Teck

SÄ DENA HES OPERATING CORPORATION

SÄ DENA HES MINE

Environmental Monitoring, Surveillance and Reporting Plan

Prepared by

Teck Resources Limited

June 30, 2016

Table of Contents

1.0 INTRODUCTION 1
1.1. Project Overview 1
1.2. SDH Mine Site Decommissioning, Closure and Reclamation 2
1.2.1. Human Health and Ecological Risk Assessments 3
1.3. Closure and Reclamation Overview 5

2.0 ENVIRONMENTAL MONITORING PROGRAM 8
2.1. Surface Water 10
2.2. Groundwater Monitoring Program 13
2.3. Aquatic Resources Monitoring Program 15
2.3.1. Stream Sediment Quality Monitoring 15
2.3.2. Fisheries Monitoring 15
2.3.3. Benthic Invertebrate Monitoring 15
2.4. Terrestrial Monitoring Program 16
2.4.1. Reclamation/Re-vegetation Success Monitoring 16
2.4.2. Terrestrial Effects Monitoring 16
2.4.3. Invasive Plant Species Monitoring Program 16

3.0 PHYSICAL MONITORING PROGRAM 17

4.0 DATA EVALUATION AND REPORTING 17

5.0 RECLAMATION LIABILITY COST ESTIMATES 18

6.0 REFERENCES 19

LIST OF EMBEDDED TABLES

Table 1-1 Summary of Closure and Reclamation Measures
Table 2-1: Summary of Proposed Post-Reclamation Monitoring Programs
Table 2-2: Description of Water Quality Sampling Stations (from SRK, Water Quality Monitoring Plan, 2014)
Table 2-3: Groundwater Monitoring Wells
Table 5-1 Sa Dena Hes Mine - Estimated Post Closure Site Management (2016- 2040)

LIST OF EMBEDDED FIGURES

Figure 1-1 Overall Risk Assessment and Risk Management Process for the SDH Mine Site
Figure 1-2 Overview of Closure/Reclamation Measures (DDRP, 2015)
Figure 2-1: Surface Water Quality Monitoring
Figure 2-3 Post-Reclamation Groundwater Monitoring Wells

APPENDICES

A – Adaptive Management Plan, Sa Dena Hes Mine – Draft (SRK, 2014)
B – Long Term Groundwater Monitoring Plan SDH Mine (Golder Associates, 2015)
C – Proposed Methodologies for Aquatic Resources Monitoring (ACG 2014)
D - Sa Dena Hes Mine Site Long-term Monitoring Plan for Terrestrial Environment Related to Human Health and Ecological Risks (Azimuth, 2016)
E – Proposed Post Reclamation Geotechnical Monitoring Program (SRK, 2014)

1.0 INTRODUCTION

The Sä Dena Hes (SDH) mine was a lead/zinc mine located 45 km north of Watson Lake in southeastern Yukon within the Traditional Territory of the Kaska First Nation. Teck Resources Limited (Teck), on behalf of the Sä Dena Hes Operating Corporation (SDHOC), recently completed decommissioning, closure and reclamation activities to permanently close the SDH mine in accordance with the licenced and approved Detailed Decommissioning and Reclamation Plan (DDRP August 2015).

In December 2015, Teck amended its Quartz Mining License (QML) QML-0004 for the proposed 25 year post-reclamation phase (the Project)[1]. The amended QML expires on December 31, 2040 and the *Environmental Monitoring, Surveillance and Reporting Plan* (EMSRP) is a requirement under Section 7.0.

The QML defines the EMSRP as "*a plan that describes methods and techniques for collecting monitoring information regarding environmental conditions at the Undertaking, as well as quantitative thresholds which trigger the implementation of adaptive management strategies*.

The purpose of the EMSRP is to outline the strategy for site monitoring in the short and long term and includes the conditions related to the water monitoring program, physical monitoring program, aquatic environmental monitoring program, terrestrial environment monitoring program, and reclamation effectiveness monitoring program.

In addition, an Adaptive Management Plan (AMP) (ACG, 2016) has been developed and will part of the data evaluation of the EMRSP.

Additionally, Teck is seeking to amend QZ15-082 to a Type B Water Use Licence which would authorize activities during the 25 year post reclamation phase. As the SDH mine is no longer in production (e.g. no milling), activities during the post-reclamation phase meet the Type B criteria outlined under Schedule 7 of the Water Board Regulations.

1.1. Project Overview

The SDH mine was constructed in 1991 and operated between August 1991 and December 1992 by Curragh Resources Inc. under Water Licence IN90-002 pursuant to the *Northern Inland Waters Act*. Approximately 700,000 tonnes of ore were mined and processed onsite during the 16-month operation of the mine. The mine has not been in operation since that time.

After 14 years in Temporary Closure, on January 26, 2012, the decommissioning, closure and reclamation activities to permanently close the SDH mine were conducted from 2013 to 2015 in accordance with the licensed and approved DDRP.

During the 25-year post-reclamation phase, Teck proposes:

- to continue to discharge neutral mine drainage;
- to decommission the Main Access Road and Site Access Road; and,

1 This Project Proposal uses the term "post-reclamation" to describe the phase that will commence upon completion of the implementation of the SDH Detailed Decommissioning and Reclamation Plan in January 2016. Other documentation provided with this submission may refer to "post-closure"; these two terms are synonymous.

- to undertake post-reclamation monitoring and adaptive management, inspections and maintenance of constructed/engineered structures.

1.2. SDH Mine Site Decommissioning, Closure and Reclamation

Teck's closure philosophy is described in the DDRP, Section 1.1. In keeping with this philosophy, the following objectives have guided development and implementation of the DDRP:

- Protection of public health and safety;
- Implementation of environmental protection measures that minimize adverse environment impacts;
- Ensuring land use commensurate with surrounding lands;
- Post-reclamation monitoring of the site to assess effectiveness of closure measures for the long term; and,
- Passive post-reclamation monitoring and management of the site where applicable.

Development of the DDRP has always been and continues to be a collaborative, iterative process. The DDRP was first compiled in 2000 after extensive consultation with regulators and First Nations, the DDRP was assessed under CEAA and subsequently approved and licenced under the Type A WUL QZ99-045 and QML-0004. Despite the fact that the property remained in temporary closure, the DDRP was updated in January 2006, January 2010, and January 2012, in accordance with regulatory requirements and based on the findings of the numerous ongoing closure studies undertaken for the site. The DDRP was released for review by regulators and Liard First Nation (LFN) in July 2013 (officially the March 2013 Update version) with the most recent update being released in August 2015.

Teck began to implement the DDRP on January 29, 2013. Through engagement with LFN, regulators and third-party reviewers, Teck and their technical consultants have undertaken several more closure studies to guide the final closure and reclamation plans. Teck and the various interested parties continue to use the findings of new and ongoing studies to inform decision-making about the most appropriate, sufficiently protective site closure and reclamation measures. As explained below, the human health risk assessment (HHRA) and ecological risk assessment (ERA) and their supporting studies have played a key role in guiding site closure and reclamation.

Teck has worked closely with LFN on the refinement and implementation of the DDRP. To support their collaboration and cooperation, the two parties formed the Sä Dena Hes Project Working Group to provide strategic guidance to Teck and LFN on the advancement of the site closure and remediation. Further, Teck and LFN established a Communication and Engagement Plan to facilitate cooperative implementation of the DDRP.

After Teck's decision to put the SDH mine into permanent closure, additional site assessment and studies were conducted through 2015 to provide additional information to refine the DDRP. The final DDRP (issued in August 2015) incorporates the studies completed to date, addresses comments raised by regulators and LFN and was used to implement closure activities.

1.2.1. Human Health and Ecological Risk Assessments

The Yukon Mine Site Closure and Reclamation Policy (YG Energy, Mines & Resources, 2006) formally recognizes that "risk management may be utilized in the development of the reclamation and closure plan by the mine operator. This approach should take into consideration ecological, human health, socioeconomic considerations and engineering factors and be designed to enable the mine operator and Yukon government agencies to fully understand the likelihood and consequence of failure in order to assess reclamation and closure options and to ensure that risks associated with implementing the mine DDRP are addressed to the satisfaction of the Yukon government."

The HHRA and ERA commissioned by Teck have played a key role in guiding closure and reclamation planning. A comprehensive, collaborative approach to development of the Risk Assessments has been taken, involving Teck and their technical consultants, LFN and several YG departments/branches, and their third-party reviewers. Numerous additional studies have been and continue to be undertaken to support the Risk Assessments.

Figure 1-1 depicts the DDRP development and implementation process in the context of the HHRA and ERA.

