	50	0.5		0.05	2	1.0		0	0	2	1	0.1	1	0.1	1		
18-WASTE-01	483	0.22	14.7	68	845	345	4.8	0.4	25	142.2	4095	0.116	1	2	0.25	1.57	23	179	11.5			0.1	Trace <1		
18-WASTE-02	869	0.15	11.7	73	678	323	4.1	0.4	25	53.2	500	0.134	1	4	0.25	1.44	24	208	8.1			0.1	Trace <1		
18-WASTE-03	406	0.24	15.3	141	746	356	6.3	0.6	25	153.0	5819	0.260	1	3	0.25	1.77	27	211	13.4			1-5	Trace <1		
18-WASTE-04	458	0.25	18.8	78	1074	377	5.1	0.6	25	77.3	3017	0.220	1	3	0.25	2.05	27	218	11.6			1-5	Trace <1		
18-WASTE-05	633	0.23	5.6	1034	398	280	2.2	0.3	25	83.9	500	0.136	1	16	0.56	1.03	21	74	4.6			10-25	Trace <1		
CLWR-3		0.30	14.0	65			8.0	1.0					5				30	248				3 5			
CLWR-4		0.34	16.0	64			8.0	1.0					5				36	238							
CLWR-5		0.05	10	1230			0.3	4					20				23	29							
CLWR-6		0.14	10	852			0.1	5					25				66	27				<1			
CLWR-7		0.17	10	867			1.2	5					25				47	71							
CLWR-10		0.20	10	1710			0.1	4					20				4	8							
CLWR-11		0.30	12	834			4.4	1					5				38	143				7			

Minimum, Median, and Maximum for all Samples

Parameter (mg/kg)

	Aluminum (Al)	Antimony (Sb)	Arsenic (As)	Barium (Ba)	Beryllium (Be)	Bismuth (Bi)	Boron (B)	Cadmium (Cd)	Calcium (Ca)	Chromium (Cr)	Cobalt (Co)	Copper (Cu)	Iron (Fe)	Lead (Pb)	Lithium (Li)	Magnesium (Mg)	Manganese (Mn)	Mercury (Hg)	Molybdenum (Mo)	Nickel (Ni)	Phosphorus (P)	Potassium (K)	Selenium (Se)	Silver (Ag)	Sodium (Na)	Strontium (Sr)	Sulpher (S)	Thallium (Tl)	Tin (Sn)	Titanium (Ti)	Tungsten (W)	Uranium (U)	Vanadium (V)	Zinc (Zn)	Zirconium (Zr)
Minimum	1713	0.97	6.8	10	0.2	0.1	3	0.05	1108	7	6	10.0	16260	2.6	1	2960	198	0.025	1.8	29	167	135	0.1	0.1	25	20	500	0.025	1	2	0.25	0.438	4	8	0.5
Median	7268	2.6	14.1	77	0.5	0.3	3	2.0	18550	25	18	46	37494	18	10	10132	484	0.2	10	72	722	419	4	0.5	25	98	3985	0.1	1	6	0.25	1.5	25	125	6
Maximum	21271	50	108	1060	1.5	0.5	99	6	93319	1810	105	119	66372	150	40	140275	869	1	29	2647	2040	1120	18	5	304	360	16000	0.3	25	519	0.57	3.87	66	366	17

Minimum, Median, and Maximum for all Surface Samples

Parameter (mg/kg)

	Aluminum (Al)	Antimony (Sb)	Arsenic (As)	Barium (Ba)	Beryllium (Be)	Bismuth (Bi)	Boron (B)	Cadmium (Cd)	Calcium (Ca)	Chromium (Cr)	Cobalt (Co)	Copper (Cu)	Iron (Fe)	Lead (Pb)	Lithium (Li)	Magnesium (Mg)	Manganese (Mn)	Mercury (Hg)	Molybdenum (Mo)	Nickel (Ni)	Phosphorus (P)	Potassium (K)	Selenium (Se)	Silver (Ag)	Sodium (Na)	Strontium (Sr)	Sulpher (S)	Thallium (Tl)	Tin (Sn)	Titanium (Ti)	Tungsten (W)	Uranium (U)	Vanadium (V)	Zinc (Zn)	Zirconium (Zr)
Minimum	0	1	9	10	0	0	0	0	0	14	10	10	0	4	0	0	0	0	2	33	0	0	0	0	0	0	0	0	1	0	0	0	4	8	0
Median	6805	3	15	77	0.5	0.3	2.5	2.0	11900	29	20	48	38740	22	9	9933	458	0.22	14	78	642	356	4	0.45	25	65	500	0.14	1	4	0.25	1.40	27	173	5
Maximum	21271	50	108	1060	1.5	0.5	99	6	47100	1810	105	73	66372	150	40	140275	869	1	29	2647	1074	1054	9	5.00	227	223	13775	0.31	25	502	0.56	3.87	66	366	17

Minimum, Median, and Maximum for Deep Samples

Parameter (mg/kg)

	Aluminum (Al)	Antimony (Sb)	Arsenic (As)	Barium (Ba)	Beryllium (Be)	Bismuth (Bi)	Boron (B)	Cadmium (Cd)	Calcium (Ca)	Chromium (Cr)	Cobalt (Co)	Copper (Cu)	Iron (Fe)	Lead (Pb)	Lithium (Li)	Magnesium (Mg)	Manganese (Mn)	Mercury (Hg)	Molybdenum (Mo)	Nickel (Ni)	Phosphorus (P)	Potassium (K)	Selenium (Se)	Silver (Ag)	Sodium (Na)	Strontium (Sr)	Sulpher (S)	Thallium (Tl)	Tin (Sn)	Titanium (Ti)	Tungsten (W)	Uranium (U)	Vanadium (V)	Zinc (Zn)	Zirconium (Zr)
Minimum	1819	0.97	6.8	50.4	0.2	0.1	2.5	0.2	1108	7	6	21.9	16260	2.6	1.0	2960	198	0.03	1.8	29	284	135	0.56	0.05	25	20	0.0	0.03	1.00	2	0.00	0.44	10	36	2
Median	4130	2	11	79	0.4	0.3	2.5	1.2	35462	16	14	40	31435	14	6	9660	476	0.2	6	44	749	592	5	0.41	25	167	1139	0.12	1.00	8	0.25	1.56	18	117	6
Maximum	19700	4	61	204	0.7	0.4	35.6	5	93319	1074	80	119	52200	42	38	117978	860	0	23	924	2040	1120	18	1.02	304	360	16000	0.30	1.00	519	0.57	2.83	30	186	17

Table S2 - Tailings - Asbestos & Metals

wood.

Legend

- Result exceeds agricultural guideline: (light yellow)
- Result exceeds residential/parkland guideline: (orange)
- Surface sample: (green)
- Sampled at depth: (grey)

Sample ID	Date	Year	Depth (m)	Depth Category	Area	Aluminum (Al)	Antimony (Sb)	Arsenic (As)	Barium (Ba)	Beryllium (Be)	Bismuth (Bi)	Boron (B)	Cadmium (Cd)	Calcium (Ca)	Chromium (Cr)	Cobalt (Co)	Copper (Cu)	Iron (Fe)	Lead (Pb)	Lithium (Li)	Magnesium (Mg)	Manganese (Mn)	Mercury (Hg)	Molybdenum (Mo)	Nickel (Ni)	Phosphorus (P)	Potassium (K)	Selenium (Se)	Silver (Ag)	Sodium (Na)	Strontium (Sr)	Sulpher (S)	Thallium (Tl)	Tin (Sn)	Titanium (Ti)	Tungsten (W)	Uranium (U)	Vanadium (V)	Zinc (Zn)	Zirconium (Zr)	Asbestos By Point Count	Other Fibres: Cellulose	Asbestos: Chrysotile	Mica	Other Fibres	Other Fibres: Synthetic
						Parameter																																			Asbestos					
Environmental Health Guidelines (Agricultural)						---	20 [3]	25 [1]	390 [3]	4 [3]	---	120 [3]	9 [1]	---	50 [1]	180 [3]	150 [1]	---	350 [1]	---	---	---	0.6 [2]	6.9 [3]	45 [2]	---	---	1 [2]	20 [3]	---	---		1 [2]	---	---		33 [2]	130 [2]	200 [1]	---						
Human Health Guidelines (Residential/Parkland)						15600 [o]	7.5 [3]	100 [1]	6800 [2]	38 [1]	---	4300 [3]	3 [1]	---	100 [1]	22 [3]	15000 [1]	11000 [o]	500 [1]	32 [o]	---	380 [o]	6.6 [2]	110 [3]	200 [2]	---	---	80 [2]	77 [3]	---	9400 [o]		1 [2]	9400 [o]	---		23 [2]	39 [3]	5600 [3]	1.3 [o]	%	%	%	%		
Reported Detection Limit						50	0.1	0.1	0.5	0.1	0.2	5	0.02	50	0.5	0.1	0.5	50	0.5	2	100	1	0.05	0.1	2.5	50	100	0.2	0.1	50	0.5		0.05	2	1.0		0	0	2	1	0.1	1	0.1	1		
						Results (mg/kg)																																			Results (%)					
16-TAIL-BH01-S	31-Aug-16	2016	0 - 0.15	Surface	Tailings Pile	5136	7.5	60	688	0.1	0.1	92	0.01	5084	1263	87	7	53678	0.3	13	189451	533	0.03	0.1	1821	25	50	0.1	0.1	25	92.5		0.025	1	63		0.13	32	11	0.5	-	-	50-75	-		
16-TAIL-BH02-S	31-Aug-16	2016	0 - 0.15	Surface	Tailings Pile	3825	2.4	12.1	68	0.1	0.1	153	0.01	3268	1240	87	2	47188	0.3	2	196530	504	0.03	0.1	1965	25	50	0.1	0.1	25	32.5		0.025	1	36		0.03	24	9	0.5	-	-	50-75	-		
16-TAIL-BH03-S	31-Aug-16	2016	0 - 0.15	Surface	Tailings Pile	3037	6.1	18.6	284	0.1	0.1	120	0.01	10059	1598	94	7	50080	1.1	4	181141	547	0.03	0.2	2110	25	50	0.1	0.1	25	61.6		0.025	1	23		0.60	22	14	0.5	-	-	50-75	-		
16-TAIL-SS03-D (SHOWN AS "16-TAIL-BH03-D" ON SAMPLE LABEL)	8-Sep-16	2016	10.4 - 11.3	Depth	Tailings Pile	3550	2.3	3.0	1	0.1	0.1	233	0.01	223	1305	82	1	45257	0.3	1	205715	481	0.03	0.1	2081	25	50	0.1	0.1	25	0.6		0.025	1	30		0.03	25	7	0.5	-	-	50-75	-		
16-TAIL-BH04-S	31-Aug-16	2016	0 - 0.15	Surface	Tailings Pile	4392	2.9	3.1	100	0.1	0.1	197	0.01	2727	1487	99	3	58120	0.8	1	223537	581	0.03	0.2	2068	25	50	0.1	0.1	25	21.7		0.025	1	66		0.06	30	12	0.5	-	-	50-75	-		
16-DUP-1 (DUPLICATE SAMPLE OF 16-TAIL-SS04-S)	31-Aug-16	2016	0 - 0.15	Surface	Tailings Pile	4573	1.1	3.4	89	0.1	0.1	241	0.03	2688	1405	99	3	56772	0.6	1	220843	579	0.03	0.2	2063	25	50	0.1	0.1	25	19.0		0.025	1	65		0.03	31	12	0.5	-	-	50-75	-		
16-TAIL-SS04-D1 (SHOWN AS "16-TAIL-BH04-D1" ON SAMPLE)	12-Sep-16	2016	4.3 - 4.9	Depth	Tailings Pile	3074	1.2	1.6	36	0.1	0.1	132	0.01	2296	1175	69	1	36568	0.3	1	177371	420	0.03	0.2	1604	25	50	0.1	0.1	25	13.8		0.025	1	19		0.03	22	10	0.5	-	-	50-75	-		
16-TAIL-SS04-D2 (SHOWN AS "16-TAIL-BH04-D2" ON SAMPLE)	12-Sep-16	2016	13.4 - 14.0	Depth	Tailings Pile	2756	1.5	5.0	8	0.1	0.1	150	0.01	897	1145	66	2	36574	0.3	1	181352	446	0.03	0.1	1793	25	50	0.1	0.1	25	6.6		0.025	1	15		0.03	19	6	0.5	-	-	50-75	-		
16-TAIL-BH05-S	29-Aug-16	2016	0 - 0.15	Surface	Tailings Pile	5480	7.7	53	174	0.1	0.1	122	0.03	4856	1352	94	5	56362	0.6	8	201739	530	0.03	0.2	1903	25	50	0.1	0.1	25	51.6		0.025	1	88		0.13	32	14	0.5	-	-	50-75	-		
16-TAIL-BH06-S	29-Aug-16	2016	0 - 0.15	Surface	Tailings Pile	4537	1.8	2.1	18	0.1	0.1	135	0.05	2248	1083	79	3	44647	0.3	1	187660	476	0.03	0.1	1753	25	50	0.1	0.1	25	25.4		0.025	1	51		0.03	28	10	0.5	-	-	50-75	-		
16-TAIL-BH06-D	2-Oct-16	2016	10.4 - 11.0	Depth	Tailings Pile	4807	1.6	9.5	299	0.4	0.3	14	1.03	3989	124	18	34	33952	14.7	4	16472	380	0.10	9.2	177	599	493	2.6	0.2	76	33.1		0.105	1	31		1.02	23	125	3.4	-	-	1-5	Trace <1		
18BH11-01	18-Aug-18	2018	0.0-0.15	Surface	Tailings Pile	4617	11.2	23.8	274	0.1	0.1	190	0.04	6645	1499	104	6	59008	1.3	5	207120	627	0.03	0.2	2114	70	50	0.1	0.1	25	59.2	500	0.025	1	87	0.78	0.18	30	14	0.5			50-75			<1
18-BH11-02	4-Sep-18	2018	34.8	Depth	Tailings Pile	4413	1.1	0.9	7	0.1	0.1	174	0.01	555	2541	145	1	79930	0.3	1	297295	841	0.03	0.1	3199	25	50	0.1	0.1	25	4.3	500	0.025	1	31	0.25	0.03	36	14	0.5			50-75	Trace <1		
18BH12-01	18-Aug-18	2018	0.0-0.15	Surface	Tailings Pile	3315	6.0	6.3	86	0.1	0.1	184	0.01	2080	1300	70	2	44745	0.3	3	193933	563	0.22	0.1	1831	25	50	0.1	0.1	25	37.6	500	0.025	1	27	0.61	0.03	23	8	0.5			10-25			<1
18-BH12-02	2-Sep-18	2018	19.8	Depth	Tailings Pile	9266	1.1	7.2	290	0.3	0.1	6	0.61	4867	24	8	21	16146	9.2	10	3288	439	0.06	2.5	27	405	608	1.5	0.2	138	37.7	500	0.103	1	247	0.25	1.10	31	62	2.0			0.1	Trace <1		
18-BH12-DUP-06 (BH12-02)	2-Sep-18	2018	19.8	Depth	Tailings Pile	10694	1.0	7.3	266	0.4	0.1	3	0.44	3803	22	8	22	19890	10.8	12	3674	300	0.03	2.3	25	405	585	1.8	0.1	116	31.2	500	0.103	1	221	0.25	1.06	32	64	3.0			0.2	Trace <1		
18BH13-01	18-Aug-18	2018	0.0-0.15	Surface	Tailings Pile	4735	5.2	19.7	148	0.1	0.1	156	0.06	5114	1170	89	4	52546	1.4	5	191766	521	0.03	0.4	1777	25	50	0.1	0.1	25	47.6	500	0.025	1	46	0.63	0.18	29	16	0.5			25-50			<1
18-BH13-02/85'	9-Sep-18	2018	25.9	Depth	Tailings Pile	2177	0.8	1.1	3	0.1	0.1	135	0.01	234	1514	52	1	23028	0.3	1	161935	344	0.03	0.1	1283	25	50	0.1	0.1	25	1.1	500	0.025	1	19	0.25	0.03	13	7	0.5			10-25	<1		
18-BH13-DUP-04/50'	9-Sep-18	2018	15.2	Depth	Tailings Pile	2591	1.2	3.4	8	0.1	0.1	186	0.01	628	2097	84	4	26022	0.3	1	222581	502	0.03	0.1	1935	25	50	0.1	0.1	25	3.1	3978	0.025	1	32	0.25	0.03	17	10	0.5			10-25	<1		
18BH14-01	18-Aug-18	2018	0.0-0.15	Surface	Tailings Pile	4097	4.3	12.0	88	0.1	0.1	186	0.01	3131	1582	96	4	57912	0.3	3	225589	629	0.09	0.1	2144	25	50	0.1	0.1	25	24.6	500	0.025	1	49	0.25	0.12	29	11	0.5			25-50			<1
18-BH14-02	29-Aug-18	2018	10.6	Depth	Tailings Pile	2243	3.4	2.8	10	0.1	0.1	218	0.01	466	1256	78	3	41018	0.3	1	201454	396	0.03	0.1	1610	25	50	0.1	0.1	25	5.2	500	0.025	1	15	0.25	0.03	18	7	0.5			10-25			<1
18BH15-01	18-Aug-18	2018	0.0-0.15	Surface	Tailings Pile	4811	0.9	3.2	72	0.2	0.1	3	0.14	530	29	3	8	6377	6.8	5	3657	63	0.03	0.6	32	85	389	0.1	0.1	25	7.3	500	0.025	1	120	0.25	0.46	13	20	0.5		Trace <1	1-5	Trace <1		
18BH16-01	18-Aug-18	2018	0.0-0.15	Surface	Tailings Pile	3768	4.6	3.2	87	0.1	0.1	160	0.01	3171	1503	87	3	46409	0.6	2	195580	562	0.03	0.2	1845	25	50	0.1	0.1	25	18.0	500	0.025	1	48	0.25	0.08	25	12	0.5			50-75			<1
BH2018-16-20'	12-Sep-18	2018	6.1	Depth	Tailings Pile	2345	2.3	4.6	8	0.1	0.1	119	0.01	396	1467	66	0.25	34475	0.3	1	169165	404	0.03	0.1	1456	25	50	0.1	0.1	25	2.3	500	0.025	1	18	0.25	0.03	16	7	0.5			25-50	<1		
18BH17-01	18-Aug-18	2018	0.0-0.15	Surface	Tailings Pile	5585	18.5	55	283	0.1	0.1	164	0.04	5164	1370	98	7	62178	0.8	6	214286	597	0.03	0.3	2073	90	117	0.1	0.1	25	55.5	500	0.025	1	124	0.84	0.11	36	13	0.5		Trace <1	75-100			
18-B17-02	31-Aug-18	2018	15.3	Depth	Tailings Pile	4037	2.8	1.3	47	0.1	0.1	183	0.01	2166	1740	109	2	63348	0.3	1	224289	671	0.03	0.1	2188	25	50	0.1	0.1	25	12.0	500	0.025	1	47	0.25	0.03	30	13	0.5			50-75	Trace <1		
18-TAIL-01	18-Aug-18	2018	0.0-0.15	Surface	Tailings Pile	2567	3.2	2.1	56	0.1	0.1	137	0.01	1289	1478	76	1	38667	0.3	2	191111	1009	0.03	0.1	1700	25	50	0.1	0.1	25	11.1	500	0.025	1	32	0.25	0.03	19	9	0.5			10-25			<1
18-TAIL-02	18-Aug-18	2018	0.0-0.15	Surface	Tailings Pile	3878	5.6	9.2	63	0.1	0.1	202	0.03	1800	1289	85	3	49667	0.6	1	201111	522	0.03	0.2	1633	25	50	0.1	0.1	25	15.6	500	0.025	1	58	0.64	0.03	27	10	0.5			25-50			<1
18-TAIL-03	18-Aug-18	2018	0.0-0.15	Surface	Tailings Pile	5411	17.0	43	462	0.1	0.1	201	0.04	7544	1356	108	5	58222	1.0	9	212222	613	0.03	0.3	2156	64	50	0.1	0.1	25	82.7	500	0.028	1	116	0.93	0.15	34	15	0.5			75-100			<1
18-TAIL-04	18-Aug-18	2018	0.0-0.15	Surface	Tailings Pile	3811	11.7	47	163	0.1	0.1	124	0.03	7189	1122	76	4	42444	0.6	5	171111	534	0.03	0.2	1556	25	50	0.1	0.1	25	79.0	500	0.025	1	59	0.79	0.09	25	10	0.5			50-75			<1
18-TAIL-05	18-Aug-18	2018	0.0-0.15	Surface	Tailings Pile	5167	12.8	39	291	0.1	0.1	172	0.08	5922	1333	103	5	56222	0.8	6	200000	610	0.03	0.3	1967	25	50	0.2	0.1	25	92.6	500	0.025	1	80	0.74	0.10	33	14	0.5			50-75			<1