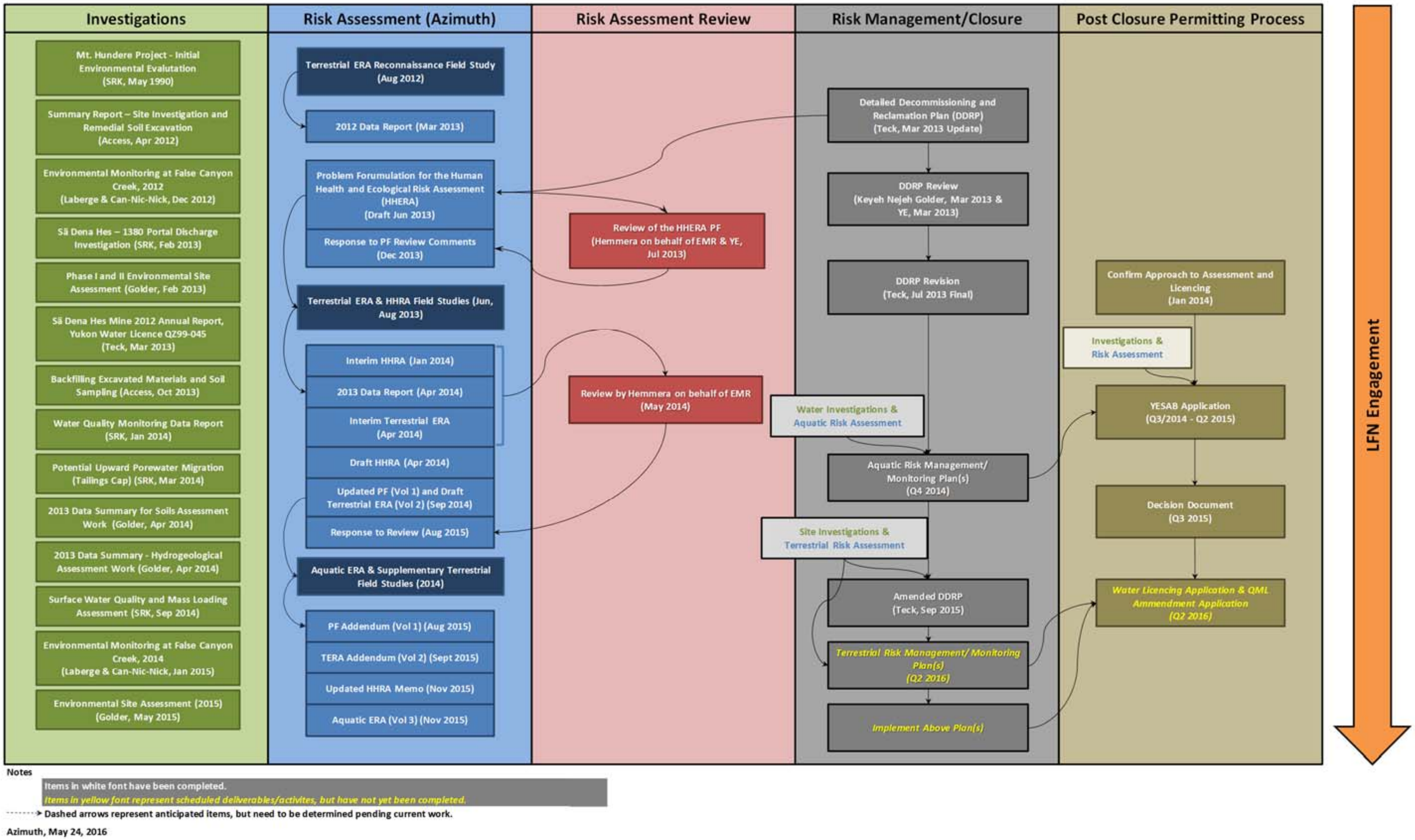


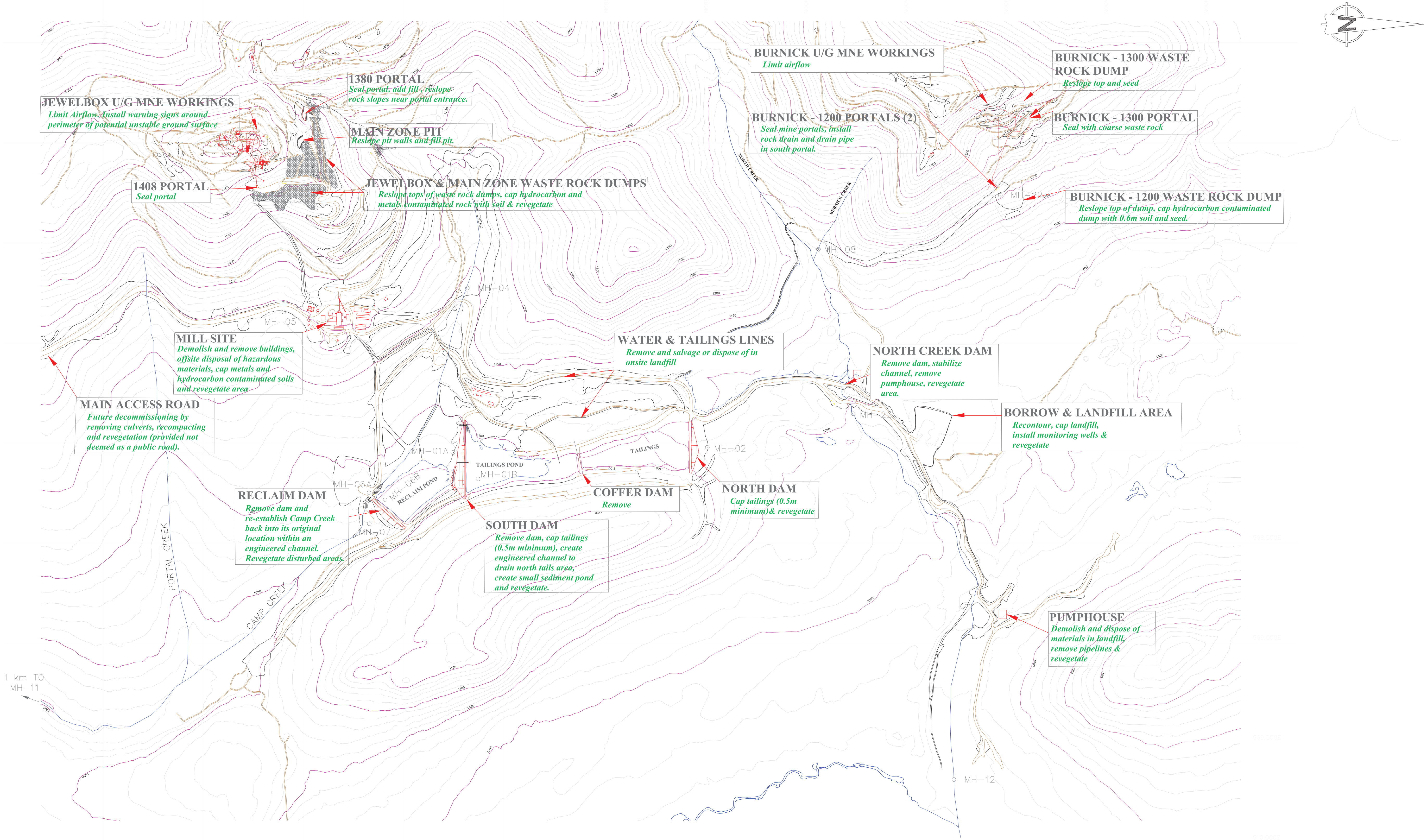
Figure 1-1 Overall Risk Assessment and Risk Management Process for the SDH Mine Site

1.3. Closure and Reclamation Overview

Figure 1-2 shows the main features of the SDH mine site. The site includes underground workings and open pits associated with three ore bodies: the Main Zone and Jewelbox ore bodies located adjacent to each other, on the south end of the site and immediately west of the Mill Site; the Burnick ore body located in the northwestern corner of the site. The Mill Site is located in the southern portion of the site, southwest of the Tailings Management Facility. The Facility comprises the Main Tailings Pond and associated North and South Dams, and the Reclaim Pond and Dam. Camp Creek is diverted around the Reclaim Pond. The main Borrow Source and Landfill Area is located in the northern portion of the site. The 25 km long Main Access Road connects the SDH mine site to the Robert Campbell Highway; there is a network of minor roads throughout the site.

Although decommissioning is, with the exception of decommissioning of the Main Access Road, outside the scope of this project, Table 1-1 summarizes the decommissioning, closure and reclamation plans detailed in the DDRP in order to provide an overall picture of the post-reclamation conditions of the SDH mine site. These plans are also shown in Figure 1-2 taken from the DDRP.

In general, the plans include decommissioning all buildings and other infrastructure on the site; draining and capping the tailings ponds; breaching the South and Reclaim dams; sealing portals; re-contouring waste rock dumps and re-sloping pit walls; as well as remediation and natural revegetation. Decommissioning and reclamation commenced in 2013 and was completed during the summer of 2015 (with the exception of decommissioning of the Main Access Road).



Teck

LEGEND

EXPLORATION TRAILS

WASTE ROCK DUMPS

HAUL ROADS

CLEARED AREA

CONTOUR INTERVAL=10m

NOTE
BASE TOPOGRAPHY FROM NORTH AMERICAN DATUM 1983
ALL SURFACE FACILITIES AND BOUNDARIES HAVE BEEN ADJUSTED FROM NAD 1927

Sä DENA HES DETAILED
DECOMMISSIONING AND RECLAMATION PLAN

GENERAL ARRANGEMENT PLAN
CLOSURE MEASURES

DRAWN BY: BJD	CHECKED BY: BJD	FIGURE NO. 1-2	REV. 2
Revised: August 25, 2015	PROJ. NO.		

Table 1-1 Summary of Closure and Reclamation Measures

Mine Site Feature (DDRP Section)	Closure and Reclamation Overview
Jewelbox Ore Body (Sec. 3.2.1)	• Seal the 1408 and 1250 portals. *Neither portal discharges*. • Re-slope to stabilze open pit walls; fill base of pit with coarse waste rock. • Re-contour waste rock dump; cap with 20 cm of clean material and revegetate where possible.
Main Zone Ore Body (Sec. 3.2.2)	• Seal 1380 portal; allow portal to infiltrate into waste rock dump. *The fate and potential environmental effects of portal discharge addressed in Section 3.6.3 of the DDRP.* • Re-slope to stabilze open pit walls; fill base of pit with coarse waste rock. • Re-contour waste rock dump; cap with 20 cm of clean material and revegetate where possible.
Burnick Ore Body (Sec. 3.3.3)	• Seal the 1200 portals (2) and 1300 portal. *No significant environmental effects predicted for drainage from the 1200 ventilation portal; the other two portals do not discharge.* • Re-contour 1200 and 1300 level waste rock dump; decompact and revegetate where possible.
Tailings Management Facility (Sec. 3.3)	• Drain and cap the North and South tailings ponds with a minimum of 50 cm of material and revegetate. • Drain and cap Reclaim Pond with a minimum of 50 cm of material *(in areas of elevated metal concentrations)* and revegetate. • Remove South Dam and Reclaim Dam. A small sediment retaining structure remains in place at the former South Dam to provide a barrier to any tailings migration. • Dismantle and remove or bury associated infrastructre (e.g., decanter tower, pipelines).
Camp Creek Diversion (Sec. 3.3.4.7(ii))	• Redirect Camp Creek back into its original channel. • Contour diversion to provide natural drainage.
Buildings and Infrastructure (Sec.3.4 and 3.5)	• Dismantle and salvage non-hazardous materials, or bury non-hazardous materials *in situ* or in the site landfill facility; remove hazardous materials from site in accordance with applicable regulations. • Cap, scarify, recontour and revegetate disturbed areas. • Remove North Creek dyke and culverts; re-contour and armour the drainage channel to stabilize.
Main Access Road, Site Access Roads and Trails (Sec. 3.7.1)	• Remove safety berms and culverts; scarify, decompact and recontour to promote natural revegetation. • Stabilize trails where required. • Place a gate at the mine entrance and signage to discourage public use.
General	• Risk manage hydrocarbon-contaminated areas: remove from or remediate contaminated soils in discrete areas (e.g., settling ponds) in accordance with applicable regulations. • Place signage in areas that have residual unstable rock faces or have the potential for surface subsidence. • Conduct Ecological Restoration through reclamation, and natural and active revegetation. • Risk manage areas with residual metal concentrations.

2.0 ENVIRONMENTAL MONITORING PROGRAM

Environmental Monitoring and Adaptive Management Planning are part of a comprehensive system of identifying and managing potential adverse effects through the post-reclamation phase of the SDH Mine. Post-reclamation environmental monitoring, physical/geotechnical inspections, and maintenance of constructed/engineered structures will be undertaken at the site in the post-closure period. Monitoring will also be prescribed in the terms of the amended WUL.

This section outlines the proposed post-reclamation monitoring and adaptive management framework for Surface Water Quality, Groundwater, Aquatic Resources, and Terrestrial Resources.

Table 2-1 presents the comprehensive monitoring schedule and summary of the various monitoring programs for the post-reclamation period.

Table 2-1: Summary of Proposed Post-Reclamation Monitoring Programs

Monitoring Program	Monitoring Locations	Timing	Summary	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
				Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10	Y11	Y12	Y13	Y14	Y15	Y16	Y17	Y18	Y19	Y20	Y21	Y22	Y23	Y24	Y25
Surface Water	MH-02, MH-04, MH-11, MH-12, MH-13, MH-15, MH-22, MH-29, MH-30, SDH-S2	BM – bimonthly S – Freshet (spring) and low flow (fall) A - low flow (fall)	Field measurements and laboratory analysis	BM	BM	S	S	S	A	A	A	A	A	-	A*	-	A*	-	A*	-	A*	_	A*	-	A*	-	A*	-
Groundwater	MW13-01, MW13-06, MW13-13	S – Freshet (spring) and low flow (fall) A - low flow (fall)	Field measurements and laboratory analysis	S	S	S	S	S	A	A	A	A	A	-	A*	-	A*	-	A*	-	A*	_	A*	-	A*	-	A*	-
	MW13-04, MW13-05, MW13-10, MW13-07	Low flow (fall)	Field measurements and laboratory analysis	A	A	A	A	-	A	-	A	-	A	-	A**	-	A**	-	A**	-	-	A**	-	-	A**	-	-	A**
	MW14-01, MW14-02, MW14-03, MW14-04	S – Freshet (spring) and low flow (fall) A - low flow (fall)	Field measurements and laboratory analysis	Q	Q	S	S	S	A	A	A	A	A	-	A**	-	A**	-	A**	-	-	A**	-	-	A**	-	-	A**
Aquatic Resources: Benthos/Sediment	MH-04, MH-11, MH-12, MH-13, MH-29, MH-30	Low flow (fall)	CABIN protocol field collection and laboratory taxonomy, laboratory analysis for sediments	A	-	A	-	A	-	-	-	-	A	-	-	-	-	-	A	-	-	-	-	-	A	-	-	-
Aquatic Resources: Fisheries	MH-30, MH-13	Low flow (fall)	Population and fish size	A	-	A	-	A	-	-	-	-	A	-	-	-	-	-	A	-	-	-	-	-	A	-	-	-
Terrestrial Resources: Revegetation Success	Specific locations where reclamation/re-vegetation occurred and other discrete locations.	Mid-summer	Seedling survival, height growth, germination success, composition, natural succession	A	A	A	A	A	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Terrestrial Resources: Metals Concentrations Monitoring	Specific locations where soil covers were applied and other discrete locations.	Mid to late summer	Monitoring of metals in soil and biota	-	-	-	-	-	-	-	-	-	A#	-	-	-	-	-	-	-	-	-	A#	-	-	-	-	-
Geotechnical	Relevant mine components.	Spring/early Summer	Geotechnical engineering inspections	A	A	A	A	A	A	A	A	A	A	-	-	-	-	A	-	-	-	-	A	-	-	-	-	A

Notes:

Y – Year; S - Semi-annual; A - Annual
** The data collected to Y10 will be evaluated to determine whether a reduction in monitoring frequency is appropriate.*
*** MH13-01, MW13-06 and MW13-13 will continue to be monitored after Year 10 as part of the Adaptive Management Plan; an evaluation will be conducted after Year 10 to determine whether the other wells will continue to be monitored.*
 # Timing of initial terrestrial metals concentrations monitoring to be confirmed based on revegetation success monitoring.

2.1. Surface Water

The Surface Water Quality Monitoring Program is a key monitoring program for the post-reclamation condition of the SDH mine site. Water quality monitoring has been conducted as a condition of the current Water Use Licence (WUL) since 1991. The ongoing monitoring has been used to identify existing mine sources that discharge water with elevated concentrations of zinc, cadmium and lead. These sources are:

- North Tailings Dam Seepage (MH-02);
- Burnick Portal (MH-22); and
- 1380 Portal (SDH-S2 as MH-25 has been decommissioned).

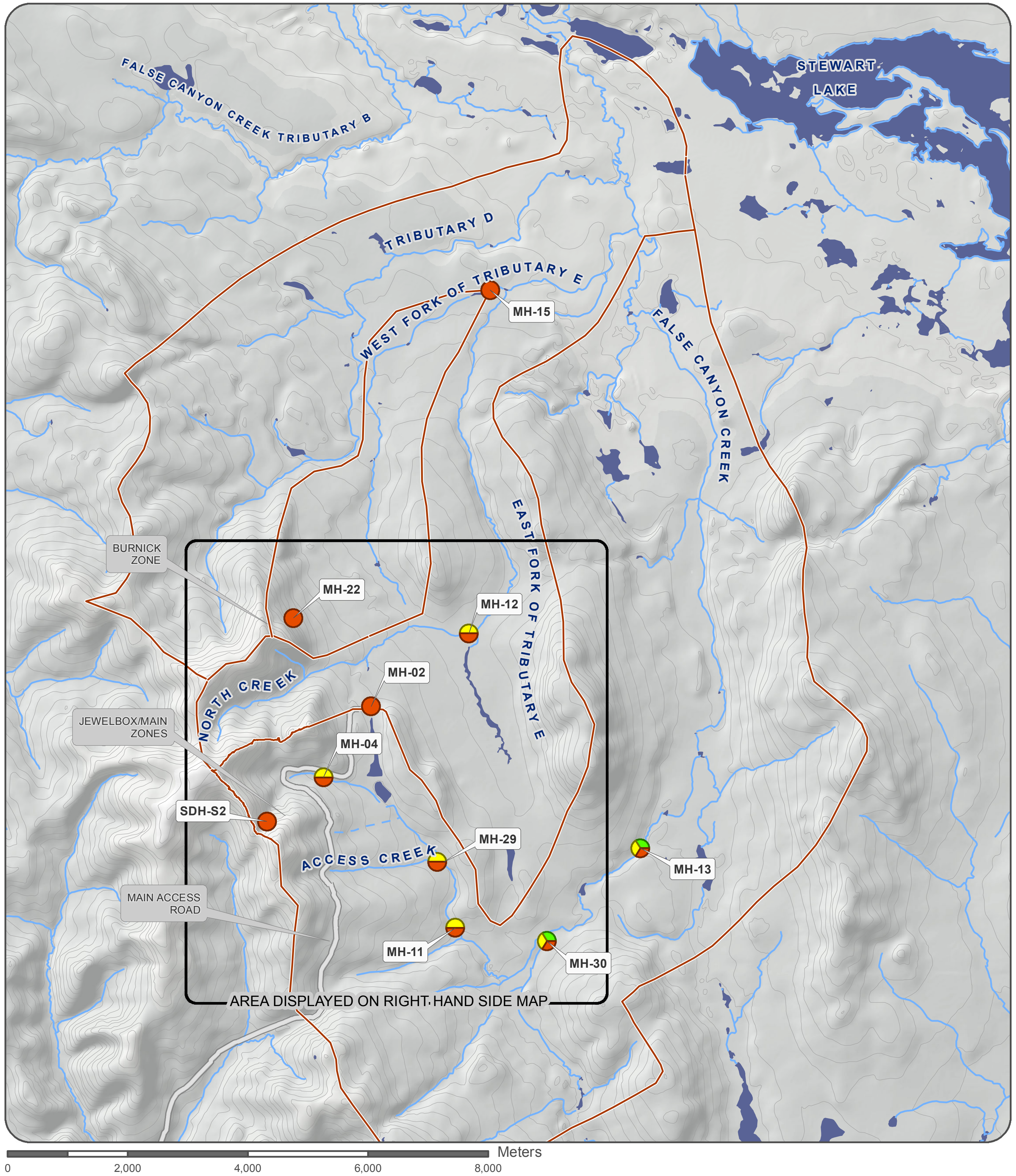
Discharge from both the 1380 Portal and Burnick Portal flow through the downgradient waste rock dumps, after which the flow infiltrates into the ground and is naturally attenuated. Groundwater from these sources ultimately discharges to False Canyon Creek.