Table S2 - Tailings - Asbestos & Metals

Legend

- Result exceeds agricultural guideline: (light yellow)
- Result exceeds residential/parkland guideline: (orange)
- Surface sample: (green)
- Sampled at depth: (grey)

Sample ID	Date	Year	Depth (m)	Depth Category	Area	Aluminum (Al)	Antimony (Sb)	Arsenic (As)	Barium (Ba)	Beryllium (Be)	Bismuth (Bi)	Boron (B)	Cadmium (Cd)	Calcium (Ca)	Chromium (Cr)	Cobalt (Co)	Copper (Cu)	Iron (Fe)	Lead (Pb)	Lithium (Li)	Magnesium (Mg)	Manganese (Mn)	Mercury (Hg)	Molybdenum (Mo)	Nickel (Ni)
Environmental Health Guidelines (Agricultural)						---	20 [3]	25 [1]	390 [3]	4 [3]	---	120 [3]	9 [1]	---	50 [1]	180 [3]	150 [1]	---	350 [1]	---	---	---	0.6 [2]	6.9 [3]	45 [2]
Human Health Guidelines (Residential/Parkland)						15600 [o]	7.5 [3]	100 [1]	6800 [2]	38 [1]	---	4300 [3]	3 [1]	---	100 [1]	22 [3]	15000 [1]	11000 [o]	500 [1]	32 [o]	---	380 [o]	6.6 [2]	110 [3]	200 [2]
Reported Detection Limit						50	0.1	0.1	0.5	0.1	0.2	5	0.02	50	0.5	0.1	0.5	50	0.5	2	100	1	0.05	0.1	2.5
Results (mg/kg)																									
CLMS-1	August 1998	1998	0 - 0.10	Surface	Tailings		50	74		1.5			0.05		1410	103	7		150				0.11	10	2210
CLMS-2	August 1998	1998	0 - 0.10	Surface	Tailings		50	14		1.5			0.05		1380	81	3		150				0.02	10	2030
CLMS-3	August 1998	1998	0 - 0.10	Surface	Tailings		50	3		1.5			0.05		1650	87	3		150				0.02	10	2140
CLMS-5	August 1998	1998	0 - 0.10	Surface	Tailings		20	160		0.5			2.00		771	60	30		50				0.17	4	1150
CLMS-10	August 1998	1998	0 - 0.10	Surface	Tailings		30	321		1.0			0.05		1430	99	3		100				0.44	10	2200
CLMS-11	August 1998	1998	0 - 0.10	Surface	Tailings		20	2		0.5			0.05		1530	65	1		50				0.00	4	1640
CLMS-12	August 1998	1998	0 - 0.10	Surface	Tailings		50	2		1.5			0.05		1470	111	3		150				0.03	10	2300

Sample ID	Phosphorus (P)	Potassium (K)	Selenium (Se)	Silver (Ag)	Sodium (Na)	Strontium (Sr)	Sulpher (S)	Thallium (Tl)	Tin (Sn)	Titanium (Ti)	Tungsten (W)	Uranium (U)	Vanadium (V)	Zinc (Zn)	Zirconium (Zr)	Asbestos By Point Count	Other Fibres: Cellulose	Asbestos: Chrysotile	Mica	Other Fibres	Other Fibres: Synthetic
Environmental Health Guidelines (Agricultural)	---	---	1 [2]	20 [3]	---	---		1 [2]	---	---		33 [2]	130 [2]	200 [1]	---						
Human Health Guidelines (Residential/Parkland)	---	---	80 [2]	77 [3]	---	9400 [o]		1 [2]	9400 [o]	---		23 [2]	39 [3]	5600 [3]	1.3 [o]	%	%	%	%		
Reported Detection Limit	50	100	0.2	0.1	50	0.5		0.05	2	1.0		0	0	2	1	0.1	1	0.1	1		
Results	Results (mg/kg)															Results (%)					
CLMS-1			0.1	5					25				26	30				40			
CLMS-2			0.1	5					25				21	13				15			
CLMS-3			0.1	5					25				11	14							
CLMS-5			3.5	2					10				34	133				40			
CLMS-10			0.1	3					15				19	12							
CLMS-11			0.1	2					10				8	9							
CLMS-12			0.1	5					25				20	14							

1. CCME SQG, direct soil contact
2. AENV Tier 1 soil standards, direct soil contact
3. OMOE soil standards - soil contact
4. USEPA Composite Worker Regional Screening Level (May 2016)

Minimum, Median, and Maximum for all Samples

Parameter (mg/kg)	Aluminum (Al)	Antimony (Sb)	Arsenic (As)	Barium (Ba)	Beryllium (Be)	Bismuth (Bi)	Boron (B)	Cadmium (Cd)	Calcium (Ca)	Chromium (Cr)	Cobalt (Co)	Copper (Cu)	Iron (Fe)	Lead (Pb)	Lithium (Li)	Magnesium (Mg)	Manganese (Mn)	Mercury (Hg)	Molybdenum (Mo)	Nickel (Ni)	Phosphorus (P)	Potassium (K)	Selenium (Se)	Silver (Ag)	Sodium (Na)	Strontium (Sr)	Sulpher (S)	Thallium (Tl)	Tin (Sn)	Titanium (Ti)	Tungsten (W)	Uranium (U)	Vanadium (V)	Zinc (Zn)	Zirconium (Zr)
Minimum	2177	0.77	0.9	1	0.1	0.1	3	0.01	223	22	3	0.3	6377	0.3	1	3288	63	0.003	0.1	25	25	50	0.1	0.1	25	1	500	0.025	1	15	0.25	0.025	8	6	0.5
Median	4097	4.5	6.7	87	0.1	0.1	156	0.0	2727	1363	86	3	46409	1	2	195580	530	0.0	0	1874	25	50	0.1	0.1	25	25	500	0.0	1	48	0.25	0.1	25	12	1
Maximum	10694	50	321	688	1.5	0.3	241	2	10059	2541	145	34	79930	150	13	297295	1009	0	10	3199	599	608	4	5	138	93	3978	0.1	25	247	0.93	1.10	35.83	133	3

Minimum, Median, and Maximum for all Surface Samples

Parameter (mg/kg)	Aluminum (Al)	Antimony (Sb)	Arsenic (As)	Barium (Ba)	Beryllium (Be)	Bismuth (Bi)	Boron (B)	Cadmium (Cd)	Calcium (Ca)	Chromium (Cr)	Cobalt (Co)	Copper (Cu)	Iron (Fe)	Lead (Pb)	Lithium (Li)	Magnesium (Mg)	Manganese (Mn)	Mercury (Hg)	Molybdenum (Mo)	Nickel (Ni)	Phosphorus (P)	Potassium (K)	Selenium (Se)	Silver (Ag)	Sodium (Na)	Strontium (Sr)	Sulpher (S)	Thallium (Tl)	Tin (Sn)	Titanium (Ti)	Tungsten (W)	Uranium (U)	Vanadium (V)	Zinc (Zn)	Zirconium (Zr)
Minimum	0	1	2	0	0	0	0	0	0	29	3	1	0	0	0	0	0	0	0	32	0	0	0	0	0	0	0	0	1	0	0	0	8	8	0
Median	3852	8	13	87	0.1	0.1	135.9	0.0	2708	1375	88	4	46798	1	2	191439	531	0.03	0	1966	25	50	0.10	0.05	25	23	0	0.03	1	48	0.00	0.04	27	13	1
Maximum	5585	50	321	688	1.5	0.1	241	2.0	10059	1650	111	30	62178	150	13	225589	1009	0.4	10	2300	90	389	4	5.00	25	93	500	0.03	25	124	0.93	0.60	36	133	1

Minimum, Median, and Maximum for Deep Samples

Parameter (mg/kg)	Aluminum (Al)	Antimony (Sb)	Arsenic (As)	Barium (Ba)	Beryllium (Be)	Bismuth (Bi)	Boron (B)	Cadmium (Cd)	Calcium (Ca)	Chromium (Cr)	Cobalt (Co)	Copper (Cu)	Iron (Fe)	Lead (Pb)	Lithium (Li)	Magnesium (Mg)	Manganese (Mn)	Mercury (Hg)	Molybdenum (Mo)	Nickel (Ni)	Phosphorus (P)	Potassium (K)	Selenium (Se)	Silver (Ag)	Sodium (Na)	Strontium (Sr)	Sulpher (S)	Thallium (Tl)	Tin (Sn)	Titanium (Ti)	Tungsten (W)	Uranium (U)	Vanadium (V)	Zinc (Zn)	Zirconium (Zr)
Minimum	2177	0.77	0.9	0.9	0.1	0.1	2.5	0.0	223	22	8	0.3	16146	0.3	1.0	3288	300	0.03	0.1	25	25	50	0.10	0.05	25	1	0.0	0.03	1.00	15	0.00	0.03	13	6	1
Median	3312	1	3	9	0.1	0.1	142	0.0	762	1281	67	2	35521	0	1	179361	430	0.0	0	1607	25	50	0.10	0.05	25	6	500	0.03	1.00	30	0.25	0.03	22	10	1
Maximum	10694	3	10	299	0.4	0.3	233	1.0	4867	2541	145	34	79930	15	12	297295	841	0	9	3199	599	608	3	0.21	138	38	3978	0.11	1.00	247	0.25	1.10	36	125	3

Table S3 - Porcupine Creek Area

wood.

Legend

Legend	
Result exceeds agricultural guideline:	(light yellow)
Result exceeds residential/parkland guideline:	(orange)
Surface sample:	(green)
Sampled at depth:	(grey)

Sample ID	Date	Year	Depth (m)	Depth Category	Area
18-BH18-01	31-Aug-18	2018	0.0-0.15	Surface	Porcupine Creek
18-BH18-DUP-03 (BH18-01)	31-Aug-18	2018	0.0-0.15	Surface	Porcupine Creek
BH2018-18-02/80'	13-Sep-18	2018	24.3	Depth	Porcupine Creek
18-BH19-01	31-Aug-18	2018	0.0-0.15	Surface	Porcupine Creek
BH2018-19-02/65'	10-Sep-18	2018	19.8	Depth	Porcupine Creek
18-PORCR-01	31-Aug-18	2018	0.0-0.15	Surface	Porcupine Creek
18-PORCR-DUP-02 (PORCP-01)	31-Aug-18	2018	0.0-0.15	Surface	Porcupine Creek
18-PORCR-02	31-Aug-18	2018	0	Surface	Porcupine Creek
18-PORCR-03	31-Aug-18	2018	0	Surface	Porcupine Creek
18-PORCR-04	31-Aug-18	2018	0	Surface	Porcupine Creek
18-PORCR-05	31-Aug-18	2018	0	Surface	Porcupine Creek

Parameter	Aluminum (Al)	Antimony (Sb)	Arsenic (As)	Barium (Ba)	Beryllium (Be)	Bismuth (Bi)	Boron (B)	Cadmium (Cd)	Calcium (Ca)	Chromium (Cr)	Cobalt (Co)	Copper (Cu)	Iron (Fe)	Lead (Pb)	Lithium (Li)	Magnesium (Mg)	Manganese (Mn)
Environmental Health Guidelines (Agricultural)	---	20 [3]	25 [1]	390 [3]	4 [3]	---	120 [3]	9 [1]	---	50 [1]	180 [3]	150 [1]	---	350 [1]	---	---	---
Human Health Guidelines (Residential/Parkland)	15600 º	7.5 [3]	100 [1]	6800 [2]	38 [1]	---	4300 [3]	3 [1]	---	100 [1]	22 [3]	15000 [1]	11000 º	500 [1]	32 º	---	380 º
Reported Detection Limit	50	0.1	0.1	0.5	0.1	0.2	5	0.02	50	0.5	0.1	0.5	50	0.5	2	100	1
Results (mg/kg)																	
18-BH18-01	5109	8.0	30	273	0.1	0.1	49	0.06	15359	1176	107	37	41394	2.4	16	192810	672
18-BH18-DUP-03 (BH18-01)	5065	7.1	24.0	168	0.2	0.1	63	0.08	13072	1111	64	54	33007	3.1	14	150327	465
BH2018-18-02/80'	10314	2.7	13.5	123	0.4	0.4	3	0.76	6074	68	24	43	43322	23.8	24	14170	618
18-BH19-01	3920	14.4	41	224	0.2	0.1	47	0.88	18400	411	44	36	39100	12.1	9	74800	480
BH2018-19-02/65'	3890	0.7	5.9	60	0.5	0.4	3	0.30	8120	13	16	28	36200	7.3	3	3790	529
18-PORCR-01	7200	3.7	17.5	86	0.5	0.3	3	4.23	12527	20	18	76	33987	17.5	12	6503	356
18-PORCR-DUP-02 (PORCP-01)	6285	4.6	21.6	83	0.5	0.3	3	5.75	14488	25	20	75	39107	19.7	10	6460	461
18-PORCR-02	2622	3.6	17.6	36	0.3	0.3	3	1.38	20111	10	6	26	27667	24.7	1	1967	148
18-PORCR-03	4544	3.6	15.9	137	0.3	0.1	12	1.44	19111	218	24	36	32333	13.9	6	33111	446
18-PORCR-04	3056	2.2	37	97	0.6	0.3	3	1.11	22778	90	22	54	42667	14.8	1	17111	534
18-PORCR-05	4544	24.2	105	133	0.1	0.1	99	0.05	5433	1322	96	6	47667	0.6	5	218889	626

Parameter	Mercury (Hg)	Molybdenum (Mo)	Nickel (Ni)	Phosphorus (P)	Potassium (K)	Selenium (Se)	Silver (Ag)	Sodium (Na)	Strontium (Sr)	Sulpher (S)	Thallium (Tl)	Tin (Sn)	Titanium (Ti)	Tungsten (W)	Uranium (U)	Vanadium (V)	Zinc (Zn)	Zirconium (Zr)	Asbestos: Asbestos By Point Count	Other Fibres: Cellulose	Asbestos: Chrysotile	Mica	Other Fibres	Other Fibres: Synthetic
Environmental Health Guidelines (Agricultural)	0.6 [2]	6.9 [3]	45 [2]	---	---	1 [2]	20 [3]	---	---		1 [2]	---	---		33 [2]	130 [2]	200 [1]	---						
Human Health Guidelines (Residential/Parkland)	6.6 [2]	110 [3]	200 [2]	---	---	80 [2]	77 [3]	---	9400 º		1 [2]	9400 º	---		23 [2]	39 [3]	5600 [3]	1.3 º	%	%	%	%		
Reported Detection Limit	0.05	0.1	2.5	50	100	0.2	0.1	50	0.5		0.05	2	1.0		0	0	2	1	0.1	1	0.1	1		
Results (mg/kg) / Results (%)																								
18-BH18-01	0.08	0.6	1645	25	50	0.1	0.2	25	144.9	500	0.025	1	50	1.29	0.91	30	18	0.5			50-75	Trace <1		
18-BH18-DUP-03 (BH18-01)	0.11	1.0	1133	58	109	0.1	0.1	25	79.4	500	0.025	1	67	0.25	0.63	24	20	0.5			25-50			
BH2018-18-02/80'	0.14	4.9	131	672	732	1.4	0.2	74	35.1	500	0.069	1	40	0.25	1.28	19	102	10.7			1-5	Trace <1		
18-BH19-01	0.14	8.1	857	479	410	4.3	0.3	25	259.0	500	0.095	1	24	1.35	1.01	20	111	3.2			25-50	Trace <1		
BH2018-19-02/65'	0.33	1.6	42	607	780	0.7	0.2	99	43.8	1700	0.110	1	42	0.25	1.50	16	145	9.2	0.05		Trace <1			
18-PORCR-01	0.03	21.6	87	784	534	8.3	0.8	25	74.0	2288	0.242	1	4	0.25	1.44	36	377	9.0			0.6	Trace <1		
18-PORCR-DUP-02 (PORCP-01)	0.03	28.8	105	699	512	10.5	0.9	25	82.1	1525	0.260	1	4	0.25	1.50	42	403	10.0			0.2	Trace <1		
18-PORCR-02	0.59	19.0	39	452	500	9.2	0.5	25	50.8	13778	0.757	1	4	0.25	1.59	33	169	9.3			0.7	Trace <1		
18-PORCR-03	0.23	8.6	334	621	600	4.0	0.4	66	106.8	500	0.180	1	18	0.25	1.43	23	122	7.8			25-50	Trace <1		
18-PORCR-04	0.21	10.6	161	770	578	3.8	0.5	25	141.1	1333	0.177	1	5	0.25	1.79	23	159	10.8			0.7	Trace <1		
18-PORCR-05	0.03	0.4	2022	25	50	0.1	0.1	25	39.4	500	0.025	1	53	0.60	0.03	29	11	0.5			25-50		<1	

Minimum, Median, and Maximum for all Samples

Parameter (mg/kg)	Aluminum (Al)	Antimony (Sb)	Arsenic (As)	Barium (Ba)	Beryllium (Be)	Bismuth (Bi)	Boron (B)	Cadmium (Cd)	Calcium (Ca)	Chromium (Cr)	Cobalt (Co)	Copper (Cu)	Iron (Fe)	Lead (Pb)	Lithium (Li)	Magnesium (Mg)	Manganese (Mn)	Mercury (Hg)	Molybdenum (Mo)	Nickel (Ni)	Phosphorus (P)	Potassium (K)	Selenium (Se)	Silver (Ag)	Sodium (Na)	Strontium (Sr)	Sulpher (S)	Thallium (Tl)	Tin (Sn)	Titanium (Ti)	Tungsten (W)	Uranium (U)	Vanadium (V)	Zinc (Zn)	Zirconium (Zr)
Minimum	2622	0.66	5.9	36	0.1	0.1	3	0.05	5433	10	6	6.4	27667	0.6	1	1967	148	0.025	0.4	39	25	50	0.1	0.1	25	35	500	0.025	1	4	0.25	0.025	16	11	0.5
Median	4544	3.7	21.6	123	0.3	0.3	3	0.9	14488	90	24	37	39100	14	9	17111	480	0.1	8	161	607	512	4	0.3	25	79	500	0.1	1	24	0.25	1.4	24	122	9
Maximum	10314	24	105	273	0.6	0.4	99	6	22778	1322	107	76	47667	25	24	218889	672	1	29	2022	784	780	10	1	99	259	13778	0.8	1	67	1.35	1.79	42	403	11

Minimum, Median, and Maximum for all Surface Samples

Parameter (mg/kg)	Aluminum (Al)	Antimony (Sb)	Arsenic (As)	Barium (Ba)	Beryllium (Be)	Bismuth (Bi)	Boron (B)	Cadmium (Cd)	Calcium (Ca)	Chromium (Cr)	Cobalt (Co)	Copper (Cu)	Iron (Fe)	Lead (Pb)	Lithium (Li)	Magnesium (Mg)	Manganese (Mn)	Mercury (Hg)	Molybdenum (Mo)	Nickel (Ni)	Phosphorus (P)	Potassium (K)	Selenium (Se)	Silver (Ag)	Sodium (Na)	Strontium (Sr)	Sulpher (S)	Thallium (Tl)	Tin (Sn)	Titanium (Ti)	Tungsten (W)	Uranium (U)	Vanadium (V)	Zinc (Zn)	Zirconium (Zr)
Minimum	2622	2	16	36	0	0	3	0	5433	10	6	6	27667	1	1	1967	148	0	0	39	25	50	0	0	25	39	500	0	1	4	0	0	20	11	1
Median	4544	5	24	133	0.3	0.1	12.0	1.1	15359	218	24	37	39100	14	9	33111	465	0.11	9	334	479	500	4	0.40	25	82	500	0.18	1	18	0.25	1.43	29	122	8
Maximum	7200	24	105	273	0.6	0.3	99	6	22778	1322	107	76	47667	25	16	218889	672	0.6	29	2022	784	600	10	0.92	66	259	13778	0.76	1	67	1.35	1.79	42	403	11

Minimum, Median, and Maximum for Deep Samples

Parameter (mg/kg)	Aluminum (Al)	Antimony (Sb)	Arsenic (As)	Barium (Ba)	Beryllium (Be)	Bismuth (Bi)	Boron (B)	Cadmium (Cd)	Calcium (Ca)	Chromium (Cr)	Cobalt (Co)	Copper (Cu)	Iron (Fe)	Lead (Pb)	Lithium (Li)	Magnesium (Mg)	Manganese (Mn)	Mercury (Hg)	Molybdenum (Mo)	Nickel (Ni)	Phosphorus (P)	Potassium (K)	Selenium (Se)	Silver (Ag)	Sodium (Na)	Strontium (Sr)	Sulpher (S)	Thallium (Tl)	Tin (Sn)	Titanium (Ti)	Tungsten (W)	Uranium (U)	Vanadium (V)	Zinc (Zn)	Zirconium (Zr)
Minimum	3890	0.66	5.9	60.0	0.4	0.4	2.5	0.3	6074	13	16	27.9	36200	7.3	3.3	3790	529	0.14	1.6	42	607	732	0.68	0.16	74	35	500.0	0.07	1.00	40	0.25	1.28	16	102	9
Median	7102	2	10	92	0.4	0.4	2.5	0.5	7097	40	20	35	39761	16	14	8980	573	0.2	3	87	640	756	1	0.18	87	39	1100	0.09	1.00	41	0.25	1.39	17	123	10
Maximum	10314	3	13	123	0.5	0.4	2.5	0.8	8120	68	24	43	43322	24	24	14170	618	0	5	131	672	780	1	0.21	99	44	1700	0.11	1.00	42	0.25	1.50	19	145	11

Table S4 - Mill & Common Areas - Asbestos & Metals

wood.

Legend

Result exceeds agricultural guideline: (yellow)

Result exceeds residential/parkland guideline: (orange)

Surface sample: (green)

Sampled at depth: (grey)

Parameter – Results (mg/kg)

Sample ID	Date	Year	Depth (m)	Depth Category	Area	Aluminum (Al)	Antimony (Sb)	Arsenic (As)	Barium (Ba)	Beryllium (Be)	Bismuth (Bi)	Boron (B)	Cadmium (Cd)	Calcium (Ca)	Chromium (Cr)	Cobalt (Co)	Copper (Cu)	Iron (Fe)	Lead (Pb)	Lithium (Li)	Magnesium (Mg)
Environmental Health Guidelines (Agricultural)						---	20 [3]	25 [1]	390 [3]	4 [3]	---	120 [3]	9 [3]	---	50 [1]	180 [3]	150 [1]	---	350 [1]	---	---
Human Health Guidelines (Residential/Parkland)						15600 [o]	7.5 [3]	100 [1]	6800 [2]	38 [1]	---	4300 [3]	3 [1]	---	100 [1]	22 [3]	15000 [1]	11000 [o]	500 [1]	32 [o]	---
Reported Detection Limit						50	0.1	0.1	0.5	0.1	0.2	5	0.02	50	0.5	0.1	0.5	50	0.5	2	100
16-MILL-SS01	31-Aug-16	2016	0 - 0.15	Surface	Mill Mine	8821	3.2	14.8	156	0.4	0.1	18	0.37	2051	174	18	21	24738	13.6	6	29947
16-MILL-SS02	31-Aug-16	2016	0 - 0.15	Surface	Mill Mine	8361	7.5	27	239	0.2	0.1	52	0.26	5593	546	74	19	64483	10.8	8	85640
16-MILL-SS03	31-Aug-16	2016	0 - 0.15	Surface	Mill Mine	7885	1.0	9.6	135	0.4	0.1	3	0.22	1350	22	11	18	17534	9.2	5	3156
16-DUP-2 (16-MILL-SS03)	31-Aug-16	2016	0 - 0.15	Surface	Mill Mine	7859	0.7	8.2	138	0.3	0.1	3	0.20	1498	24	11	18	17616	13.9	6	3587
16-MILL-SS04	31-Aug-16	2016	0 - 0.15	Surface	Mill Mine	9288	1.4	9.8	143	0.4	0.1	6	0.28	2206	89	11	21	20868	13.0	6	11894
16-MINE-SS05	29-Aug-16	2016	0 - 0.15	Surface	Mill Mine	14491	1.0	11.5	334	0.5	0.1	3	0.22	8219	32	10	29	25328	9.3	15	6308
16-MINE-SS06	29-Aug-16	2016	0 - 0.15	Surface	Mill Mine	14783	1.2	6.4	594	0.5	0.1	3	0.92	5447	75	11	27	18276	11.3	8	9805
16-MINE-SS07	29-Aug-16	2016	0 - 0.15	Surface	Mill Mine	6510	2.4	9.9	114	0.4	0.3	3	0.88	14407	21	14	62	32977	22.5	14	9285
16-MINE-SS08	30-Aug-16	2016	0 - 0.15	Surface	Mill Mine	6470	15.5	49	1659	0.1	0.1	73	0.36	3197	1148	57	8	34241	2.8	10	104994
16-MINE-SS09	31-Aug-16	2016	0 - 0.15	Surface	Mill Mine	8026	5.0	13.7	1099	0.3	0.1	22	0.30	8814	350	35	19	21062	3.9	6	50335
16-MINE-SS10	31-Aug-16	2016	0 - 0.15	Surface	Mill Mine	5943	2.1	8.4	207	0.2	0.1	12	0.88	19811	109	12	20	17275	8.0	6	15331
18-MILL-01	2-Sep-18	2018	0.0-0.15	Surface	Mill Mine	17744	1.0	12.9	392	0.5	0.1	3	0.14	4550	41	10	36	27123	10.8	13	5754
18-MILL-DUP-05 (18-MILL-01)	2-Sep-18	2018	0.0-0.15	Surface	Mill Mine	18000	1.1	11.4	334	0.5	0.1	3	0.13	4400	39	10	32	26400	10.1	12	6380
18-MILL-02	2-Sep-18	2018	0.0-0.15	Surface	Mill Mine	3574	2.4	8.0	110	0.2	0.1	11	0.31	2307	99	12	16	13942	12.5	1	12548
18-MILL-03	2-Sep-18	2018	0.0-0.15	Surface	Mill Mine	14702	1.4	12.5	236	0.4	0.1	3	0.14	2370	51	11	24	22307	14.2	9	6502
18-MILL-04	2-Sep-18	2018	0.0-0.15	Surface	Mill Mine	4385	3.3	8.9	73	0.1	0.1	9	0.20	5475	128	13	11	17871	10.1	4	15082
18-MILL-05	2-Sep-18	2018	0.0-0.15	Surface	Mill Mine	3232	1.4	5.9	72	0.1	0.1	3	0.21	1356	85	8	12	9810	14.4	1	8695
18-MILL-06	2-Sep-18	2018	0.0-0.15	Surface	Mill Mine	2319	1.1	4.8	87	0.2	0.1	3	0.28	11229	30	9	52	17997	11.8	1	7452
18-MILL-07	2-Sep-18	2018	0.0-0.15	Surface	Mill Mine	1939	1.6	5.9	103	0.2	0.1	3	0.90	14068	14	12	83	23447	12.6	1	6185
18-MILL-08	2-Sep-18	2018	0.0-0.15	Surface	Mill Mine	5779	1.0	4.6	64	0.3	0.1	3	0.35	5171	47	9	24	17364	12.9	13	7617
18-MILL-09	2-Sep-18	2018	0.0-0.15	Surface	Mill Mine	5095	1.7	8.3	134	0.2	0.1	3	0.97	6743	50	12	36	25475	11.9	8	7795
18-MILL-10	2-Sep-18	2018	0.0-0.15	Surface	Mill Mine	11014	4.6	11.6	189	0.4	0.1	18	1.24	19518	203	25	47	35995	13.6	17	37389

Parameter – Results (mg/kg) (continued); Asbestos – Results (%)