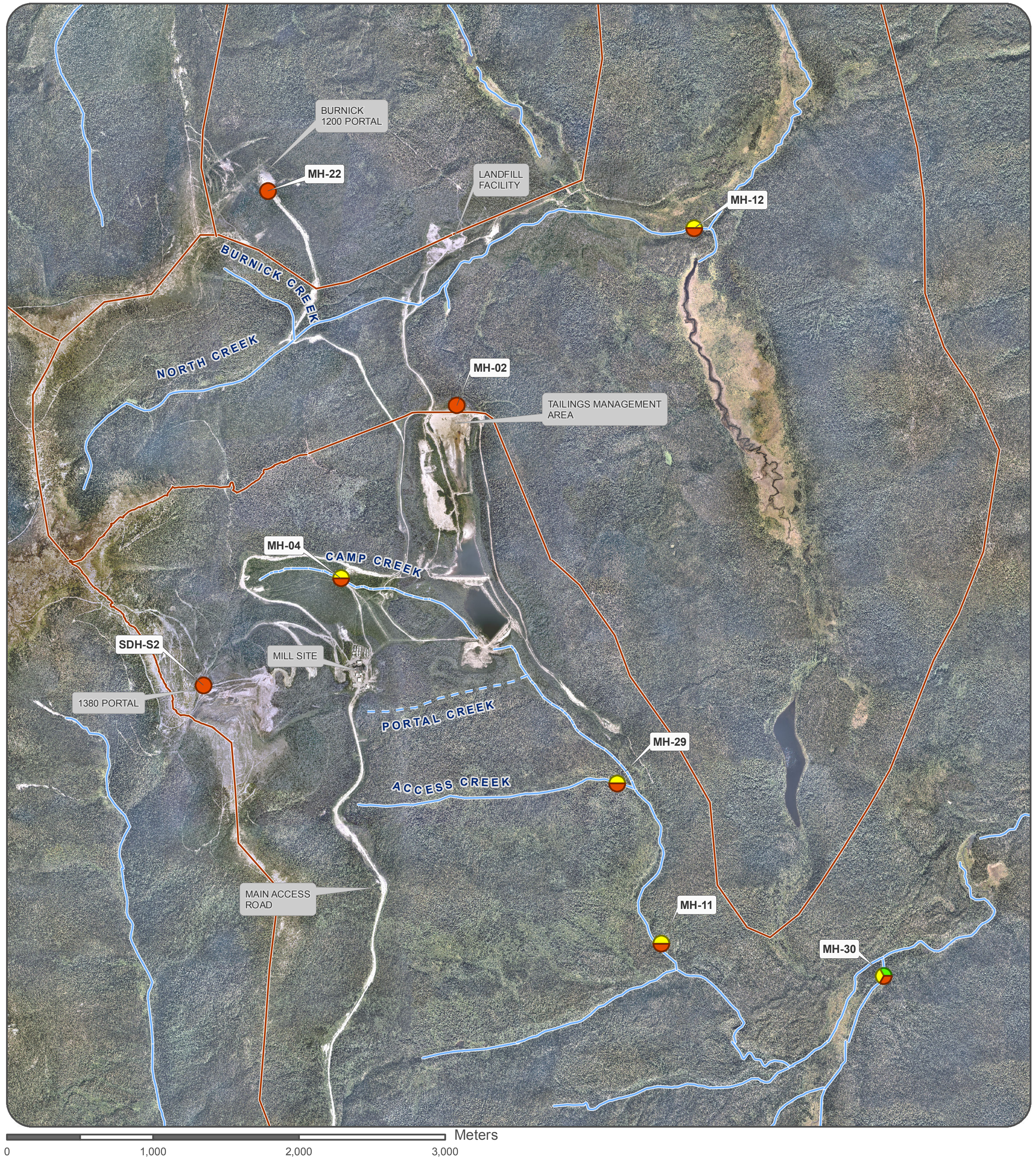
The surface water monitoring program includes monitoring of the discharge sources, downstream stations which are potentially influenced by mine discharge (compliance stations), and downstream reference stations which are not exposed to effluent. Figure 2-1 shows post-closure surface water sampling locations that will be routinely monitored. Table 2-2 lists coordinates and the purpose of the monitoring locations. Two of the ten stations are proposed compliance points (MH-11 and MH-12).

Table 2-2: Description of Water Quality Sampling Stations (from SRK, Water Quality Monitoring Plan, 2014)

Station Category	Station ID	Coordinates		Station Description
		Northing	Easting	
Compliance Point	MH-11	509460	6707788	Camp Creek located 2 km downstream of the Reclaim Pond (Upper False Canyon Creek)
	MH-12	509688	6712755	East Fork of Tributary E – of False Canyon Creek, approximately 2 km downstream of the north tailings dam
Discharge Source	MH-02	508060	6711477	North Dam seepage
	MH-22	506767	6712946	Burnick 1200 Portal discharge
	SDH-S2	506325	6709558	Drainage from the 1380 Portal, present as a seep in the downslope waste rock dump
Downstream Receiving Environment	MH-13	512541	6709113	False Canyon Creek main channel located 10 km downstream of the mine site
Reference Station	MH-04	507267	6710292	Located near the Camp Creek headwaters above the former Reclaim Pond
	MH-15	510041	6718408	West Fork of Tributary E
	MH-29	509146	6708895	Access Creek Upstream of Camp Creek
	MH-30	510985	6707568	Unnamed Tributary Upstream of False Canyon Creek

The proposed frequency is to sample bi-monthly in 2016-2017, semi-annual in 2018-2020, annual from 2021-2025 and every other year from 2026-2040. If Teck can show that the reclamation works at the site have stabilized and that sediment mobilization from the site has been mitigated, Teck will recommend that monitoring move to the proposed bi-annual (freshet and low-flow fall) frequency presented in Table 2-1 above.





National Topographic Data Base (NTDB) compiled by Natural Resources Canada at a scale of 1:50,000. Cadastral data compiled by Natural Resources Canada. Reproduced underlicense from Her Majesty the Queen in Right of Canada, Department of Natural Resources Canada. All rights reserved.

Datum: NAD 83; Map Projection: UTM Zone 9N

Post-Reclamation Monitoring Stations

- Fisheries Monitoring
- Benthos/Sediment Monitoring
- Surface Water Quality Monitoring

— Catchments Boundaries

Teck

ACCESS

SÃ DENA HES MINE
POST- RECLAMATION PHASE WATER LICENSE APPLICATION

FIGURE 2-1
POST-RECLAMATION SURFACE WATER MONITORING STATIONS

JULY 2015

I:\Sa_Dena_Hes\GIS\Maps\02-Permitting\04-Closure WUL 2015\Fig-5-1_Post_Reclamation_MonitoringProgram_20150708.mxd (Last edited by: mducharme;7/8/2015/14:09 PM)

2.2. Groundwater Monitoring Program

There are three post-reclamation groundwater monitoring programs for SDH: the first is designed to monitor downgradient of mine-influenced loading sources and is linked to the AMP (Appendix A), the second is designed to monitor areas where soil contamination has been identified as part of the Contaminated Site Assessment process (Appendix B), and the third is to monitor the landfill area. The wells listed in Table 2-3 and shown in Figure 2-2 will be monitored during the post-reclamation phase for both programs.

Table 2-3: Groundwater Monitoring Wells

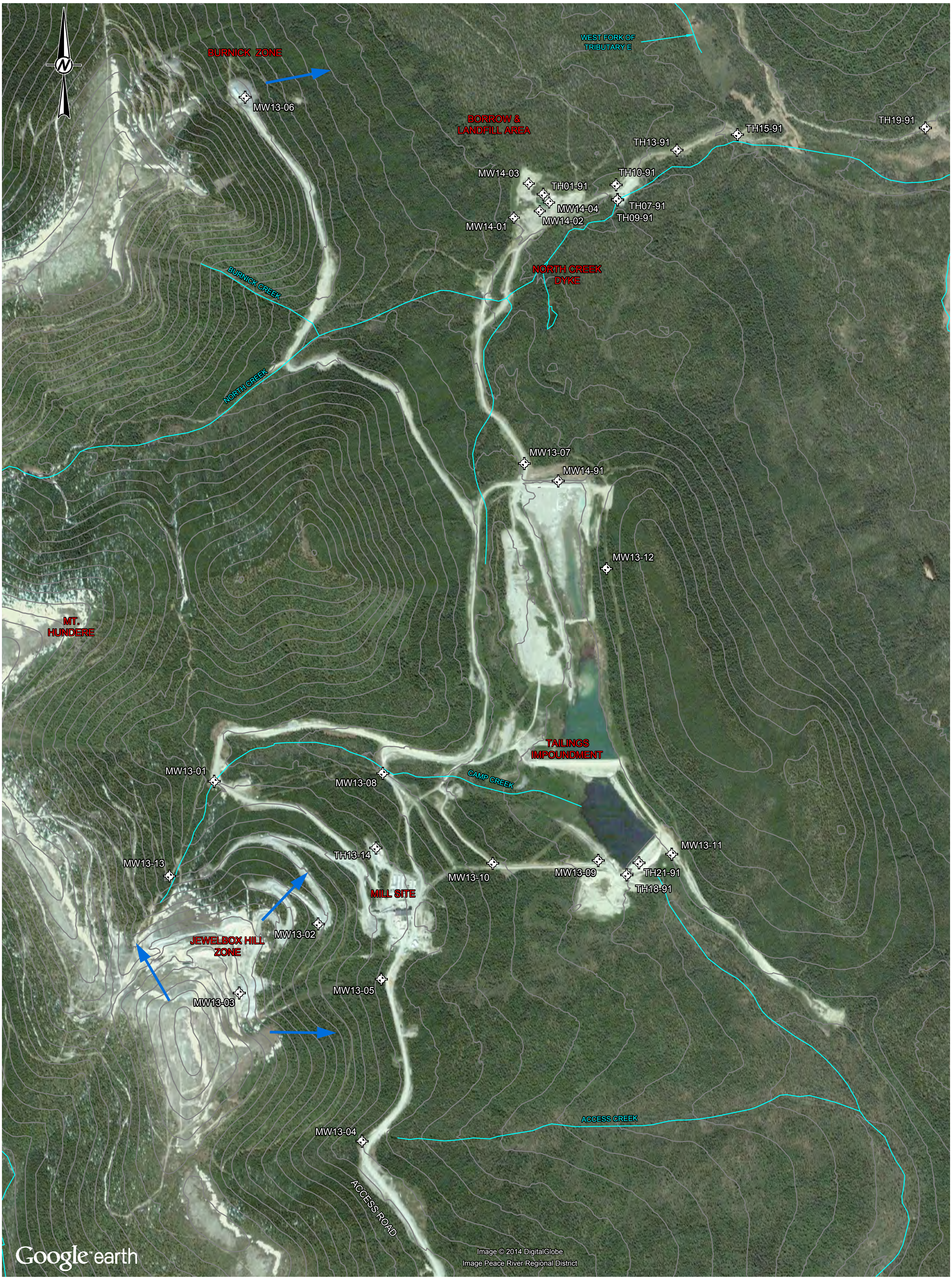
Station ID	Station Description	Purpose
MW13-01	Jewelbox/Main Zone – in 1380 Gully, downgradient of 1380 Portal.	To monitor groundwater flow and quality from Jewelbox/Main Zone towards Camp Creek.
MW13-04	Main Access Road	Background reference well
MW13-05	Main Access Road – south of the Mill Site on the Main Access Road.	To monitor groundwater flow and quality from Jewelbox/ Main Zone.
MW13-06	Burnick 1200 Portal	To monitor groundwater flow and quality from Burnick Zone.
MW13-07	North Dam – north of the North Dam and tailings pond area.	To monitor groundwater flow and quality from the tailings pond area.
MW13-10	Mill site - northeast of the Mill Site	To monitor groundwater flow and quality from the Mill Site and Jewelbox/ Main Zone.
MW13-13	Downgradient of 1380 Portal	To monitor groundwater flow and quality from Jewelbox/Main Zone towards Camp Creek
MW14-01	In proximity to the landfill.	To monitor groundwater flow from the landfill.
MW14-02	In proximity to the landfill.	To monitor groundwater flow from the landfill.
MW14-03	In proximity to the landfill.	To monitor groundwater flow from the landfill.
MW14-04	In proximity to the landfill.	To monitor groundwater flow from the landfill.

The frequency of the monitoring and sampling is shown in Table 2-1. In summary, monitoring wells MW13-01, MW13-06 and MW13-13 will be sampled and analyzed semi-annually for five years (i.e., 2020) then reducing the monitoring to annually for the following 5 years. The monitoring is consistent with the proposed surface water monitoring schedule and will better assist in evaluating to the data.

The landfill monitoring program was developed in response to Compliance Monitoring and Inspections (CMI) request for an adequate plan to ensure the bottom of the SDH landfill cells are not within 3 m of groundwater as part of Waste Management Permit 81-020. The monitoring plan was provided to CMI on Nov. 18, 2015. The plan includes monitoring the water table elevation and water quality in the monitoring wells within the landfill quarterly for two years and then semi-annually for the next three years (i.e., 2020) and then reduce to annually for five years. In 2025, the 10 years of data will be evaluated to determine whether a further reduction in monitoring frequency is appropriate.

Samples from monitoring wells MW13-01, MW13-04, MW13-05, MW13-06, MW13-10 will be sampled and analyzed annually for hydrocarbons, dissolved metals, and anions. Samples from MW13-07 and MW13-13 will be analyzed for dissolved metals and anions. Groundwater samples from the landfill wells will be analyzed for hydrocarbons, dissolved metals, nutrients and anions.

\\golder.gds\gal\Burnaby\CAD-GIS\Bur-Graphics\Projects\2012\1021\12-1021-0006\CAD_Phase 7000\1210210006-7000-01.dwg | Layout: 1210210006-7000-01 | Modified: RYJames 01/14/2015 10:44 AM | Plotted: RYJames 01/14/2015



LEGEND

SDH MW WELL LOCATION

INFERRED GROUNDWATER FLOW DIRECTION FROM JEWELBOX AND BURNICK

CONTOURS (20m INTERVAL)

REFERENCE

All units are in metres unless otherwise noted.
Base imagery obtained from Google Earth Pro under licence.
Google Earth Imagery date June 12th, 2006.
Google Earth Image is to be used for surrounding detail reference only.
Datum: NAD 83 Projection: UTM Zone 9

0 300 600 900
SCALE METRES

PROJECT
TECK METALS
SA DENA HES HYDROGEOLOGICAL ASSESSMENT
SA DENA HES MINE, YUKON TERRITORY

TITLE
MONITORING WELL & TESTHOLE LOCATIONS

PROJECT No.	12-1021-0006-7000		FILE No.	1210210006-7000-01
DESIGN	TR	2013-12-03	SCALE	AS SHOWN
CADD	LYT	2013-12-03	FIGURE	
CHECK	TR	2014-03-24		Figure 2-2
REVIEW	HG	2014-03-24		

Golder Associates

2.3. Aquatic Resources Monitoring Program

Monitoring of aquatic biological resources and stream sediments has been ongoing in the SDH study area in various forms since the initial baseline biophysical resource characterization work prior to development of the mine. Teck proposes to continue the monitoring of these conditions in the post-reclamation period to provide context to the ongoing water quality results and to provide additional comparison points for the ongoing evaluation of the potential for effects to aquatic resources. The monitoring programs for these resources have been modified to focus on the potential for effects nearer to the mine – as opposed to the very far downstream stations that have been monitored historically. Should triggering of AMP thresholds warrant a re-evaluation of this network or the program frequencies, this can be conducted.

2.3.1. Stream Sediment Quality Monitoring

Monitoring of stream sediment quality will be conducted at the same time and same frequency as the benthic community monitoring – in the fall in low flow conditions. Harmonized monitoring of these programs will allow for more meaningful interpretation of results, and sediment quality is a key link between water column contaminant concentrations and benthic community health.

The sample locations include the compliance locations (MH-11 and MH-12), AMP indicator stations (MH-04, MH-13) and reference stations (MH-29 and MH-30). The proposed methodology for conducting stream sediment quality monitoring is presented in Appendix C.

2.3.2. Fisheries Monitoring

Monitoring of fisheries resources will be conducted in the fall, which is when fish have historically been observed the highest up in the receiving environment watercourses, and individuals are developed to a size which allows for on the same frequency and timing as the benthic and sediment monitoring programs.

The proposed methodology for conducting fisheries monitoring is presented in Appendix C. The fisheries monitoring will be conducted at MH-13 and reference location MH-30.

2.3.3. Benthic Invertebrate Monitoring

Monitoring of benthic invertebrate communities will be conducted at the standard collection time – in the fall in low flow conditions. This ensures that organisms are developed sufficiently to effectively identify to appropriate taxonomic levels.

The sampling frequency for the monitoring of benthic invertebrate communities will follow the same frequency as the current licence monitoring program (every two years, even years) until 2020, at which point it will reduce to be conducted in 2025 (Y10) to coincide with the last annual surface water sampling event. The sampling would then be conducted every 6 years for the duration of the licenced monitoring period such that monitoring of benthic invertebrate communities will always be conducted in a year during which water quality monitoring is conducted. Harmonized monitoring of these programs will allow for more meaningful interpretation of results.

The proposed methodology for conducting benthic invertebrate sampling is presented in Appendix C.

2.4. Terrestrial Monitoring Program

2.4.1. Reclamation/Re-vegetation Success Monitoring

Assessments of the revegetation program will be conducted in midsummer for a minimum of five years. The main focus of the monitoring will be to ensure that the prescriptions applied to the disturbed sites on the mine are successful. During the assessments, assessments will be made on seedling survival and height growth, seeded germination success, composition and natural succession.

There are three main areas that have been seeded with a native seed mixture; Jewelbox waste dump, Burnick 1200 waste dump, and the decommisioned access roads. Overall assessments will be conducted at the waste dumps and permanent vegetation plots will be established. Jewelbox covers the largest area, approximately 8.2 ha, and it is proposed to set up three 5m x 5m plots here to represent the overall area plus the various aspects. One will also be established at Burnick 1200. Vegetative cover, seeded species composition, natural colonization of other species, UTM coordinates, aspect, elevation, and photographs will be taken at each plot. The decommissioned roads will be flown to assess the success of the seeding program.

All the areas planted with tree seedlings in the summer season of 2015 will be assessed. A total of 14 permanent monitoring plots were established throughout the planting areas and each one will be assessed following Forestry protocols. Specifically survival rates, height growth, plant health indications, species composition, ground cover and general observations (soil conditions, browse sign, etc.) will be noted. Photographs will be taken for further documentation. Maintenance will be undertaken at the plots where required, i.e. stake dislodgement, relabeling, reflagging, etc. In addition, overall observations will be made at each of the areas to determine areas of stress, healthy growth, natural succession, productivity, animal and bird usage, etc.

Analysis for metals uptake will be conducted as per the Terrestrial Effects Monitoring (below).

2.4.2. Terrestrial Effects Monitoring

Remediation of the mill site and tailings management facility conducted will decrease contaminant exposure for wildlife using the property. To confirm that the contaminant pathway has been cut and exposure has been reduced or eliminated in these areas, concentrations of metals in soil and various biota tissues will be monitored periodically to confirm risk predictions. The monitoring requirements including sampling locations, parameters, and monitoring frequency are included in *Sa Dena Hes Mine Site Long-term Monitoring Plan for Terrestrial Environment Related to Human Health and Ecological Risks, dated June 27, 2016* prepared by Azimuth Consulting (Appendix D).

2.4.3. Invasive Plant Species Monitoring Program

Throughout the revegetation assessment any invasive plants will be identified and recorded following the protocols as set out by the Yukon Invasive Species Council's Spotter's Network. Early detection and rapid response are the best defense against the spread of invasive species.

Depending on the invasive species identified and the extent of the growth, immediate action while on site may be taken. Otherwise a plan will be drawn up accordingly.

3.0 PHYSICAL MONITORING PROGRAM

Physical/geotechnical inspections and maintenance of constructed/engineered structures remaining at the site will be conducted throughout the post-closure phase. Geotechnical monitoring, inspections and maintenance is outlined in Appendix E. The focus of the inspections include the North Dam, the Sediment retaining structure (SRS) and spillway, soil covers, diversions and waste rock dumps.

Additionally, the Main Access Road will be routinely inspected and maintained for four-wheel drive access until it is decommissioned. Maintenance activities may include: debris removal, drainage re-establishment, embankment re-stabilization, surface compaction, and general culvert maintenance (debris removal, bank re-stabilization, erosion and sediment control, etc.).

Land use monitoring will also include sign inspection and observation of human access.

4.0 DATA EVALUATION AND REPORTING

EMSRP data evaluation and reporting will be conducted in accordance with the WUL and QML.