Sample ID	Manganese (Mn)	Mercury (Hg)	Molybdenum (Mo)	Nickel (Ni)	Phosphorus (P)	Potassium (K)	Selenium (Se)	Silver (Ag)	Sodium (Na)	Strontium (Sr)	Sulpher (S)	Thallium (Tl)	Tin (Sn)	Titanium (Ti)	Tungsten (W)	Uranium (U)	Vanadium (V)	Zinc (Zn)	Zirconium (Zr)	Asbestos By Point Count	Other Fibres: Cellulose	Asbestos: Chrysotile	Mica	Other Fibres	Other Fibres: Synthetic
Environmental Health Guidelines (Agricultural)	---	0.6 [2]	6.9 [3]	45 [2]	---	---	1 [2]	20 [3]	---	---		1 [2]	---	---		33 [2]	130 [2]	200 [1]	---						
Human Health Guidelines (Residential/Parkland)	380 [o]	6.6 [2]	110 [3]	200 [2]	---	---	80 [2]	77 [3]	---	9400 [o]		1 [2]	9400 [o]	---		23 [2]	39 [3]	5600 [3]	1.3 [o]	%	%	%	%		
Reported Detection Limit	1	0.05	0.1	2.5	50	100	0.2	0.1	50	0.5		0.05	2	1.0		0	0	2	1	0.1	1	0.1	1		
16-MILL-SS01	346	0.07	2.0	271	404	651	0.6	0.1	65	22.7		0.098	1	302		0.88	32	65	3.3	-	1-5	1-5	-		
16-MILL-SS02	517	0.25	1.2	1148	529	551	0.4	0.1	79	49.7		0.070	1	259		0.71	36	51	1.4	-	1-5	5-10	Trace <1		
16-MILL-SS03	492	0.03	2.0	24	295	436	0.5	0.1	63	14.8		0.025	1	323		0.68	30	48	3.0	-	1-5	1-5	Trace <1		
16-DUP-2 (16-MILL-SS03)	514	0.03	1.2	26	372	411	0.4	0.1	53	19.1		0.025	1	303		0.71	29	49	3.0	-	Trace <1	0.8	Trace <1		
16-MILL-SS04	279	0.06	1.5	111	359	649	0.4	0.1	84	18.6		0.063	1	349		0.82	32	58	2.1	-	1-5	1-5	Trace <1		
16-MINE-SS05	427	0.03	1.4	31	697	1023	0.4	0.2	331	41.0		0.086	1	605		0.59	60	72	1.9	-	1-5	0.3	Trace <1		
16-MINE-SS06	1026	0.16	2.0	99	669	1409	0.9	2.6	143	47.1		0.128	1	255		0.84	44	72	0.5	-	50-75	1-5	Trace <1		
16-MINE-SS07	683	0.38	8.3	65	444	630	2.4	0.8	25	101.3		0.101	1	8		0.85	16	122	4.3	-	1-5	0.6	Trace <1		
16-MINE-SS08	651	0.03	0.3	1122	426	473	0.1	0.1	148	44.6		0.025	1	191		0.60	30	30	0.5	-	75-100	1-5	Trace <1		
16-MINE-SS09	485	0.03	0.6	619	582	487	0.1	0.1	232	74.2		0.025	1	246		0.46	25	34	0.5	-	75-100	1-5	Trace <1		
16-MINE-SS10	376	0.03	3.6	159	683	667	1.8	0.2	96	87.8		0.025	1	122		1.19	21	66	2.4	-	75-100	1-5	Trace <1		
18-MILL-01	392	0.07	1.2	35	630	875	0.5	0.2	234	37.4	500	0.120	1	797	0.25	1.33	65	76	5.4			0.3	Trace <1		
18-MILL-DUP-05 (18-MILL-01)	391	0.05	1.1	38	628	880	0.4	0.1	238	34.0	500	0.123	1	753	0.25	1.39	60	67	5.8	0.05			Trace <1		
18-MILL-02	276	0.03	1.5	152	279	583	0.4	0.1	25	16.3	500	0.025	1	106	0.25	0.62	14	41	0.5			10-25	Trace <1		
18-MILL-03	255	0.03	1.4	55	256	672	0.4	0.1	112	20.8	500	0.096	1	513	0.25	0.71	52	61	0.5			5-10	Trace <1		
18-MILL-04	302	0.03	1.0	193	234	456	0.4	0.1	25	24.8	500	0.025	1	107	0.25	0.39	15	34	2.0			1-5	Trace <1		
18-MILL-05	152	0.03	1.1	106	143	482	0.4	0.2	25	9.8	500	0.025	1	93	0.25	0.52	11	33	1.9			1-5	Trace <1		
18-MILL-06	521	0.08	1.0	77	366	710	3.2	0.7	25	49.9	500	0.025	1	28	0.25	0.55	10	90	1.9			0.7	Trace <1		
18-MILL-07	420	0.21	3.4	76	335	824	7.1	1.8	25	71.7	500	0.079	1	9	0.25	0.75	10	151	5.8			0.8	Trace <1		
18-MILL-08	364	0.03	1.5	67	274	469	0.7	0.2	76	33.8	500	0.025	1	32	0.25	0.62	10	55	1.8			1-5	Trace <1		
18-MILL-09	847	0.08	4.0	85	455	583	2.6	0.5	25	41.4	500	0.089	1	48	0.25	0.99	15	105	1.4			1-5	Trace <1		
18-MILL-10	630	0.22	5.7	322	535	621	2.5	0.3	150	99.4	1521	0.165	1	98	0.25	1.05	29	121	6.1			10-25	Trace <1		

Table S4 - Mill & Common Areas - Asbestos & Metals

Legend

- Result exceeds agricultural guideline: (light yellow shading)
- Result exceeds residential/parkland guideline: (orange shading)
- Surface sample: (green shading)
- Sampled at depth: (grey shading)

Parameter (part 1)

Sample ID	Date	Year	Depth (m)	Depth Category	Area	Aluminum (Al)	Antimony (Sb)	Arsenic (As)	Barium (Ba)	Beryllium (Be)	Bismuth (Bi)	Boron (B)	Cadmium (Cd)	Calcium (Ca)	Chromium (Cr)	Cobalt (Co)	Copper (Cu)	Iron (Fe)	Lead (Pb)	Lithium (Li)	Magnesium (Mg)	Manganese (Mn)
Environmental Health Guidelines (Agricultural)						---	20 [3]	25 [1]	390 [3]	4 [3]	---	120 [3]	9 [3]	---	50 [1]	180 [3]	150 [1]	---	350 [1]	---	---	---
Human Health Guidelines (Residential/Parkland)						15600 [0]	7.5 [3]	100 [1]	6800 [2]	38 [1]	---	4300 [3]	3 [1]	---	100 [1]	22 [3]	15000 [1]	11000 [0]	500 [1]	32 [0]	---	380 [0]
Reported Detection Limit						50	0.1	0.1	0.5	0.1	0.2	5	0.02	50	0.5	0.1	0.5	50	0.5	2	100	1
						Results (mg/kg)																
18BH20-01	13-Aug-18	2018	0.0-0.15	Surface	Mill Mine	5313	4.3	12.6	134	0.3	0.1	29	0.22	1754	257	37	16	33383	7.5	4	42607	417
18BH20-02	13-Aug-18	2018	2.5	Depth	Mill Mine	6040	1.4	10.7	148	0.4	0.1	3	0.47	1290	21	8	25	23200	13.1	4	2550	379
18BH20-03	13-Aug-18	2018	5	Depth	Mill Mine	6667	1.5	7.8	52	0.3	0.1	3	0.41	1103	20	10	31	16040	14.2	6	3930	152
18BH20-04	13-Aug-18	2018	7.5	Depth	Mill Mine	13300	1.3	13.3	184	0.5	0.1	3	0.98	3590	35	18	28	28100	16.0	10	4780	954
18BH20-05	13-Aug-18	2018	10	Depth	Mill Mine	9050	2.0	12.0	130	0.4	0.1	3	0.42	1820	30	12	26	21700	16.2	6	4220	241
18BH20-06	13-Aug-18	2018	12	Depth	Mill Mine	5343	2.1	8.5	73	0.4	0.1	3	0.60	1233	16	9	26	21554	14.9	5	3038	322
18BH21-01	13-Aug-18	2018	0.0-0.15	Surface	Mill Mine	11200	1.2	10.1	199	0.4	0.1	3	0.30	2390	26	9	27	21700	12.4	7	3750	303
18BH21-02	13-Aug-18	2018	2.5	Depth	Mill Mine	4920	1.5	8.3	75	0.3	0.1	3	0.64	810	18	9	23	21900	11.6	3	2640	208
18BH21-03	13-Aug-18	2018	5	Depth	Mill Mine	11000	1.5	16.5	247	0.4	0.2	3	0.49	2650	31	13	36	32400	18.0	8	4280	395
18BH21-04	13-Aug-18	2018	7.5	Depth	Mill Mine	11400	1.0	12.6	211	0.4	0.1	3	0.39	2440	29	12	24	25600	16.4	8	3440	432
18BH21-DUP-01	13-Aug-18	2018	7.5	Depth	Mill Mine	19300	0.8	12.1	382	0.7	0.2	3	0.51	4340	41	25	30	32400	19.2	14	4600	906
18BH21-05	13-Aug-18	2018	10	Depth	Mill Mine	6420	1.7	13.5	125	0.3	0.1	3	0.59	1600	27	12	20	25100	13.6	4	3790	436
18BH21-06	13-Aug-18	2018	12	Depth	Mill Mine	6720	1.4	9.5	139	0.3	0.1	3	0.43	1210	22	7	22	20100	16.7	4	3410	131

Parameter (part 2) and Asbestos

Sample ID	Mercury (Hg)	Molybdenum (Mo)	Nickel (Ni)	Phosphorus (P)	Potassium (K)	Selenium (Se)	Silver (Ag)	Sodium (Na)	Strontium (Sr)	Sulpher (S)	Thallium (Tl)	Tin (Sn)	Titanium (Ti)	Tungsten (W)	Uranium (U)	Vanadium (V)	Zinc (Zn)	Zirconium (Zr)	Asbestos By Point Count	Other Fibres: Cellulose	Asbestos: Chrysotile	Mica	Other Fibres	Other Fibres: Synthetic
Environmental Health Guidelines (Agricultural)	0.6 [2]	6.9 [3]	45 [2]	---	---	1 [2]	20 [3]	---	---		1 [2]	---	---		33 [2]	130 [2]	200 [1]	---						
Human Health Guidelines (Residential/Parkland)	6.6 [2]	110 [3]	200 [2]	---	---	80 [2]	77 [3]	---	9400 [0]		1 [2]	9400 [0]	---		23 [2]	39 [3]	5600 [3]	1.3 [0]	%	%	%	%		
Reported Detection Limit	0.05	0.1	2.5	50	100	0.2	0.1	50	0.5		0.05	2	1.0		0	0	2	1	0.1	1	0.1	1		
	Results (mg/kg)																		**Results (%)**					
18BH20-01	0.06	1.6	609	216	291	0.5	0.1	25	13.8	500	0.025	1	192	0.25	0.54	25	52	1.7		1-5	10-25	Trace <1		
18BH20-02	0.10	2.1	27	508	720	0.9	0.2	53	13.5	500	0.061	1	129	0.25	1.44	24	70	9.7	0.05	Trace <1		Trace <1		
18BH20-03	0.10	1.9	27	317	431	2.2	0.2	25	8.7	500	0.062	1	167	0.25	0.80	22	74	8.0		Trace <1	0.1	Trace <1		
18BH20-04	0.13	2.7	43	575	730	1.6	0.3	95	26.1	500	0.118	1	387	0.25	2.34	38	107	15.1	0.05	Trace <1		Trace <1		
18BH20-05	0.23	3.6	32	385	770	2.2	0.3	75	19.8	500	0.079	1	354	0.25	1.81	31	97	12.4	0.05	Trace <1		Trace <1		
18BH20-06	0.06	1.8	27	483	381	1.5	0.5	25	13.2	500	0.250	1	248	0.25	2.04	22	90	8.4		Trace <1	0.1	1-5		
18BH21-01	0.08	1.8	28	431	750	0.5	0.2	108	20.1	500	0.077	1	414	0.25	0.96	38	61	5.0	0.05	1-5		Trace <1		
18BH21-02	0.08	1.8	26	367	570	0.7	0.2	25	8.4	500	0.058	1	92	0.25	0.81	21	69	7.4	0.05	Trace <1		1-5		
18BH21-03	0.06	3.4	35	795	920	1.3	0.2	117	22.1	500	0.094	1	412	0.25	1.39	40	94	12.9	0.05	Trace <1		Trace <1		
18BH21-04	0.08	3.2	29	405	660	0.7	0.1	75	19.2	500	0.074	1	209	0.25	1.63	30	70	10.2	0.05	Trace <1		Trace <1		
18BH21-DUP-01	0.11	2.6	40	360	870	0.6	0.2	128	28.6	500	0.114	1	240	0.25	2.41	41	103	9.1	0.05	Trace <1		Trace <1		
18BH21-05	0.07	2.5	30	414	530	1.4	0.1	25	13.2	500	0.052	1	198	0.25	0.94	28	76	8.2	0.05	Trace <1		Trace <1		
18BH21-06	0.06	1.8	23	629	720	0.8	0.1	25	13.3	500	0.025	1	135	0.62	1.16	21	99	7.3	0.05	Trace <1		Trace <1		

Minimum, Median, and Maximum for all Samples

Parameter (mg/kg)

	Aluminum (Al)	Antimony (Sb)	Arsenic (As)	Barium (Ba)	Beryllium (Be)	Bismuth (Bi)	Boron (B)	Cadmium (Cd)	Calcium (Ca)	Chromium (Cr)	Cobalt (Co)	Copper (Cu)	Iron (Fe)	Lead (Pb)	Lithium (Li)	Magnesium (Mg)	Manganese (Mn)	Mercury (Hg)	Molybdenum (Mo)	Nickel (Ni)	Phosphorus (P)	Potassium (K)	Selenium (Se)	Silver (Ag)	Sodium (Na)	Strontium (Sr)	Sulpher (S)	Thallium (Tl)	Tin (Sn)	Titanium (Ti)	Tungsten (W)	Uranium (U)	Vanadium (V)	Zinc (Zn)	Zirconium (Zr)
Minimum	1939	0.74	4.6	52	0.1	0.1	3	0.13	810	14	7	7.8	9810	2.8	1	2550	131	0.025	0.3	23	143	291	0.1	0.1	25	8	500	0.025	1	8	0.25	0.387	10	30	0.5
Median	7859	1.5	10.1	143	0.4	0.1	3	0.4	2650	39	12	24	22307	13	6	6380	395	0.1	2	55	414	649	0.7	0.2	75	23	500	0.1	1	209	0.25	0.8	29	70	3
Maximum	19300	15	49	1659	0.7	0.3	73.2	1.2	19811	1148	74	83	64483	23	16.6	104994	1026	0.4	8	1148	795	1409	7	3	331	101	1521	0.3	1	797	0.62	2.41	65	150.8	15

Minimum, Median, and Maximum for all Surface Samples

Parameter (mg/kg)

	Aluminum (Al)	Antimony (Sb)	Arsenic (As)	Barium (Ba)	Beryllium (Be)	Bismuth (Bi)	Boron (B)	Cadmium (Cd)	Calcium (Ca)	Chromium (Cr)	Cobalt (Co)	Copper (Cu)	Iron (Fe)	Lead (Pb)	Lithium (Li)	Magnesium (Mg)	Manganese (Mn)	Mercury (Hg)	Molybdenum (Mo)	Nickel (Ni)	Phosphorus (P)	Potassium (K)	Selenium (Se)	Silver (Ag)	Sodium (Na)	Strontium (Sr)	Sulpher (S)	Thallium (Tl)	Tin (Sn)	Titanium (Ti)	Tungsten (W)	Uranium (U)	Vanadium (V)	Zinc (Zn)	Zirconium (Zr)
Minimum	1939	1	5	64	0	0	3	0	1350	14	8	8	9810	3	1	3156	152	0	0	24	143	291	0	0	25	10	0	0	1	8	0	0	10	30	1
Median	7872	1	10	149	0.3	0.1	2.5	0.3	4861	63	11	23	22003	12	7	8990	418	0.05	2	92	415	625	0.47	0.15	77	36	500	0.07	1	219	0.25	0.71	29	61	2
Maximum	18000	15	49	1659	0.5	0.3	73	1.2	19811	1148	74	83	64483	23	17	104994	1026	0.4	8	1148	697	1409	7	2.61	331	101	1521	0.16	1	797	0.25	1.39	65	151	6

Minimum, Median, and Maximum for Deep Samples

Parameter (mg/kg)

	Aluminum (Al)	Antimony (Sb)	Arsenic (As)	Barium (Ba)	Beryllium (Be)	Bismuth (Bi)	Boron (B)	Cadmium (Cd)	Calcium (Ca)	Chromium (Cr)	Cobalt (Co)	Copper (Cu)	Iron (Fe)	Lead (Pb)	Lithium (Li)	Magnesium (Mg)	Manganese (Mn)	Mercury (Hg)	Molybdenum (Mo)	Nickel (Ni)	Phosphorus (P)	Potassium (K)	Selenium (Se)	Silver (Ag)	Sodium (Na)	Strontium (Sr)	Sulpher (S)	Thallium (Tl)	Tin (Sn)	Titanium (Ti)	Tungsten (W)	Uranium (U)	Vanadium (V)	Zinc (Zn)	Zirconium (Zr)
Minimum	4920	0.75	7.8	52.2	0.3	0.1	2.5	0.4	810	16	7	20.2	16040	11.6	3.0	2550	131	0.06	1.8	23	317	381	0.56	0.10	25	8	500.0	0.03	1.00	92	0.25	0.80	21	69	7
Median	6720	1	12	139	0.4	0.1	2.5	0.5	1600	27	12	26	23200	16	6	3790	379	0.1	3	29	414	720	1	0.18	53	14	500	0.07	1.00	209	0.25	1.44	28	90	9
Maximum	19300	2	17	382	0.7	0.2	2.5	1.0	4340	41	25	36	32400	19	14	4780	954	0	4	43	795	920	2	0.53	128	29	500	0.25	1.00	412	0.62	2.41	41	107	15

Table S5 - Mill Area Hydrocarbons and PCB Data

wood.