The QML Annual Report will include:

- a summary of decommissioning and reclamation activities undertaken;
- a summary of decommissioning and reclamation activities planned for the upcoming year;
- the effectiveness of the remediation measures implemented;
- a map showing the status of all decommissioning and reclamation activities;
- details respecting any action taken as a result of the recommendations made by the engineer in relation to the inspection referred to in 11.2 of QML -0004;
- a summary of the programs undertaken for environmental monitoring and surveillance, including an analysis of data and any action taken or adaptive management strategies implemented to monitor or address any changes in environmental performance;
- a summary of invasive plants that have been identified on site and measures taken to control or remove invasive plants;
- a summary of spills and accidents that occurred at the site and measures taken to respond to any spills or accidents;
- a summary of wildlife incidents and other accidents, and any upgrade or maintenance
- work planned for the upcoming year; and
- a summary of any site improvements undertaken to address sediment and erosion control.

The Adaptive Management Plan (AMP) (ACG, 2016) is also a critical component for evaluating and responding to emerging or changing conditions on site. Receiving environment surface water quality, mine source water, groundwater quantity and quality, physical stability and soil covers are the AMP components that have been identified as having the potential for unexpected conditions during the post-reclamation period for which the DDRP may not provide adequate mitigation against potential effects to the environment or human health and safety.

All data collected in the previous year is submitted to the Yukon Government, Energy, Mines and Resources Branch and to the Yukon Water Board as a single report by March 31st of the following year.

5.0 RECLAMATION LIABILITY COST ESTIMATES

The estimate of costs to conduct the post closure management of the site is based on the following:

- to decommission the Site Access Road; and
- to undertake post-reclamation monitoring and adaptive management, inspections and maintenance of constructed/engineered structures.

At this time is it unclear if the Main Access Road will be required to be decommissioned or if it is considered a public road. As such, the estimated cost to decommission the Main Access Road is not included within the cost estimate table. However, if the road were to be decommissioned, the additional estimated cost is $3,850,000.

Table 5-1 Sa Dena Hes Mine - Estimated Post Closure Site Management (2016- 2040)

Post Closure Maintenance and Reclamation	Units	Quantity	Unit Cost	Cost
Site stabilization / revegetation	Lump sum	2	$ 50,000	$ 100,000
Geotechnical upgrades	Lump sum	1	$ 130,000	$ 130,000
Misc. maintenance	per event	5	$ 10,000	$ 50,000
Fertilization for revegetation areas	per event	3	$ 15,000	$ 45,000
Invasive Plant Management/Control	per event	3	$ 10,000	$ 30,000
Subtotal				**$ 355,000**
Road Decommissioning				
Site Access Road	Lump sum	1	$ 630,000	$ 630,000
Subtotal				**$ 630,000**
Compliance Monitoring and Reporting				
Water Quality monitoring and reporting (analytical, collection, heli./travel)	per event	30	$ 30,000	$ 900,000
Aquatic Resource monitoring	per event	6	$ 60,000	$ 360,000
Geotechnical Dam inspections and cover performance monitoring	per event	13	$ 35,000	$ 455,000
Revegetation assessments	per event	5	$ 25,000	$ 125,000
Terrestrial Ecological Risk Assessment monitoring	per event	2	$ 100,000	$ 200,000
Subtotal				**$ 2,040,000**
Site Management				
Staff site management, reporting, documentation	Yearly	25	$ 30,000	$ 750,000
Local site caretaker	Yearly	25	$ 10,000	$ 250,000
Subtotal				**$ 1,000,000**
TOTAL COST FORECAST				**$ 4,025,000**

6.0 REFERENCES

Access Consulting Group, 2016, Sä Dena Hes Mine Post-Reclamation Adaptive Management Plan,

SRK Consulting, 2014, Sä Dena Hes Mine Post-Reclamation Water Quality Monitoring Plan,

YG Energy, Mines & Resources, 2006, Yukon Mine Site Closure and Reclamation Policy

APPENDIX A

Adaptive Management Plan, Sa Dena Hes Mine – Draft (SRK, 2014)

Adaptive Management Plan, Sä Dena Hes Mine - DRAFT

Prepared for

Teck Resources Ltd.

Prepared by

SRK Consulting (Canada) Inc.
1CT008.043
October 2014

Adaptive Management Plan, Sä Dena Hes Mine - DRAFT

October 2014

Prepared for

Dormant Properties
Teck Resources Ltd.
601 Knighton Road
Kimberley, BC V1O 1C7

Tel: +1 250 427 8423
Web: www.teck.com

Prepared by

SRK Consulting (Canada) Inc.
2200–1066 West Hastings Street
Vancouver, BC V6E 3X2
Canada

Tel: +1 604 681 4196
Web: www.srk.com

Project No: 1CT008.043

File Name: Adaptive_Management_Plan_1CT008_043_DRAFT_LC_LB_TRS_20141023

Table of Contents

1 Introduction 1
1.1 Regulatory Context 1
1.2 Problem Statement 1
1.3 Purpose 2
1.4 Approach 2
1.5 Implementation Process 3
1.6 Annual Reporting 3
2 Adaptive Management Plan 7
2.1 Description of AMP Loading Sources and Flow Paths 7
2.1.1 North Dam Seepage 7
2.1.2 Burnick Portal Discharge 8
2.1.3 1380 Portal Discharge 9
2.2 Indicator Parameters 10
2.3 Thresholds 10
2.4 Evaluation of Monitoring Results 11
2.4.1 Level 1 11
2.4.2 Level 2 11
2.5 Response and Actions 11
2.5.1 Verification of Data 12
2.5.2 Investigate Nature and Extent of the Threshold Exceedance 12
2.5.3 Revise Water Quality Predictions 14
2.5.4 Mitigation Options Assessment 14
2.5.5 Implement Mitigation 14
3 Conclusion 14
4 References 16

List of Figures

Figure 1: Monitoring Locations 4

Figure 2: Relationship between Water Quality Monitoring Plan and Adaptive Management Plan 5

Figure 3: Conceptual Loading Diagram 6

Figure 4: Framework of Escalating Responses and Actions 13

List of Attachments

Attachment 1: Sä Dena Hes Mine Post-Reclamation Water Quality Environmental Monitoring Plan

List of Abbreviations

AMP	Adaptive Management Plan
CCME	Canadian Council of Ministers of the Environment
WQMP	Water Quality Monitoring Plan
M-K	Mann-Kendall
SDH	Sä Dena Hes Mine
SWQO	Site Water Quality Objective
TDS	Total Dissolved Solids
USEPA	United States Environmental Protection Agency
WUL	Water Use Licence

1 Introduction

The Sä Dena Hes lead/zinc mine (SDH) operated from 1991 to 1992 and is currently owned by Teck Resources Limited and Korea Zinc. The mine was in care and maintenance from 1992 to 2013. Permanent closure of the mine is currently underway in 2014 and 2015. Closure activities completed in the summer of 2014 include demolishing of the mill and other site buildings, backfilling of portals, removing the South Dam and Reclaim Dams, reconstructing a portion of the Camp Creek channel and selectively covering portions of the site. Work in 2015 includes decommissioning site roads, final resloping and capping, and revegetation. Following reclamation, the site will be monitored to ensure objectives have been met.

1.1 Regulatory Context

Operation and closure of the site is authorized by a Quartz Mining Licence issued by the Yukon Department of Energy, Mines and Resources. The Quartz Mining Licence expires December 31, 2015. A Detailed Decommissioning Reclamation Plan (Teck 2013) describes closure objectives and activities.

Water use and discharge is regulated by the Yukon Territory Water Board under the Water Use Licence (WUL) QZ99-045, which expires on December 31, 2015. Water quality and flow have been monitored according to the licence since 1991. The licence requires monthly data reports and an annual report. The most recent annual report was submitted to the Yukon Water Board in April 2014 (SRK 2014a).

A WUL will continue to govern water discharge after closure. The application for a new licence or renewal of the existing WUL will include this adaptive management plan (AMP) and a water quality monitoring plan (WQMP). The WQMP for surface water and groundwater is presented in Attachment 1. Biological monitoring of the site will also occur and is described in the YESAB Project Proposal for Post-Reclamation Activities, in Section 7 (Access, 2014)

The AMP and WQMP are companion documents. The WQMP describes the monitoring locations, frequency, and parameters for the post-reclamation WUL application. Monitoring locations for the WQMP and referenced in the AMP are shown on Figure 1. The WQMP provides the data necessary for evaluating if water quality conditions are changing. The AMP describes how these data are evaluated, thresholds that trigger additional action, potential management actions and reporting requirements for the AMP. The connection between the WQMP and the AMP is presented in Figure 2.

1.2 Problem Statement

Water quality monitoring has been conducted as a condition of the current water licence since 1991. The ongoing monitoring dataset has been used to identify existing loading sources that discharge water with elevated concentrations of zinc, cadmium, and lead. These sources are:

- North Tailings Dam Seepage (MH-02)

- Burnick Portal (MH-22)
- 1380 Portal (MH-25)

Figure 3 is a conceptual loading diagram for each of these sources, including flow paths, attenuation mechanisms and AMP water quality monitoring stations. Water from these sources infiltrates to groundwater near the source and then migrates downgradient as groundwater to areas of groundwater discharge (i.e., surface water features). Discharge from both the 1380 Portal and the Burnick Portal drainage flow through the downgradient waste rock dumps, after which the flow infiltrates into the ground. Monthly and quarterly water quality monitoring results currently meet the effluent quality limits in the WUL at the receiving water bodies (Camp Creek, False Canyon Creek, and Tributary E).

SRK conducted previous investigations (SRK 2014b) that demonstrated that the loads (mass per time or kg/day) of dissolved zinc, cadmium, and lead from the Burnick and 1380 portals are not observed at the downstream monitoring locations, indicating that these loads are attenuated along the migration pathway or have not yet arrived at the monitoring location. Additional information about the attenuation mechanisms and water quality predictions is provided in the Water Quality Loading Assessment report (SRK 2014b).