Sample ID	Lowest Detection Limit	Units	CCME PHC & PCB Criteria (Coarse Grained Subsoil/ Residential, Parkland)	18BH20-01	18BH20-02	18BH20-03	18BH20-04	18BH20-05	18BH20-06	18BH21-01	18BH21-02	18BH21-03	18BH21-04	18BH21-DUP-01	18BH21-05	18BH21-06
Parameter			Depth Increment	0.0-0.15	2.5	5.00	7.50	10.00	12.00	0.0-0.15	2.5	5	7.5	7.5	10	12
			Sample Matrix	Waste	Soil	Waste	Soil	Soil	Waste	Soil	Soil	Soil	Soil	Soil	Soil	Soil
Volatile Organic Compounds (Soil)																
Benzene	0.0050	mg/kg	0.03	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050		<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Benzene	0.0050	mg/kg wwt							<0.0050							
Ethylbenzene	0.010	mg/kg	0.082	<0.010	<0.010	<0.010	<0.010	<0.010		<0.010	0.532	0.017	0.025	0.063	<0.010	<0.010
Ethylbenzene	0.010	mg/kg wwt							<0.010							
Toluene	0.050	mg/kg	0.37	<0.050	<0.050	<0.050	<0.050	<0.050		<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Toluene	0.050	mg/kg wwt							<0.050							
o-Xylene	0.050	mg/kg		<0.050	<0.050	<0.050	<0.050	<0.050		<0.050	3.06	<0.050	<0.050	<0.050	<0.050	<0.050
o-Xylene	0.050	mg/kg wwt							<0.050							
m+p-Xylene	0.050	mg/kg		<0.050	<0.050	<0.050	<0.050	<0.050		<0.050	1.02	<0.050	<0.050	<0.050	<0.050	<0.050
m+p-Xylene	0.050	mg/kg wwt							<0.050							
Xylenes	0.10	mg/kg	11	<0.10	<0.10	<0.10	<0.10	<0.10		<0.10	4.08	<0.10	<0.10	<0.10	<0.10	<0.10
Xylenes	0.10	mg/kg wwt							<0.10							
4-Bromofluorobenzene (SS)		%		94.3	123.9	124.9	113	119.1	126.6	101.1	SMI	105.7	124	127.8	115.1	126.8
3,4-Dichlorotoluene (SS)		%		97.9	107.2	108.4	96.1	127.1	106.4	116.4	SMI	91.4	88.8	103.8	114.7	103.7
1,4-Difluorobenzene (SS)		%		83	83.5	101.2	92.7	87.9	106.7	83.3	97.8	81.3	95	99.5	95.7	84.1
Hydrocarbons (Soil)																
F1 (C6-C10)	10	mg/kg	30	<10	<10	<10	<10	<10	<10	<10	354	11	<10	<10	<10	<10
F1-BTEX	10	mg/kg		<10	<10	<10	<10	<10	<10	<10	349	11	<10	<10	<10	<10
F2 (C10-C16)	20	mg/kg	150	<20	<20	<20	<20	76	<20	<20	1770	<20	<20	<20	<20	<20
F3 (C16-C34)	20	mg/kg	300	57	<20	<20	33	<20	<20	<20	177	<20	<20	<20	<20	<20
F4 (C34-C50)	20	mg/kg	2800	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20
Total Hydrocarbons (C6-(	20	mg/kg		57	<20	<20	33	76	<20	<20	2300	<20	<20	<20	<20	<20
Chrom. to baseline at nC50		-		YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
2-Bromobenzotrifluoride		%		81.3	90	89.2	91.4	70.7	80.5	77.6	108.9	87.1	88	86.1	87.7	71.5
Polychlorinated Biphenyls (Soil)																
Aroclor 1016	0.010	mg/kg			<0.010		<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Aroclor 1221	0.010	mg/kg			<0.010		<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Aroclor 1232	0.010	mg/kg			<0.010		<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Aroclor 1242	0.010	mg/kg			<0.010		<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Aroclor 1248	0.010	mg/kg			<0.010		<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Aroclor 1254	0.010	mg/kg			<0.010		<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Aroclor 1260	0.010	mg/kg			<0.010		<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Aroclor 1262	0.010	mg/kg			<0.010		<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Aroclor 1268	0.010	mg/kg			<0.010		<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Decachlorobiphenyl		%			91.3		86.9	92.7	SMI	80.4	83.2	89.9	96	SMI	109.7	83.9
Total PCBs	0.050	mg/kg	1.3		<0.050		<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050

Qualifier Legend

SMI	Surrogate recovery could not be measured due to sample matrix interference.
SOL:MI	Surrogate recovery outside acceptable limits due to matrix interference
DLHC	Detection Limit Raised: Dilution required due to high concentration of test analyte(s).

Legend

Parameter detected

Result exceeds residential/parkland guideline:

Table S6 - Background - Asbestos & Metals

Legend

- Result exceeds agricultural guideline: (yellow)
- Result exceeds residential/parkland guideline: (orange)
- Surface sample: (green)
- Sampled at depth: (grey)

Results (mg/kg); Parameter: Aluminum to Iron

Sample ID	Date	Year	Depth (m)	Depth Category	Area	Aluminum (Al)	Antimony (Sb)	Arsenic (As)	Barium (Ba)	Beryllium (Be)	Bismuth (Bi)	Boron (B)	Cadmium (Cd)	Calcium (Ca)	Chromium (Cr)	Cobalt (Co)	Copper (Cu)	Iron (Fe)
Environmental Health Guidelines (Agricultural)						---	20 [3]	25 [1]	390 [3]	4 [3]	---	120 [3]	9 [1]	---	50 [1]	180 [3]	150 [1]	---
Human Health Guidelines (Residential/Parkland)						15600 [o]	7.5 [3]	100 [1]	6800 [2]	38 [1]	---	4300 [3]	3 [1]	---	100 [1]	22 [3]	15000 [1]	11000 [o]
Reported Detection Limit						50	0.1	0.1	0.5	0.1	0.2	5	0.02	50	0.5	0.1	0.5	50
16-BKG-SS01	1-Sep-16	2016	0 - 0.15	Surface	Background	5925	0.5	21.2	77	0.2	0.1	3	0.16	5781	22	8	18	
16-BKG-SS02	1-Sep-16	2016	0 - 0.15	Surface	Background	7752	0.7	16.2	121	0.2	0.1	3	0.38	6917	37	10	29	
16-BKG-SS03	1-Sep-16	2016	0 - 0.15	Surface	Background	7261	0.9	13.3	123	0.2	0.1	3	0.36	6852	23	8	26	
16-BKG-SS04	1-Sep-16	2016	0 - 0.15	Surface	Background	6230	0.8	20.7	173	0.2	0.1	3	0.52	3812	27	8	25	
16-DUP-3 (DUPLICATE SAMPLE OF 16-BKG-SS04)	1-Sep-16	2016	0 - 0.15	Surface	Background	4884	0.6	15.9	107	0.2	0.1	3	0.20	3032	15	7	23	
16-BKG-SS05	1-Sep-16	2016	0 - 0.15	Surface	Background	10618	0.8	12.5	295	0.4	0.1	3	0.31	8045	24	9	26	
16-BKG-SS06	1-Sep-16	2016	0 - 0.15	Surface	Background	6935	0.5	10.8	138	0.2	0.1	3	0.29	8005	23	7	21	
16-BKG-SS07	1-Sep-16	2016	0 - 0.15	Surface	Background	8025	0.7	37	151	0.2	0.2	3	0.46	7003	22	9	27	
16-BKG-SS08	1-Sep-16	2016	0 - 0.15	Surface	Background	6894	0.5	16.7	123	0.2	0.1	3	0.33	7062	28	8	26	
16-BKG-SS09	1-Sep-16	2016	0 - 0.15	Surface	Background	8256	0.4	8.0	100	0.2	0.1	3	0.14	3525	16	8	23	
16-BKG-SS10	1-Sep-16	2016	0 - 0.15	Surface	Background	6746	0.6	11.9	124	0.2	0.1	3	0.31	5043	19	8	25	

Results (mg/kg) continued: Lead to Zirconium; Asbestos Results (%)

Sample ID	Lead (Pb)	Lithium (Li)	Magnesium (Mg)	Manganese (Mn)	Mercury (Hg)	Molybdenum (Mo)	Nickel (Ni)	Phosphorus (P)	Potassium (K)	Selenium (Se)	Silver (Ag)	Sodium (Na)	Strontium (Sr)	Sulpher (S)	Thallium (Tl)	Tin (Sn)	Titanium (Ti)	Tungsten (W)	Uranium (U)	Vanadium (V)	Zinc (Zn)	Zirconium (Zr)	Asbestos By Point Count	Other Fibres: Cellulose	Asbestos: Chrysotile	Mica	Other Fibres	Other Fibres: Synthetic
Environmental Health Guidelines (Agricultural)	350 [1]	---	---	---	0.6 [2]	6.9 [3]	45 [2]	---	---	1 [2]	20 [3]	---	---		1 [2]	---	---		33 [2]	130 [2]	200 [1]	---						
Human Health Guidelines (Residential/Parkland)	500 [1]	32 [o]	---	380 [o]	6.6 [2]	110 [3]	200 [2]	---	---	80 [2]	77 [3]	---	9400 [o]		1 [2]	9400 [o]	---		23 [2]	39 [3]	5600 [3]	1.3 [o]	%	%	%	%		
Reported Detection Limit	0.5	2	100	1	0.05	0.1	2.5	50	100	0.2	0.1	50	0.5		0.05	2	1.0		0	0	2	1	0.1	1	0.1	1		
16-BKG-SS01	6.4	7	3991	333	0.03	0.7	24	461	648	0.3	0.1	89	40.4		0.059	1	248		0.82	22	47		-	Trace <1	0.4	Trace <1	0	
16-BKG-SS02	13.3	8	5876	396	0.03	2.5	41	564	649	0.8	0.2	166	29.0		0.063	1	197		0.99	32	81		-	Trace <1	0.5	Trace <1	0	
16-BKG-SS03	13.9	8	5508	336	0.03	1.8	32	477	635	0.7	0.2	97	29.2		0.056	1	199		0.85	26	74		-	Trace <1	1-5	Trace <1	0	
16-BKG-SS04	12.6	8	4466	793	0.03	1.8	41	443	588	0.6	0.2	75	21.7		0.059	1	192		1.19	24	74		-	1-5	0.1	Trace <1	0	
16-DUP-3 (DUPLICATE SAMPLE OF 16-BKG-SS04)	15.2	5	3108	288	0.03	1.1	23	629	617	0.6	0.2	58	19.9		0.065	1	175		0.74	20	53		-	1-5	0.2	Trace <1	0	
16-BKG-SS05	8.7	10	5021	458	0.03	1.4	27	627	835	0.4	0.2	211	38.4		0.082	1	504		0.77	47	64		<0.10	Trace <1	-	Trace <1	0	
16-BKG-SS06	8.1	7	4521	285	0.03	1.4	30	486	590	0.6	0.2	105	35.9		0.025	1	270		0.60	26	56		<0.10	1-5	-	Trace <1	0	
16-BKG-SS07	13.9	9	4992	350	0.03	1.8	30	533	646	0.7	0.2	108	28.8		0.061	1	257		0.87	29	83		<0.10	1-5	-	Trace <1	0	
16-BKG-SS08	11.4	7	5396	328	0.03	1.5	31	457	629	0.7	0.2	100	31.4		0.025	1	249		0.78	25	62		<0.10	Trace <1	-	Trace <1	0	
16-BKG-SS09	5.0	10	4710	341	0.03	0.7	18	585	818	0.3	0.1	143	20.5		0.025	1	334		0.64	34	48		-	Trace <1	0.1	Trace <1	0	
16-BKG-SS10	13.8	7	4069	388	0.03	1.3	27	448	685	0.5	0.1	112	28.8		0.069	1	232		0.80	25	63		-	1-5	0.3	Trace <1	0	

Minimum, Median, and Maximum for all Samples

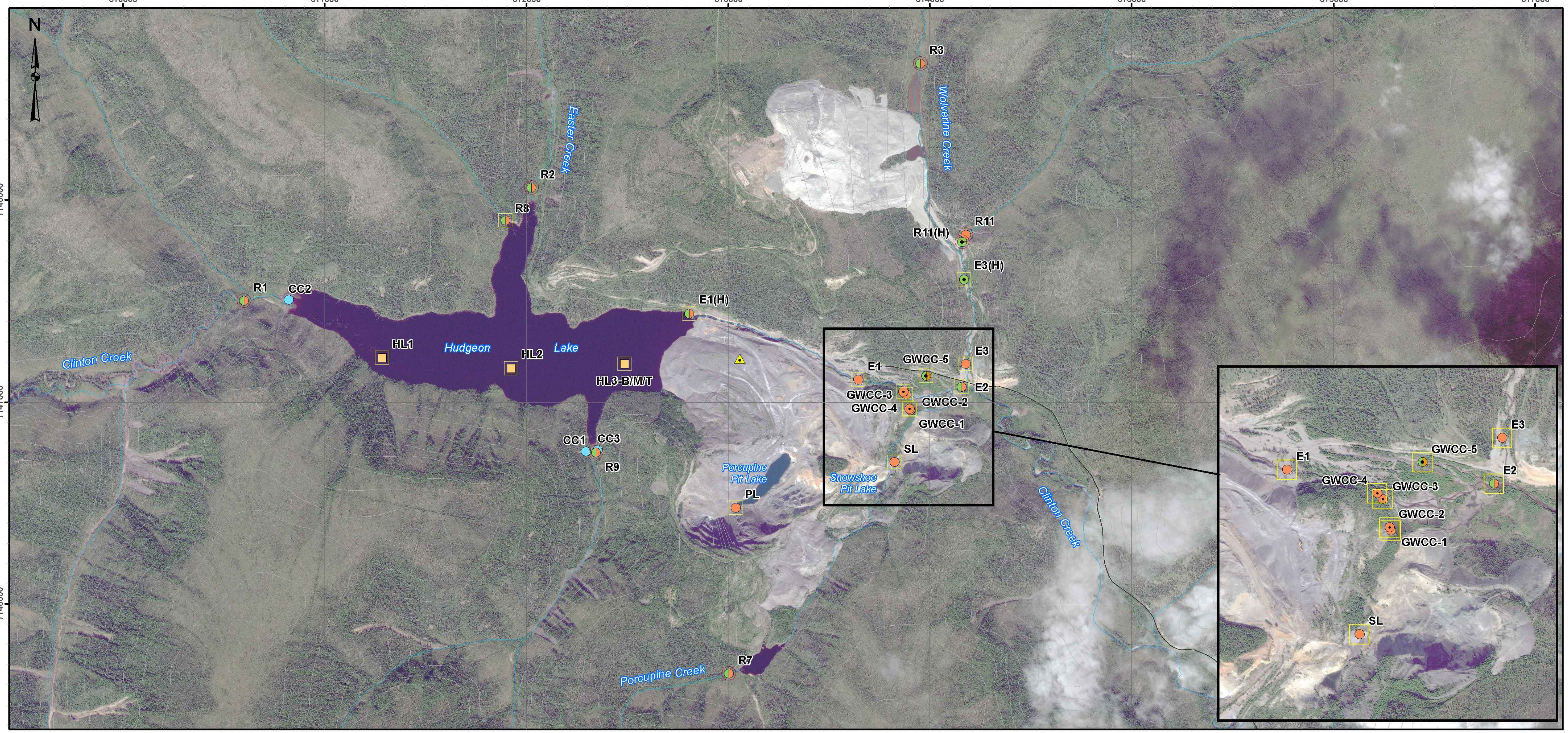
Parameter (mg/kg)

	Aluminum (Al)	Antimony (Sb)	Arsenic (As)	Barium (Ba)	Beryllium (Be)	Bismuth (Bi)	Boron (B)	Cadmium (Cd)	Calcium (Ca)	Chromium (Cr)	Cobalt (Co)	Copper (Cu)	Iron (Fe)	Lead (Pb)	Lithium (Li)	Magnesium (Mg)	Manganese (Mn)	Mercury (Hg)
Minimum	4884	0.40	8.0	77	0.2	0.1	3	0.14	3032	15	7	17.9		5.0	5	3108	285	0.025
Median	6935	0.6	15.9	123	0.2	0.1	3	0.3	6852	23	8	25		13	8	4710	340.9	0.0
Maximum	10617.9	0.9	37.1	294.5	0.4	0.2	2.5	0.5	8045	37.3	9.7	29		15	10.5	5876	793	0.0

	Molybdenum (Mo)	Nickel (Ni)	Phosphorus (P)	Potassium (K)	Selenium (Se)	Silver (Ag)	Sodium (Na)	Strontium (Sr)	Sulpher (S)	Thallium (Tl)	Tin (Sn)	Titanium (Ti)	Tungsten (W)	Uranium (U)	Vanadium (V)	Zinc (Zn)	Zirconium (Zr)
Minimum	0.7	18	443	588	0.3	0.1	58	20	0	0.025	1	175	0	0.596	20	47	1.1
Median	1	29.8	486	646	0.6	0.2	105	29	0	0.1	1	248	0	0.8	26	63	2
Maximum	2.5	40.7	629	835	0.8	0	211	40	0	0.1	1	504	0.00	1.19	47	82.7	2

Figures and Analytical Data

Water Quality



Clinton Creek Sampling Program North Area

Legend

- Environment Yukon - Water Resources Hydrometric Station
- Approximate Meteorological Station Location

Site Type

- Exposed
- Reference

Sampling Stations

- Water Quality - Groundwater Seepage
- Water Quality - Surface Water
- Hydrology
- Water Quality/Hydrology
- Water Quality/Hydrology - Groundwater Seepage
- In-situ/Depth Profile
- Snow Survey Locations

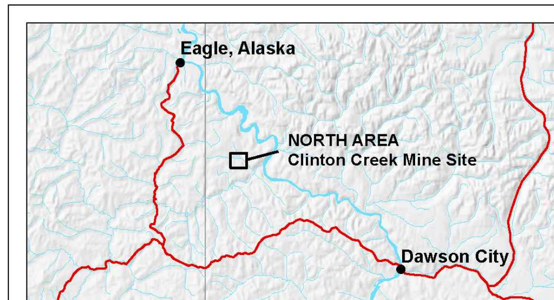
Data sources
1:50,000 Topographic Spatial Data courtesy of Her Majesty the Queen in Right of Canada, Department of Natural Resources. All Rights Reserved.

Digital Elevation Model provided by Geomatics Yukon - Yukon Government via online source (Corporate Spatial Warehouse) www.geomaticsyukon.ca.

This document is not an official land survey and the spatial data presented is subject to change.

0 100 200 400 600 800 1,000 Metres

Map Scale: 1:20,000 (printed on 11 x 17)
Map Projection: NAD 1983 UTM Zone 7N



NOTE:
THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH THE WOOD ENVIRONMENT AND INFRASTRUCTURE SOLUTIONS REPORT DATED JUNE 2019

0m 100 200 300 400 500
1 : 12500

wood.
Environment & Infrastructure Solutions
a Division of Wood Canada Limited
#600 - 4445 Lougheed Highway
Burnaby, BC V5C 0E4
Tel. 604-294-3811 Fax 604-294-4664

CLIENT: Yukon

DWN BY:	TH
CHK'D BY:	BG
DATUM:	NAD 83
PROJECTION:	UTM Zone 7
SCALE:	AS SHOWN

PROJECT:
CLINTON CREEK REMEDIATION PROJECT
ENVIRONMENTAL CHARACTERIZATION UPDATE

TITLE:
WATER QUALITY SAMPLING LOCATIONS FROM EDI (2018)

DATE:	JUNE 2019
PROJECT NO:	VE52705D.100.1
REV. NO:	A
FIGURE NO:	W1

P:\CAD\CIV\2018 Site Investigation PDF\VE52705D.100.01-ENV-Character-W1.dwg - W1 - Jul. 02, 2019 2:50pm - Juliana.Matos

Table W1 - Surface Water Quality Excerpts for Reference (Background) Locations

R1

Sampling Event	Date	Lab pH	Field pH	$CaCo_3$	Total					Dissolved				
					Cr	Cr III	Cr VI	Ni	Se	Cr	Cr III	Cr VI	Ni	Se
Criteria (mg/L)	CCME- Aquatic Life (AL)	6.5 - 9.0	6.5 - 9.0	-	-	0.0089	0.001	0.15 (a)	0.001	-	0.0089	0.001	0.15 (a)	0.001
	Drinking Water Guidelines	7.0-10.5	7.0-10.5	-	0.05 (b)	-	-	-	0.05	0.05 (b)	-	-	-	0.05
Pre Freshet														
Hemmera (Feb 2016) Table 3	26/01/2016	7.29	7.21	609	0.00026	-	-	0.0327	0.000215	0.00019	-	-	0.0334	0.000229
	24/01/2016													
EDI (2018)	08/11/2017													
	06/12/2017	8.28		614	<0.00030	-	-	0.00581	0.000747	<0.00010	-	-	0.00547	0.000794
Mean (Metals Pre Freshet) (c)					**0.00026**			**0.01926**	**0.00048**	**0.00019**			**0.01944**	**0.00051**
Post Freshet														
Laberge Env (2011) Table 2 July 2011	28/07/2011		8.35	155	0.0025				0.0016	0.0005				0.0016
	27/07/2011													
Hemmera (2015) Table 3	25/07/2015	7.95	7.97	411	0.00042	-	-	0.005	0.00126	0.00021	-	-	0.00478	0.00137
	26/07/2015													
Hemmera (Dec 2016) Table 9.1 - June 2016 data	16/06/2016	8.17	7.89	392	<0.00070	-	-	0.00431	0.00246	0.00023	-	-	0.00407	0.00256
	17/062016													
EDI (2018)	10/06/2018													
	11/06/2018	7.53		114	0.00458	<0.0010	<0.0010	0.00955	0.00137	0.00084	-	-	0.00432	0.000991
Mean (Metals Post Freshet) (c)					**0.00250**			**0.00629**	**0.00167**	**0.00045**			**0.00439**	**0.00163**
Fall														
Laberge (2010) Table 2 - (these are total metals)	18&19/08/2010	7.88		491	0.0004									
	02&03/09/2010	7.73		273	0.0009									
Laberge Env (2011) Table 2 Sept 2011	27/09/2011		7.94	182	0.0008				0.0013	0.0005				0.0012
	28/09/2011													
Hemmera (Oct 2015) Table 3	02/10/2015	8	6.76	416	0.00074	-	-	0.0054	0.00193	0.00026	-	-	0.0046	0.00208
	03/10/2015													
Hemmera (Dec 2016) Table 9.1 - Sept 2016 data	23/09/2016	8.36	8.14	416	0.0005	-	-	0.00577	0.00281	0.00026	-	-	0.00503	0.00287
	20/09/2016													
EDI (2018)	06/09/2017													
	07/09/2017	8.22		717	0.00052	-	-	0.00672	0.00135	0.00019	-	-	0.00685	0.00125
	10/09/2018													
	11/09/2018	7.92		756	0.00031	-	-	0.0192	0.000412	0.00022	-	-	0.018	0.00043
Mean (Metals Fall) (c)					**0.00060**			**0.00927**	**0.00156**	**0.00029**			**0.00862**	**0.00157**

R2

Sampling Event	Date	Lab pH	Field pH	$CaCo_3$	Total					Dissolved				
					Cr	Cr III	Cr VI	Ni	Se	Cr	Cr III	Cr VI	Ni	Se
Criteria (mg/L)	CCME- Aquatic Life (AL)	6.5 - 9.0	6.5 - 9.0	-	-	0.0089	0.001	0.15 (a)	0.001	-	0.0089	0.001	0.15 (a)	0.001
	Drinking Water Guidelines	7.0-10.5	7.0-10.5	-	0.05 (b)	-	-	-	0.05	0.05 (b)	-	-	-	0.05
Pre Freshet														
Hemmera (Feb 2016) Table 3	26/01/2016	7.68	7.74	562	0.00023	-	-	0.00296	0.000448	0.00014	-	-	0.00283	0.000485
	24/01/2016													
EDI (2018)	08/11/2017													
	06/12/2017	8.16		211	0.0031	0.0031	<0.00050	0.00705	0.000523	0.00136	0.00136	<0.0010	0.0049	0.00042
Mean (Metals Pre Freshet) (c)					**0.00167**	**0.00310**		**0.00501**	**0.00049**	**0.00075**	**0.00136**		**0.00387**	**0.00045**
Post Freshet														
Laberge Env (2011) Table 2 July 2011	28/07/2011		8.12	174	0.0011				<0.0006	0.0006				<0.0006
	27/07/2011													
Hemmera (2015) Table 3	25/07/2015	7.98	8.03	383	0.00058	-	-	0.00288	0.000832	0.00035	-	-	0.00278	0.000797
	26/07/2015													
Hemmera (Dec 2016) Table 9.1 - June 2016 data	16/06/2016	8.22	8.03	356	<0.00070	-	-	0.00299	0.000448	0.0005	-	-	0.00302	0.000428
	17/062016													
EDI (2018)	10/06/2018													
	11/06/2018	8.3		576	0.00047	-	-	0.00315	0.000624	0.0004	-	-	0.00306	0.000657
Mean (Metals Post Freshet) (c)					**0.00072**			**0.00301**	**0.00063**	**0.00046**			**0.00295**	**0.00063**
Fall														
Laberge (2010) Table 2 - (these are total metals)	18&19/08/2010	8.05		532	<0.0004									
	02&03/09/2010	7.94		396	0.0009									
Laberge Env (2011) Table 2 Sept 2011	27/09/2011		8.07	198	0.0007				<0.0006	0.0005				<0.0006
	28/09/2011													
Hemmera (Oct 2015) Table 3	02/10/2015	8.11	7.96	335	0.00105	-	-	0.0038	0.000892	0.0007	-	-	0.00356	0.000901
	03/10/2015													
Hemmera (Dec 2016) Table 9.1 - Sept 2016 data	23/09/2016	8.41	8.27	363	0.00067	-	-	0.004	0.000628	0.0005	-	-	0.00353	0.000609
	20/09/2016													
EDI (2018)	06/09/2017													
	07/09/2017	8.28		543	0.0004	-	-	0.00374	0.000602	0.00026	-	-	0.0029	0.000662
	10/09/2018													
	11/09/2018	8.32		369	0.00088	-	-	0.00389	0.000818	0.00065	-	-	0.00358	0.000842
Mean (Metals Fall) (c)					**0.00077**			**0.00386**	**0.00074**	**0.00052**			**0.00339**	**0.00075**

a for hardness > 180 mg/l
b protective of health effects from chromium (VI)
c excludes non detects

Exceeds CCME AL
Exceeds DWG

wood.

Table W1 - Surface Water Quality Excerpts for Reference (Backgı

Sampling Event	Date	R3												
		Lab pH	Field pH	$CaCo_3$	Total					Dissolved				
					Cr	Cr III	Cr VI	Ni	Se	Cr	Cr III	Cr VI	Ni	Se
Criteria (mg/L)	CCME- Aquatic Life (AL)	6.5 - 9.0	6.5 - 9.0	-	-	0.0089	0.001	0.15 (a)	0.001	-	0.0089	0.001	0.15 (a)	0.001
	Drinking Water Guidelines	7.0-10.5	7.0-10.5	-	0.05 (b)	-	-	-	0.05	0.05 (b)	-	-	-	0.05
Pre Freshet														
Hemmera (Feb 2016) Table 3	26/01/2016													
	24/01/2016	-	-	-	-			-	-	-			-	-
EDI (2018)	08/11/2017	8.27		606	0.00563	0.00563	<0.0010	0.0104	0.000678	0.00026	-	-	0.00293	0.000549
	06/12/2017													
Mean (Metals Pre Freshet) (c)					**0.00563**	**0.00563**		**0.01040**	**0.00068**	**0.00026**			**0.00293**	**0.00055**
Post Freshet														
Laberge Env (2011) Table 2 July 2011	28/07/2011													
	27/07/2011		8.03	134	0.0058				<0.0006	0.0027				0.0006
Hemmera (2015) Table 3	25/07/2015													
	26/07/2015	7.99	8.2	440	0.00471	0.00141	0.0033	0.00893	0.000642	0.0006	-	-	0.00363	0.000465
Hemmera (Dec 2016) Table 9.1 - June 2016 data	16/06/2016													
	17/062016	8.26	8.2	461	0.00425	0.00325	0.001	0.0088	0.00057	0.00044	-	-	0.00309	0.000471
EDI (2018)	10/06/2018	8.12		984	0.00062	-	-	0.00471	0.000603	0.00016	-	-	0.00397	0.000543
	11/06/2018													
Mean (Metals Post Freshet) (c)					**0.00385**	**0.00233**	**0.00215**	**0.00748**	**0.00061**	**0.00098**			**0.00356**	**0.00052**
Fall														
Laberge (2010) Table 2 - (these are total metals)	18&19/08/2010													
	02&03/09/2010	7.96		444	0.0011									
Laberge Env (2011) Table 2 Sept 2011	27/09/2011													
	28/09/2011		8.13	167	0.0161				0.0006	0.0006				<0.0006
Hemmera (Oct 2015) Table 3	02/10/2015													
	03/10/2015	8.1	6.78	384	0.00095	-	-	0.0035	0.000875	0.00065	-	-	0.00308	0.000846
Hemmera (Dec 2016) Table 9.1 - Sept 2016 data	23/09/2016													
	20/09/2016	8.24	8.12	341	0.0019	0.0019	<0.0010	0.00529	0.001	0.00052	-	-	0.0036	0.000872
EDI (2018)	06/09/2017	8.3		817	0.0003	-	-	0.00337	0.000549	0.00025	-	-	0.00326	0.0006
	07/09/2017													
	10/09/2018	8.29		620	0.00286	-	-	0.00764	0.000538	0.00021	-	-	0.00288	0.000531
	11/09/2018													
Mean (Metals Fall) (c)					**0.00387**	**0.00190**		**0.00495**	**0.00071**	**0.00045**			**0.00321**	**0.00071**

a for hardness > 180 mg/l
b protective of health effects
c excludes non detects

Exceeds CCME AL
Exceeds DWG

Table W2 - Surface Water Quality Excerpts for Downgradient Monitoring Locations

Sampling Event	Date	E1													E2												
		Lab pH	Field pH	$CaCo_3$	Total					Dissolved					Lab pH	Field pH	$CaCo_3$	Total					Dissolved				
					Cr	Cr III	Cr VI	Ni	Se	Cr	Cr III	Cr VI	Ni	Se				Cr	Cr III	Cr VI	Ni	Se	Cr	Cr III	Cr VI	Ni	Se
Criteria (mg/L)	CCME- Aquatic Life (AL)	6.5 - 9.0	6.5 - 9.0	-	-	0.0089	0.001	0.15 (a)	0.001	-	0.0089	0.001	0.15 (a)	0.001	6.5 - 9.0	6.5 - 9.0	-	-	0.0089	0.001	0.15 (a)	0.001	-	0.0089	0.001	0.15 (a)	0.001
	Drinking Water Guidelines	7.0-10.5	7.0-10.5	-	0.05 (b)	-	-	-	0.05	0.05 (b)	-	-	-	0.05	7.0-10.5	7.0-10.5	-	0.05 (b)	-	-	-	0.05	0.05 (b)	-	-	-	0.05
Pre Freshet																											
Hemmera (Feb 2016) Table 3	23/01/2016	-	-	-	-	-	-	-	-	-	-	-	-	-	7.65	7.45	961	0.00088	-	-	0.0464	0.00179	0.00053	-	-	0.0446	0.00163
EDI (2018)	04/12/2017																										
	11/02/2018	8.06		491	0.00092	-	-	0.0235	0.00301	0.00037	-	-	0.0172	0.00306													
	12/03/2018														8.23		712	0.00072	-	-	0.0323	0.00274	0.00056	-	-	0.0304	0.00301
Mean (Metals Pre Freshet) (c)					**0.00092**			**0.02350**	**0.00301**	**0.00037**			**0.01720**	**0.00306**				**0.00080**			**0.03935**	**0.00227**	**0.00055**			**0.03750**	**0.00232**
Post Freshet																											
Laberge Env (2011) Table 2 July 2011	26/07/2011		8.33	95	0.001				0.0007	0.0006				0.0009		8.14	134	0.001				0.0011	0.0006				0.0011
Hemmera (2015) Table 3	24/07/2015	8.07	8.27	263	0.00066	-	-	0.00606	0.00121	0.00053	-	-	0.00573	0.00121	7.87	7.92	400	0.00074	-	-	0.0161	0.00129	0.00056	-	-	0.0156	0.00121
	23/07/2015																										
Hemmera (Dec 2016) Table 9.1 - June 2016 data	14/06/2016	8.04	8.27	264	0.00047	-	-	0.00459	0.00219	0.00036	-	-	0.0043	0.0022													
	15/06/2016														8.11	7.92	373	0.0006	-	-	0.012	0.00198	0.00045			0.0115	0.00191
EDI (2018)	10/06/2018																										
	11/06/2018	8.1		232	0.00102	0.00102	<0.00050	0.00565	0.00112	0.00047	-	-	0.00529	0.00101													
	12/06/2018														7.85		891	0.00062	-	-	0.0582	0.00138	0.00027	-	-	0.0524	0.00133
Mean (Metals Post Freshet) (c)					**0.00079**	**0.00102**		**0.00543**	**0.00131**	**0.00049**			**0.00511**	**0.00133**				**0.00074**			**0.02877**	**0.00144**	**0.00047**			**0.02650**	**0.00139**
Fall																											
Laberge (2010) Table 2	18&19/08/2010	7.77		311	0.0007										7.84		584	0.0008									
	02&03/09/2010	7.91		281	0.0008										7.86		346	0.0009									
	20/09/2010	7.92		263	0.0024										7.93		265	0.0029									
Minnow (2010) Table 3.1 - Sept 2004 and Sept 2007	21/09/2007														-		-	0.0023			0.0084	0.0003					
	16/09/2004																										
Laberge Env (2011) Table 2 Sept 2011	28/09/2011		8.28	140	0.0009				0.0012	0.002				0.0014													
	27/09/2011															7.97	161	0.0011				0.0007	0.0008				0.0007
Hemmera (Dec 2016) Table 9.1 - Sept 2016 data	20/09/2016	8.26	8.31	290	0.00064	-	-	0.00489	0.00182	0.00046	-	-	0.00447	0.00195	8.26	8.12	382	0.00568	0.00568	<0.0010	0.0211	0.00195	0.00064	-	-	0.0114	0.00205
	22/09/2016																										
EDI (2018)	06/09/2017	8.22		274	0.00109	0.00109	<0.00050	0.00499	0.00155	0.00057	-	-	0.00413	0.0015													
	08/09/2017														7.61		147	0.00552	0.0055	<0.0010	0.0165	0.00158	0.00126	<0.010	<0.0010	0.00699	0.00129
	09/09/2017																										
	10/09/2018	8.16		400	0.00067	-	-	0.00862	0.00226	0.00057	-	-	0.00803	0.00232	8.3		984	0.00089	-	-	0.0417	0.00231	<0.00010	-	-	0.0405	0.00217
Mean (Metals Fall) (c)					**0.00103**	**0.00109**		**0.00617**	**0.00171**	**0.00090**			**0.00554**	**0.00179**				**0.00251**	**0.00559**		**0.02193**	**0.00137**	**0.00090**			**0.01963**	**0.00155**

a for hardness > 180 mg/l
b protective of health effects from chromium (VI)
c excludes non detects