Drainage from all three loading sources travels as groundwater ultimately discharging to False Canyon Creek. Consequently, the rate at which surface water concentrations change is a function of reactive transport along the groundwater flowpath. Any potential concentration increase in the receiving waters would be gradual and would depend on many factors, including mixing with other groundwater, dispersion, attenuation, the subsequent consumption of attenuation capacity, and the travel time between the source and discharge locations. The lag time between the initial increase in concentration and the maximum predicted concentration could be tens to hundreds of years (SRK 2014b).

1.3 Purpose

Surface water quality will be monitored after reclamation to observe any potential changes indicative of indicative of loading from the North Dam, Burnick Portal and 1380 Portal. The objective of the AMP is to detect changes from existing conditions and ensure that water quality does not exceed post-reclamation WUL limits.

1.4 Approach

Site water quality has remained relatively constant over the last twenty years and is expected to remain the same as in the past. The AMP is a tool to identify changes in water quality from current and historical conditions. It provides a framework describing the process to identify, evaluate, and manage/mitigate potential changes to water quality. If water quality changes from current conditions, the AMP describes the process for developing a plan to understand why the change has occurred and how it may be addressed.

Monitoring data is collected and evaluated relative to prescribed thresholds to assess if additional action is warranted. Changes in water quality that exceed thresholds trigger action as described in Section 2.

The general method and objectives are the same for the three potential loading sources (North Dam seepage, Burnick Portal discharge and 1380 Portal discharge), and is described as follows:

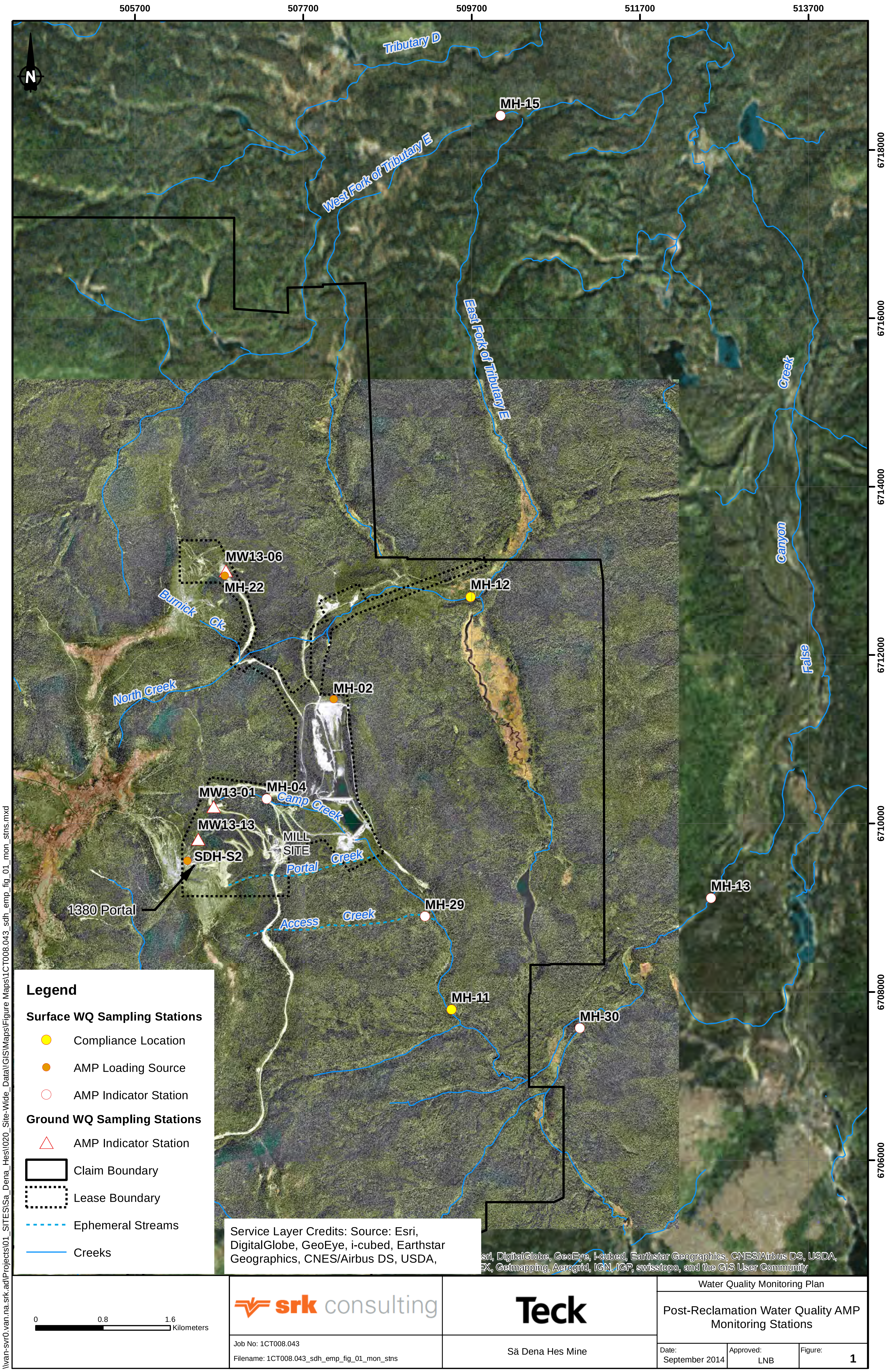
1. Description of AMP Loading Sources and Objectives of the AMP monitoring (developed from the conceptual model for each source),
2. Identification of specific indicators to be monitored,
3. Establishing thresholds for triggering action,
4. Evaluation of monitoring results, and
5. Description of a framework for escalating response if thresholds are exceeded.

1.5 Implementation Process

This AMP will be in effect for the duration of the post-reclamation water licence. It is a living document and can be revised as additional data and information become available over time. The AMP was prepared in support of the application to renew the water licence. It is anticipated that the AMP will be revised to incorporate other relevant permit requirements as the regulatory process proceeds to the water use licensing phase.

1.6 Annual Reporting

Reporting of the results of the WQMP monitoring and interpretation and recommendations from the AMP will be included in the annual report, submitted to the Water Board each March.



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Sä Dena Hes Mine

Water Quality Monitoring Plan

Post-Reclamation Water Quality AMP Monitoring Stations

Date:	Approved:	Figure:
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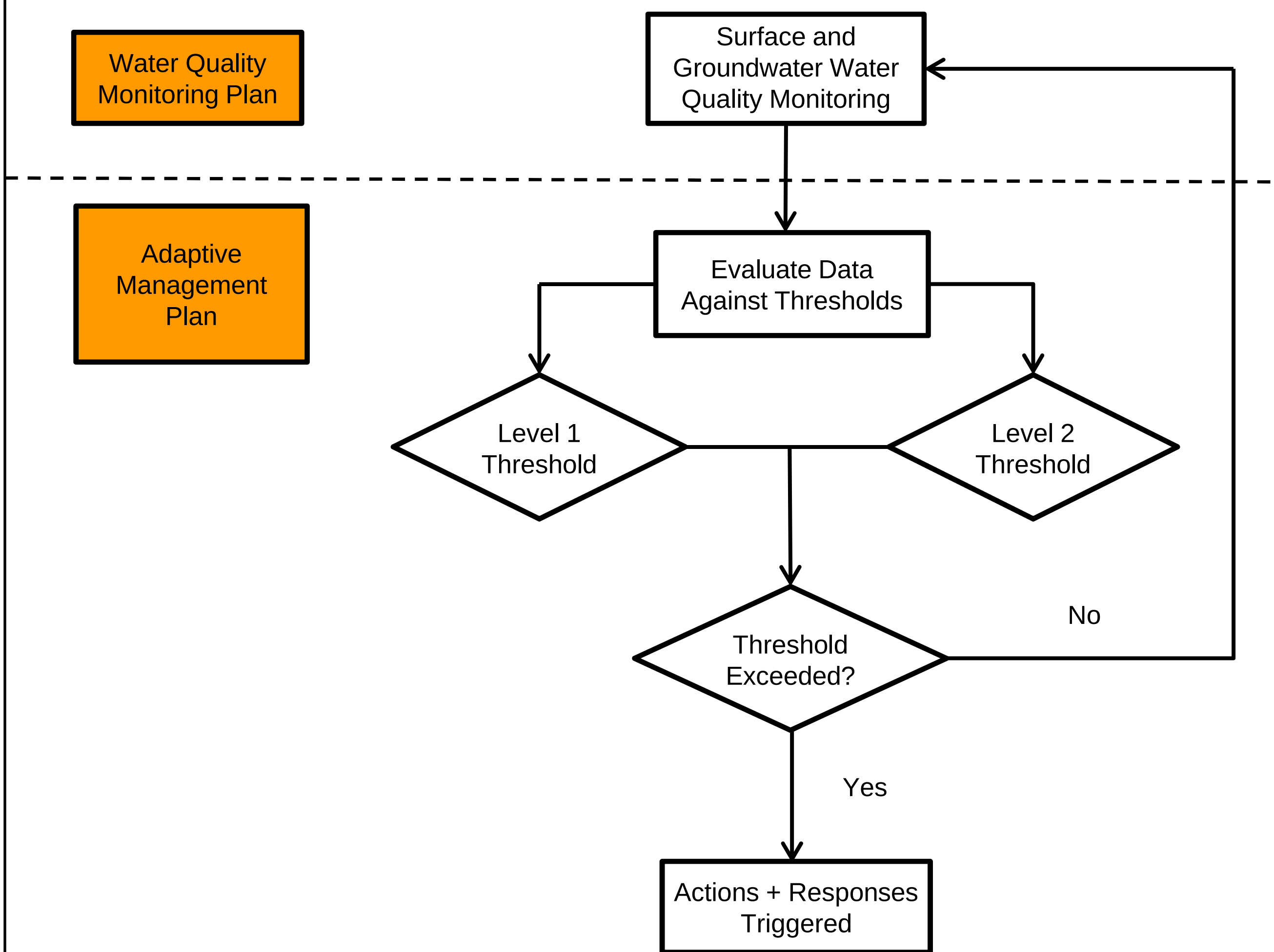
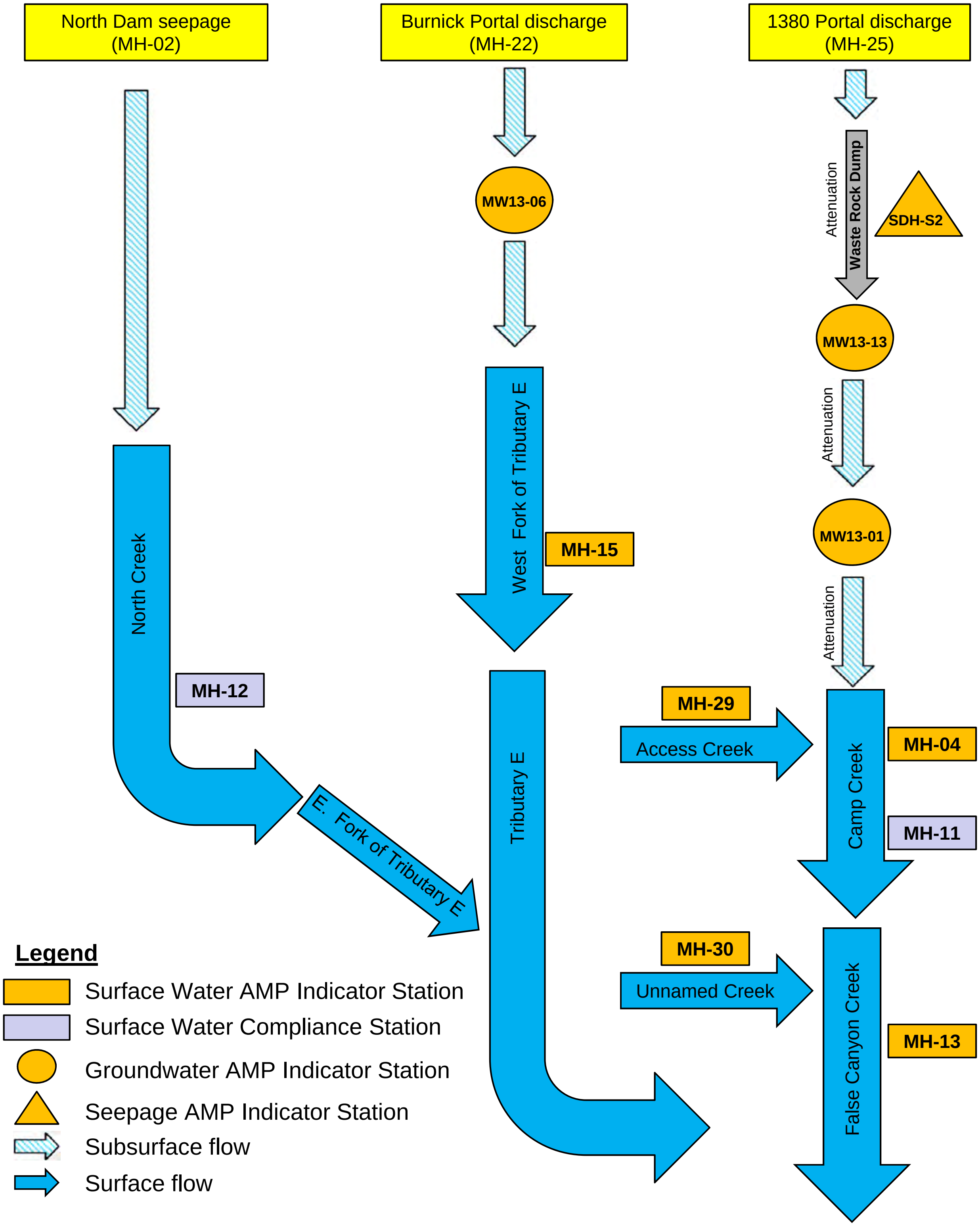