Exceeds CCME AL
Exceeds DWG

Table W2 - Surface Water Quality Excerpts for Downgradient Mo

Sampling Event	Date	E3													E4												
		Lab pH	Field pH	$CaCO_3$	Total					Dissolved					Lab pH	Field pH	$CaCO_3$	Total					Dissolved				
					Cr	Cr III	Cr VI	Ni	Se	Cr	Cr III	Cr VI	Ni	Se				Cr	Cr III	Cr VI	Ni	Se	Cr	Cr III	Cr VI	Ni	Se
Criteria (mg/L)	CCME- Aquatic Life (AL)	6.5 - 9.0	6.5 - 9.0	-	-	0.0089	0.001	0.15 (a)	0.001	-	0.0089	0.001	0.15 (a)	0.001	6.5 - 9.0	6.5 - 9.0	-	-	0.0089	0.001	0.15 (a)	0.001	-	0.0089	0.001	0.15 (a)	0.001
	Drinking Water Guidelines	7.0- 10.5	7.0- 10.5	-	0.05 (b)	-	-	-	0.05	0.05 (b)	-	-	-	0.05	7.0- 10.5	7.0- 10.5	-	0.05 (b)	-	-	-	0.05	0.05 (b)	-	-	-	0.05
Pre Freshet																											
Hemmera (Feb 2016) Table 3	23/01/2016	8.05	7.1	719	0.00119	<0.00072	0.0014	0.024	0.000946	0.00116	<0.00042	0.0012	0.0247	0.00101	7.37	7.56	898	0.00067	-	-	0.0345	0.001	0.00044	-	-	0.0332	0.000988
EDI (2018)	04/12/2017	8.28		657	0.00092	-	-	0.0159	0.0006	0.00085	-	-	0.0151	0.000679													
	11/02/2018																										
	12/03/2018														8.26		837	0.00083	-	-	0.0319	0.00102	0.00015	-	-	0.0298	0.000971
Mean (Metals Pre Freshet) (c)					**0.00106**		**0.00140**	**0.01995**	**0.00077**	**0.00101**		**0.00120**	**0.01990**	**0.00084**				**0.00075**			**0.03320**	**0.00101**	**0.00030**			**0.03150**	**0.00098**
Post Freshet																											
Laberge Env (2011) Table 2 July 2011	26/07/2011		8.67	132	0.0029				0.001	0.0013				0.0009		8	168	0.0022				0.0007	0.0008				0.0009
Hemmera (2015) Table 3	24/07/2015														7.87	7.9	431	0.008	-	-	0.0183	0.00106	0.0006	-	-	0.0178	0.00116
	23/07/2015	8.12	8.23	444	0.00137	0.00137	<0.0010	0.0131	0.00132	0.00112	0.00112	<0.0010	0.0127	0.00129													
Hemmera (Dec 2016) Table 9.1 - June 2016 data	14/06/2016	8.2	8.28	393	0.00171	<0.00074	0.0012	0.0097	0.000881	0.00085	-	-	0.00817	0.000919													
	15/06/2016														8.12	7.76	415	0.00068	-	-	0.0139	0.00165	0.00053	-	-	0.0133	0.00153
EDI (2018)	10/06/2018	8.1		264	0.00873	0.00873	<0.00050	0.0156	0.000819	0.00139	0.00139	<0.0010	0.00616	0.000678	8.31		683	<0.00080	-	-	0.0293	0.000789	0.00044	-	-	0.0261	0.0008
	11/06/2018																										
	12/06/2018																										
Mean (Metals Post Freshet) (c)					**0.00368**	**0.00505**	**0.00120**	**0.01280**	**0.00101**	**0.00117**	**0.00126**		**0.00901**	**0.00095**				**0.00363**			**0.02050**	**0.00105**	**0.00059**			**0.01907**	**0.00110**
Fall																											
Laberge (2010) Table 2	18&19/08/2010	8.36		565	0.0014										7.97		819	0.0009									
	02&03/09/2010	8.2		497	0.0014										7.84		472	0.0009									
	20/09/2010	7.87		244	0.0056										7.85		296	0.0047									
Minnow (2010) Table 3.1 - Sept 2004 and Sept 2007	21/09/2007														-		-	0.0021			0.0139	0.0009					
	16/09/2004														-		-	0.0008			0.0278	0.0012					
Laberge Env (2011) Table 2 Sept 2011	28/09/2011																										
	27/09/2011		8.27	172	0.0012				0.0008	0.0009				0.0007		7.65	195	0.001				0.0007	0.0008				0.0007
Hemmera (Dec 2016) Table 9.1 - Sept 2016 data	20/09/2016	8.25	8.26	322	0.00631	0.00631	<0.0010	0.0143	0.0017	0.00079	-	-	0.00501	0.00135													
	22/09/2016														8.17	7.9	425	0.00117	0.00117	<0.0010	0.0143	0.00151	0.0006	-	-	0.0125	0.0016
EDI (2018)	06/09/2017																										
	08/09/2017	8.39		669	0.00095	-	-	0.0133	0.00119	0.00088	-	-	0.0134	0.00129													
	09/09/2017														7.58		1010	0.00131	0.00131	<0.0010	0.0448	0.00108	0.00057	-	-	0.0454	0.00104
	10/09/2018	8.31		638	0.00086	-	-	0.018	0.000469	0.00067	-	-	0.0174	0.000478	7.42		1250	0.00118	0.00118	<0.0010	0.0342	0.00072	0.00051	-	-	0.0317	0.00075
Mean (Metals Fall) (c)					**0.00253**	**0.00631**		**0.01520**	**0.00104**	**0.00081**			**0.01194**	**0.00095**				**0.00156**	**0.00122**		**0.02700**	**0.00102**	**0.00062**			**0.02987**	**0.00102**

a for hardness > 180 mg/l
b protective of health effe
c excludes non detects

Exceeds CCME AL
Exceeds DWG

Table W2 - Water Quality Excerpts Waste Dump Groundwater Seeps

GWCC-1

Sampling Event	Date	Lab pH	Field pH	$CaCo_3$	Total Cr	Total Cr III	Total Cr VI	Total Ni	Total Se	Dissolved Cr	Dissolved Cr III	Dissolved Cr VI	Dissolved Ni	Dissolved Se
Criteria (mg/L)	CCME- Aquatic Life (AL)	6.5 - 9.0	6.5 - 9.0	-	-	0.0089	0.001	0.15 (a)	0.001	-	0.0089	0.001	0.15 (a)	0.001
	Drinking Water Guidelines	7.0-10.5	7.0-10.5	-	0.05 (b)	-	-	-	0.05	0.05 (b)	-	-	-	0.05
Pre Freshet														
Hemmera (Feb 2016) Table 3	24/01/2016	7.56	7.11	1880	0.00257	<0.00078	0.0026	0.0762	0.00466	0.00242	<0.00047	0.0025	0.0742	0.0047
	25/01/2016													
EDI (2018)	11/02/2018													
	12/03/2018													
	13/03/2018	8.05		1500	0.0024	0.0013	0.0011	0.0667	0.00798	0.00226	0.00116	0.0011	0.0649	0.0084
	14/05/2018													
Mean (Metals Pre Freshet) (c)					**0.00249**	**0.00130**	**0.00185**	**0.07145**	**0.00632**	**0.00234**	**0.00116**	**0.00180**	**0.06955**	**0.00655**
Post Freshet														
Laberge Env (2011) Table 2 July 2011	27/07/2011		7.87	1506	0.0026				0.0037	0.0025				0.0037
Hemmera (2015) Table 3	26/07/2011	7.44	7.36	1720	0.002	<0.00048	0.0024	0.075	0.00419	0.00203	<0.00045	0.0018	0.0723	0.00435
Hemmera (Dec 2016) Table 9.1 - June 2016 data	15/06/2016	8.05	7.32	1680	0.00287	<0.00088	0.0036	0.0693	0.00501	0.00296	<0.00064	0.0037	0.0741	0.00509
	14/06/2016													
EDI (2018)	12/06/2018	7.99		2520	0.00306	0.00116	0.0019	0.105	0.00406	0.00181	<0.00074	0.0016	0.0996	0.00433
Mean (Metals Post Freshet) (c)					**0.00263**	**0.00116**	**0.00263**	**0.08310**	**0.00424**	**0.00233**		**0.00237**	**0.08200**	**0.00437**
Fall														
Laberge (2010) Table 2 - (these are total metals)														
Minnow (2010) Table 3.1 - Sept 2004 and Sept 2007														
Laberge Env (2011) Table 2 Sept 2011	28/09/2011		7.28	2540	0.0019				0.0024	0.0021				0.0021
Laberge Env (2011) Table 3 Sept 28 2011 (GWCC samples)	28/09/2011		7.28	323	0.0019			0.074	0.0024	0.0021			0.073	0.0021
Hemmera (Oct 2015) Table 3	01/10/2015	7.84	7.4	1730	0.00252	<00087	0.0029	0.0743	0.00381	0.0024	<0.00047	0.0026	0.0728	0.00415
Hemmera (Dec 2016) Table 9.1 - Sept 2016 data	21/09/2016	8.12	7	1700	0.00429	<0.00097	0.0037	0.0877	0.005	0.00364	<0.00080	0.0034	0.0799	0.00467
EDI (2018)	08/09/2017	8.19		1020	0.00126	<0.0010	0.0016	0.0479	0.0406	0.00125	<0.010	0.0019	0.0505	0.0368
	10/09/2018	8.2		1840	0.00291	0.00111	0.0018	0.0833	0.00509	0.00279	0.00129	0.0015	0.0806	0.00549
Mean (Metals Fall) (c)					**0.00246**	**0.00111**	**0.00250**	**0.07344**	**0.00988**	**0.00238**	**0.00129**	**0.00235**	**0.07136**	**0.00922**

GWCC-2

Sampling Event	Date	Lab pH	Field pH	$CaCo_3$	Total Cr	Total Cr III	Total Cr VI	Total Ni	Total Se	Dissolved Cr	Dissolved Cr III	Dissolved Cr VI	Dissolved Ni	Dissolved Se
Criteria (mg/L)	CCME- Aquatic Life (AL)	6.5 - 9.0	6.5 - 9.0	-	-	0.0089	0.001	0.15 (a)	0.001	-	0.0089	0.001	0.15 (a)	0.001
	Drinking Water Guidelines	7.0-10.5	7.0-10.5	-	0.05 (b)	-	-	-	0.05	0.05 (b)	-	-	-	0.05
Pre Freshet														
Hemmera (Feb 2016) Table 3	24/01/2016	7.66	7.6	1400	0.00428	0.00258	0.0017	0.0476	0.00379	0.0014	<0.00043	0.0017	0.0427	0.00374
	25/01/2016													
EDI (2018)	11/02/2018	8.22		1170	0.00142	<0.00078	0.0012	0.0429	0.00323	0.00108	0.00108	<0.0010	0.0422	0.0033
	12/03/2018													
	13/03/2018													
	14/05/2018													
Mean (Metals Pre Freshet) (c)					**0.00285**	**0.00258**	**0.00145**	**0.04525**	**0.00351**	**0.00124**	**0.00108**	**0.00170**	**0.04245**	**0.00352**
Post Freshet														
Laberge Env (2011) Table 2 July 2011	27/07/2011													
Hemmera (2015) Table 3	26/07/2011	7.63	7.54	1230	0.0012	<0.00044	0.0016	0.0424	0.00319	0.0011	<0.00042	0.0014	0.0413	0.00323
Hemmera (Dec 2016) Table 9.1 - June 2016 data	15/06/2016	8.12	7.57	1160	0.00135	<0.00073	0.0021	0.0396	0.00341	0.00125	<0.000042	0.0019	0.0386	0.00359
	14/06/2016													
EDI (2018)	12/06/2018	8.18		1500	0.00208	<0.0010	0.0023	0.0567	0.0328	0.00177	<0.010	0.0023	0.0575	0.0292
Mean (Metals Post Freshet) (c)					**0.00154**		**0.00200**	**0.04623**	**0.01313**	**0.00137**		**0.00187**	**0.04580**	**0.01201**
Fall														
Laberge (2010) Table 2 - (these are total metals)														
Minnow (2010) Table 3.1 - Sept 2004 and Sept 2007														
Laberge Env (2011) Table 2 Sept 2011	28/09/2011													
Laberge Env (2011) Table 3 Sept 28 2011 (GWCC samples)	28/09/2011		7.54	254	0.0014			0.039	0.0015	0.0012			0.04	0.0022
Hemmera (Oct 2015) Table 3	01/10/2015	7.98	7.76	1310	0.00503	0.00303	0.002	0.0482	0.00328	0.00162	<0.00043	0.0019	0.0444	0.00352
Hemmera (Dec 2016) Table 9.1 - Sept 2016 data	21/09/2016	8.2	7.6	1350	0.00363	0.00093	0.0027	0.0606	0.00441	0.00266	<0.00075	0.0024	0.052	0.0041
EDI (2018)	08/09/2017	8.27		1080	0.00099	-	-	0.0371	0.003	0.0008	-	-	0.034	0.0325
	10/09/2018	8.04		1450	0.00682	0.00612	0.0007	0.0508	0.00479	0.00178	0.00178	<0.0010	0.0447	0.00472
Mean (Metals Fall) (c)					**0.00357**	**0.00336**	**0.00180**	**0.04714**	**0.00340**	**0.00161**	**0.00178**	**0.00215**	**0.04302**	**0.00941**

GWCC-3

Sampling Event	Date	Lab pH	Field pH	$CaCo_3$	Total Cr	Total Cr III	Total Cr VI	Total Ni	Total Se	Dissolved Cr	Dissolved Cr III	Dissolved Cr VI	Dissolved Ni	Dissolved Se
Criteria (mg/L)	CCME- Aquatic Life (AL)	6.5 - 9.0	6.5 - 9.0	-	-	0.0089	0.001	0.15 (a)	0.001	-	0.0089	0.001	0.15 (a)	0.001
	Drinking Water Guidelines	7.0-10.5	7.0-10.5	-	0.05 (b)	-	-	-	0.05	0.05 (b)	-	-	-	0.05
Pre Freshet														
Hemmera (Feb 2016) Table 3	24/01/2016	-	-	-	-	-	-	-	-	-	-	-	-	-
	25/01/2016													
EDI (2018)	11/02/2018													
	12/03/2018													
	13/03/2018													
	14/05/2018	7.91		605	0.00106	0.00106	<0.00050	0.033	0.00155	0.00054	-	-	0.03	0.0016
Mean (Metals Pre Freshet) (c)					**0.00106**	**0.00106**		**0.03300**	**0.00155**	**0.00054**			**0.03000**	**0.00160**
Post Freshet														
Laberge Env (2011) Table 2 July 2011	27/07/2011													
Hemmera (2015) Table 3	26/07/2011	7.55	7.44	609	0.00067	-	-	0.0304	0.00129	0.00049	-	-	0.0304	0.00135
Hemmera (Dec 2016) Table 9.1 - June 2016 data	15/06/2016	8.07	7.44	622	0.00045	-	-	0.0282	0.00153	0.00042	-	-	0.0282	0.00149
	14/06/2016													
EDI (2018)	12/06/2018	8.03		774	0.00068	-	-	0.0329	0.00198	0.00066	-	-	0.0348	0.00191
Mean (Metals Post Freshet) (c)					**0.00060**			**0.03050**	**0.00160**	**0.00052**			**0.03113**	**0.00158**
Fall														
Laberge (2010) Table 2 - (these are total metals)														
Minnow (2010) Table 3.1 - Sept 2004 and Sept 2007														
Laberge Env (2011) Table 2 Sept 2011	28/09/2011													
Laberge Env (2011) Table 3 Sept 28 2011 (GWCC samples)	28/09/2011		7.44	192	0.0007			0.031	0.0007	0.0005			0.031	0.0006
Hemmera (Oct 2015) Table 3	01/10/2015	7.9	7.69	735	0.00072	-	-	0.0288	0.00163	0.00056	-	-	0.0269	0.00192
Hemmera (Dec 2016) Table 9.1 - Sept 2016 data	21/09/2016	8.2	7.3	773	0.00061	-	-	0.034	0.00182	0.00059	-	-	0.0326	0.00186
EDI (2018)	08/09/2017	8.27		679	0.0005	-	-	0.0295	0.00156	0.00042	-	-	0.028	0.00156
	10/09/2018	8.21		1290	0.00108	<0.0010	0.0016	0.0492	0.00976	0.00109	<0.010	0.0017	0.0521	0.00879
Mean (Metals Fall) (c)					**0.00072**		**0.00160**	**0.03450**	**0.00309**	**0.00063**		**0.00170**	**0.03412**	**0.00295**

a for hardness > 180 mg/l
b protective of health effects from chromium (VI)
c excludes non detects

Exceeds CCME AL
Exceeds DWG

wood.

Table W2 - Water Quality Excerpts Waste Dump Groundwat

Sampling Event	Date	GWCC-4													GWCC-5												
					Total					Dissolved								Total					Dissolved				
		Lab pH	Field pH	$CaCo_3$	Cr	Cr III	Cr VI	Ni	Se	Cr	Cr III	Cr VI	Ni	Se	Lab pH	Field pH	$CaCo_3$	Cr	Cr III	Cr VI	Ni	Se	Cr	Cr III	Cr VI	Ni	Se
Criteria (mg/L)	CCME- Aquatic Life (AL)	6.5 - 9.0	6.5 - 9.0	-	-	0.0089	0.001	0.15 (a)	0.001	-	0.0089	0.001	0.15 (a)	0.001	6.5 - 9.0	6.5 - 9.0	-	-	0.0089	0.001	0.15 (a)	0.001	-	0.0089	0.001	0.15 (a)	0.001
	Drinking Water Guidelines	7.0-10.5	7.0-10.5	-	0.05 (b)	-	-	-	0.05	0.05 (b)	-	-	-	0.05	7.0-10.5	7.0-10.5	-	0.05 (b)	-	-	-	0.05	0.05 (b)	-	-	-	0.05
Pre Freshet																											
Hemmera (Feb 2016) Table 3	24/01/2016	7.64	7.61	683	0.0006	-	-	0.0328	0.00227	0.00047	-	-	0.032	0.00238													
	25/01/2016														7.37	7.22	324	0.00083	-	-	0.0198	0.00372	0.00028	-	-	0.011	0.00205
EDI (2018)	11/02/2018																										
	12/03/2018														8.07		606	<0.00060			0.0273	0.00126	0.0004			0.0265	0.00118
	13/03/2018																										
	14/05/2018	8.17		542	0.00049	-	-	0.0334	0.000948	0.0004	-	-	0.0327	0.000917													
Mean (Metals Pre Freshet) (c)					**0.00055**			**0.03310**	**0.00161**	**0.00044**			**0.03235**	**0.00165**				**0.00083**			**0.02355**	**0.00249**	**0.00034**			**0.01875**	**0.00162**
Post Freshet																											
Laberge Env (2011) Table 2 July 2011	27/07/2011																										
Hemmera (2015) Table 3	26/07/2011	7.55	7.5	427	0.00048	-	-	0.033	0.000712	0.00041	-	-	0.0325	0.000672													
Hemmera (Dec 2016) Table 9.1 - June 2016 data	15/06/2016	8.05	7.57	474	0.0005	-	-	0.0304	0.00104	0.00043	-	-	0.0298	0.00101													
	14/06/2016														8.09	7.54	530	0.00067	-	-	0.018	0.00935	0.00065	-	-	0.0176	0.00987
EDI (2018)	12/06/2018	8.24		501	0.00048	-	-	0.0317	0.00165	0.00046	-	-	0.0324	0.00182	8.14		559	0.00121	-	-	0.0202	0.0247	0.00102	<0.00071	0.001	0.0184	0.0264
Mean (Metals Post Freshet) (c)					**0.00049**			**0.03170**	**0.00113**	**0.00043**			**0.03157**	**0.00117**				**0.00094**			**0.01910**	**0.01703**	**0.00084**		**0.00100**	**0.01800**	**0.01814**
Fall																											
Laberge (2010) Table 2 - (these are total metals)																											
Minnow (2010) Table 3.1 - Sept 2004 and Sept 2007																											
Laberge Env (2011) Table 2 Sept 2011	28/09/2011																										
Laberge Env (2011) Table 3 Sept 28 2011 (GWCC samples)	28/09/2011		7.54	181	0.0005			0.032	<0.0006	<0.0004			0.033	<0.0006		7.37	250	0.0007			<0.001	<0.0006	0.0004			0.038	0.0042
Hemmera (Oct 2015) Table 3	01/10/2015	7.91	7.73	451	0.00047	-	-	0.03	0.000824	0.00038	-	-	0.0302	0.000859													
Hemmera (Dec 2016) Table 9.1 - Sept 2016 data	21/09/2016	8.23	7.6	507	0.00078	-	-	0.0351	0.000994	0.00045	-	-	0.0335	0.00103	8.26	7.3	541	0.00056	-	-	0.0226	0.00434	0.00049	-	-	0.0218	0.0044
EDI (2018)	08/09/2017	8.21		990	0.00114	<0.0010	0.0015	0.0458	0.00631	0.00071	-	-	0.046	0.00585	7.83		589	0.0005	-	-	0.0234	0.00503	0.00044	-	-	0.0228	0.00539
	10/09/2018	8.11		526	0.00068	-	-	0.0341	0.00108	0.0005	-	-	0.036	0.00105	8.24		518	0.00037	-	-	0.0262	0.000814	0.00026	-	-	0.0269	0.000729
Mean (Metals Fall) (c)					**0.00071**		**0.00150**	**0.03540**	**0.00230**	**0.00051**			**0.03574**	**0.00220**				**0.00053**			**0.02407**	**0.00339**	**0.00040**			**0.02738**	**0.00368**

a for hardness > 180
b protective of health
c excludes non detect

Exceeds CCME AL
Exceeds DWG

Table W4 - Water Quality Excerpts for Hudgeon Lake

WQID	Reference	Location	Date	Conductivity	CaCO3	pH	Sulfate (SO4)	Sulphide (as S)	Sulphide (as H2S)	Total Metals								Dissolved Metals							
										Arsenic (As)	Chromium (Cr)	Trivalent Chromium (Cr III)	Hexavalent Chromium (Cr VI)	Manganese (Mn)	Nickel (Ni)	Selenium (Se)	Zirconium (Zr)	Arsenic (As)	Chromium (Cr)	Trivalent Chromium (Cr III)	Hexavalent Chromium (Cr VI)	Manganese (Mn)	Nickel (Ni)	Selenium (Se)	Zirconium (Zr)
CCME- Aquatic Life(AL)						**6.5 - 9.0**				**0.005**		**0.0089**	**0.001**			**0.001**		**0.005**		**0.0089**	**0.001**			**0.001**	
Drinking Water Guidelines						**7.0-10.5**				**0.01**	**0.05 (b)**				**0.104**	**0.05**		**0.01**	**0.05 (b)**				**0.104**	**0.05**	
HL-T	Liebau (2003)	A	Mar-03			7.5			<.005																
HL-M	Liebau (2003)	A	Mar-03						0.94																
HL-B	Liebau (2003)	A	Mar-03			7.08			1.34																
HL-T	Liebau (2003)	A	Sep-03						<.005																
HL-M	Liebau (2003)	A	Sep-03						0.19																
HL-B	Liebau (2003)	A	Sep-03						0.39																
HL-T	Liebau (2010)	A	Jun-08	468		8.02																			
HL-T	Liebau (2010)	C	Jun-08	467		7.97																			
HL3-T	EDI (2017)	C	07-Sep-17	691	370	*8.17*	246	<0.018	<0.019	0.00076	0.00042	-	-	0.119	0.00551	0.0012	0.00062	0.00069	0.00025	-	-	0.106	0.00449	0.00132	0.00057
HL3-T	EDI (2018)	C	13-Mar-18	895	540	*8.11*	322	<0.018	<0.019	0.00064	0.00042	-	-	0.319	0.00532	0.00122	0.00065	0.00057	0.0003	-	-	0.3	0.00552	0.0013	0.00062
HL3-T	EDI (2018)	C	11-Jun-18	400	207	*8.06*	123	<0.018	<0.019	0.00081	0.00102	0.00102	<0.00050	0.146	0.0051	0.000994	0.00093	0.00077	0.00087	-	-	0.132	0.00475	0.000965	0.00105
HL3-T	EDI (2018)	C	11-Sep-18	539	276	*8.08*	179	<0.018	<0.019	0.00103	0.00095	-	-	0.171	0.00442	0.00156	0.00104	0.00075	0.00054	-	-	0.104	0.00388	0.00156	0.00106
HL3-M	EDI (2017)	C	07-Sep-17	979	556	*7.87*	312	0.056	0.06	0.00481	0.0014	-	-	3.48	0.0058	0.00131	0.00235	0.00455	0.00119	0.00119	<0.0010	3.27	0.00457	0.00149	0.00218
HL3-M	EDI (2018)	C	13-Mar-18	1060	627	*7.84*	325	0.048	0.051	0.00437	0.00131	0.00131	<0.0010	3.27	0.00487	0.00145	0.00227	0.0041	0.0011	0.0011	<0.0010	3.56	0.0042	0.00118	0.00213
HL3-M	EDI (2018)	C	11-Jun-18	1060	701	*8.37*	326	<0.018	<0.019	0.00392	0.00121	0.00121	<0.00050	3.32	0.00484	0.00143	0.00212	0.00371	0.00085	-	-	3.6	0.00499	0.00129	0.002
HL3-M	EDI (2018)	C	11-Sep-18	1060	556	*7.73*	342	<0.018	<0.019	0.00279	0.00111	0.00111	<0.00050	3.29	0.00547	0.00133	0.00152	0.00314	0.00093	-	-	3.08	0.00494	0.00137	0.00165
HL3-B	EDI (2017)	C	07-Sep-17	1120	653	*7.8*	362	0.062	0.066	0.00511	0.0016	-	-	3.82	0.00457	0.00156	0.00292	0.00503	0.0013	0.0013	<0.0010	3.65	0.00371	0.00151	0.00279
HL3-B	EDI (2018)	C	13-Mar-18	2180	1360	*8.08*	881	0.048	0.051	0.0113	0.00287	0.00287	<0.0010	7.99	0.0025	0.00073	0.00372	0.00905	0.00147	0.00147	<0.0010	7.54	0.0014	0.00049	0.00273
HL3-B	EDI (2018)	C	11-Jun-18	2070	1390	*8.16*	799	0.097	0.103	0.00999	0.00225	0.00225	<0.00050	7.21	0.0017	0.00078	0.00475	0.011	0.00206	0.00206	<0.0010	7.11	0.00169	0.00111	0.00498
HL3-B	EDI (2018)	C	11-Sep-18	2000	1230	*7.47*	749	0.077	0.082	0.01	0.00245	0.00245	<0.00050	6.75	0.00244	0.00097	0.00417	0.00949	0.00203	0.00203	<0.0010	6.34	0.002	0.00085	0.00433

a for hardness > 180 mg/l
b protective of health effects from chromium (VI)
T Lake top
M Lake middle
B Lake bottom

Exceeds CCME AL
Exceeds DWG

wood.

Table W5 - Porcupine and Snowshoe Pit Lake Water Quality Excerpts

Pit	Date	Hardness (as CaCO3)	pH (lab)	Sulfate (SO4)	Arsenic (As)-Total	Boron (B)-Total	Chromium (Cr)-Total	Trivalent Chromium (Cr III)-Total	Hexavalent Chromium (Cr VI)-Total	Nickel (Ni)-Total	Selenium (Se)-Total	Arsenic (As)-Dissolved	Boron (B)-Dissolved	Chromium (Cr)-Dissolved	Trivalent Chromium (Cr III)-Dissolved	Hexavalent Chromium (Cr VI)-Dissolved	Nickel (Ni)-Dissolved	Selenium (Se)-Dissolved
Criteria (mg/L)	CCME- Aquatic Life (AL)	-	6.5 - 9.0	-	0.005	1.5	-	0.0089	0.001	0.15 (a)	0.001	0.005	1.5	-	0.0089	0.001	0.15 (a)	0.001
	Drinking Water Guidelines	-	7.0-10.5	-	0.01	5	0.05 (b)	-	-	-	0.05	0.01	5	0.05 (b)	-	-	-	0.05
Porcupine Pit Lake	16-Sep-13	1700	8.00	1580	0.00724	4.44	<0.00050			0.104	0.00576	0.00757	4.01		0.00104		0.105	0.00584
Snowshoe Pit Lake																		
	16-Sep-13	762	8.21	671	0.0165	<0.25	0.00101			0.0172	0.0203	0.0166	<0.25	0.00122			0.0168	0.0194
	16-May-18	745	8.29	552	0.02	0.052	0.00172	<0.0010	0.0017	0.0168	0.0406	0.0198	0.048	0.00117	<0.010	0.0016	0.0161	0.0389
	12-Jun-18	888	8.24	702	0.0176	0.038	0.00164	0.00164	<0.00050	0.0183	0.0236	0.0177	0.038	0.00174	0.00174	<0.0010	0.0177	0.0265
	10-Jul-18	1090	8.36	935	0.0163	0.043	0.00838	0.00708	0.0013	0.0264	0.0117	0.0151	0.041	0.00133	<0.00073	0.0013	0.0176	0.012
	13-Aug-18	1040	8.41	870	0.0168	0.049	0.00386	0.00336	0.0005	0.0225	0.0124	0.0156	0.045	0.00142	0.00142	<0.0010	0.0177	0.0124
	11-Sep-18	772	8.36	576	0.0163	0.047	0.0014	0.0014	<0.00050	0.0172	0.0158	0.016	0.046	0.00131	0.00131	<0.0010	0.0154	0.0158
	15-Oct-18	1110	8.34	841	0.0194	0.062	0.00172	<0.00083	0.0016	0.0177	0.0122	0.0186	0.058	0.00149	<0.00073	0.001	0.0166	0.012

a for hardness > 180 mg/l
b protective of health effects from chromium (VI)

Exceeds CCME AL
Exceeds DWG

wood.

Appendix A

Limitations

Limitations

1. The work performed in the preparation of this report and the conclusions presented are subject to the following:
   a. The Standard Terms and Conditions which form a part of our Professional Services Contract;
   b. The Scope of Services;
   c. Time and Budgetary limitations as described in our Contract; and
   d. The Limitations stated herein.
2. No other warranties or representations, either expressed or implied, are made as to the professional services provided under the terms of our Contract, or the conclusions presented.
3. The conclusions presented in this report were based, in part, on visual observations of the Site and attendant structures. Our conclusions cannot and are not extended to include those portions of the Site or structures, which are not reasonably available, in Wood's opinion, for direct observation.
4. The environmental conditions at the Site were assessed, within the limitations set out above, having due regard for applicable environmental regulations as of the date of the inspection. A review of compliance by past owners or occupants of the Site with any applicable local, provincial or federal bylaws, orders-in-council, legislative enactments and regulations was not performed.
5. The Site history research included obtaining information from third parties and employees or agents of the owner. No attempt has been made to verify the accuracy of any information provided, unless specifically noted in our report.
6. Where testing was performed, it was carried out in accordance with the terms of our contract providing for testing. Other substances, or different quantities of substances testing for, may be present on-site and may be revealed by different or other testing not provided for in our contract.
7. Because of the limitations referred to above, different environmental conditions from those stated in our report may exist. Should such different conditions be encountered, Wood must be notified in order that it may determine if modifications to the conclusions in the report are necessary.
8. The utilization of Wood's services during the implementation of any remedial measures will allow Wood to observe compliance with the conclusions and recommendations contained in the report. Wood's involvement will also allow for changes to be made as necessary to suit field conditions as they are encountered.
9. This report is for the sole use of the party to whom it is addressed unless expressly stated otherwise in the report or contract. Any use which any third party makes of the report, in whole or the part, or any reliance thereon or decisions made based on any information or conclusions in the report is the sole responsibility of such third party. Wood accepts no responsibility whatsoever for damages or loss of any nature or kind suffered by any such third party as a result of actions taken or not taken or decisions made in reliance on the report or anything set out therein.
10. This report is not to be given over to any third party for any purpose whatsoever without the written permission of Wood.
11. Provided that the report is still reliable, and less than 12 months old, Wood will issue a third-party reliance letter to parties that the client identifies in writing, upon payment of the then current fee for such letters. All third parties relying on Wood's report, by such reliance agree to be bound by our proposal and Wood's standard reliance letter. Wood's standard reliance letter indicates that in no event shall Wood be liable for any damages, howsoever arising, relating to third-party reliance on Wood's report. No reliance by any party is permitted without such agreement.