srk consulting	Teck	**Adaptive Management Plan**
		Relationship between Water Quality Monitoring Plan and AMP
Job No: 1CT008.043 Filename: AdaptiveManagementPlanFigures_1CT008.043_Rev01_LMC_LNB.pptx	Sä Dena Hes	Date: October 2014 / Approved: LNB / Figure: **2**



srk consulting	Teck	Adaptive Management Plan Conceptual Loading Diagram
Job No: 1CT008.043 Filename: AdaptiveManagementPlanFigures_1CT008.043_Rev01_LMC_LNB.pptx	Sä Dena Hes	Date: Sept 26, 2014 · Approved: LNB · Figure: 3

2 Adaptive Management Plan

As discussed in Section 1.2, the AMP applies to three loading sources from the mine site, specifically:

- North Dam Seepage (MH-02)
- Burnick Portal (MH-22)
- 1380 Portal (MH-25)

2.1 Description of AMP Loading Sources and Flow Paths

Loading from each of the three mine site loading sources (North Dam Seepage, Burnick Portal and 1380 Portal) could increase mining related constituent concentrations. Currently geochemical attenuation, groundwater transport and mixing with other surface water and groundwater limit these potential changes. This section describes each loading source, the geochemical conceptual model and the drainage/seepage flow path.

2.1.1 North Dam Seepage

During operations, most tailings were discharged to the North Tailings Pond. Currently, there is no ponded water in the pond, but the tailings are saturated at depth. There is seepage from the toe of the North Dam, which is routinely monitored at MH-02 as required by the WUL. The seepage at MH-02 is tailings porewater that has been diluted by groundwater from the valley sides and runoff from the North Dam face (SRK 2000). The seepage quality at MH-02 is routinely in compliance for all WUL parameters.

Seepage from the North Tailings Dam flows throughout the entire year. Flow at MH-02 is highest during freshet and lowest during the winter. The seepage flows aboveground for a short distance from the North Dam before infiltrating the ground. It then flows as groundwater before discharging to North Creek and the headwaters of the East Fork of Tributary E. From the East Fork of Tributary E, the water flows to Tributary E and then to False Canyon Creek (Figure 1 and Figure 3).

Metal attenuation along this pathway has not been evaluated. The flowpath is relatively short compared to the groundwater pathways downgradient of the Burnick Portal and 1380 Portal. For the purposes of the post-reclamation water quality predictions, it was conservatively assumed that the entire constituent load from the seepage discharges to North Creek above MH-12 and that there was no attenuation of metals by the soil (SRK 2014b).

Specific Issues

The objective of the AMP for the North Dam seepage is to detect any deterioration in water quality in the tailings dam seepage and manage and mitigate these changes before any effects are observed in the downstream receiving surface waters. AMP monitoring locations include tailings seepage monitoring at MH-02 located at the toe of the dam and surface water monitoring station MH-12 in North Creek.

Monitoring MH-02 would detect any changes in water quality proximal to the loading source. Downstream of these stations, tailings seepage flows as groundwater. Any potential change in surface water quality in the receiving waters would therefore be a function of groundwater reactive transport. Any water quality changes are expected to be slow and would be detected by monitoring over multiple years for a statistically significant increasing trend.

2.1.2 Burnick Portal Discharge

The Burnick Portal is located 3 km from the SDH mill and was constructed to access the Burnick Zone ore body. There are two portals (1200 and 1300) at the Burnick Zone. The lower portal previously discharged continuously and has been routinely monitored during temporary closure at MH-22 as part of WUL QZ99-045. Now discharge from MH-22 is ephemeral (June to November). The discharge water quality exceeds the WUL limits for zinc during low flow months.

MH-22 discharge flows through a buried culvert, cascades over the crest of the Burnick waste rock dump, and then infiltrates under the waste rock dump. It then flows downgradient to the east-northeast as groundwater) to the headwaters of the West Fork of Tributary E, which is more than 1.5 km downgradient of the portal (Figure 1). The headwaters of the West Fork of Tributary E are marshy and channeled surface flow is intermittent. Surface water flows to the east-northeast from the West Fork of Tributary E to Tributary E and then to False Canyon Creek. There is currently no evidence that the zinc load from the Burnick Portal is observed in Tributary E or False Canyon Creek (SRK 2005). From this observation, SRK concluded zinc is attenuated through extensive contact with the soils between the Burnick Portal and the West Fork of Tributary E.

Column experiments using discharge from the Burnick Portal and downstream soils were used to evaluate the attenuation mechanism (SRK 2005). The testwork concluded that downgradient soils have the potential to significantly attenuate zinc concentrations at the levels observed in the discharge for much longer than 200 years. Column tests showed the attenuation capacity was not exhausted and no secondary minerals were formed. The studies confirmed that zinc is passively removed by contact with downgradient soils.

Because the zinc attenuation mechanism has more than 200 years of capacity, the attenuation capacity of the soils was considered to last for the duration of the licenced post-reclamation period.

Specific Issues

The objective of the AMP for the Burnick Portal discharge is to detect any deterioration in water quality in the drainage flowing from the Burnick Portal and downgradient surface water. AMP monitoring locations include the Burnick portal drainage (MH-22), groundwater monitoring well MW13-06 downgradient of the Burnick portal and surface water monitoring stations and MH-15 in the West Fork of Tributary E (Figure 1).

Monitoring at MH-22 and MW13-06 would detect any changes in water quality in the portal drainage or groundwater near the portal. Downstream of these stations, the drainage flows as groundwater. Any potential change in surface water quality in the receiving waters would be a function of reactive transport along the groundwater flowpath. Any changes are expected occur slowly and would be detected by monitoring over time to establish statistically significant increasing trend.

2.1.3 1380 Portal Discharge

The Main Zone Pit is a box cut located in the headwaters of Camp Creek. The 1380 Portal is located at the south end of the cut. In June 1999, drainage from the portal was observed. The drainage is routinely monitored at MH-25 as part of WUL QZ99-045. MH-25 was sampled for the first time in 1999 to support the closure plan and was found to contain 41 mg/L dissolved zinc.

Drainage from MH-25 is ephemeral (June to October) and consistently exceeds the WUL limits for zinc and cadmium and less frequently for lead. The zinc is leached from oxidizing exposed rock and talus around the portal area, which contain sphalerite. The source water is likely shallow groundwater with minor contributions from Jewelbox Pit (SRK 2000).

In 2000, MH-25 was monitored continuously for two months to assess variations in flow and chemistry. SRK (2000) reported that the drainage from the Main Zone pit portal contained elevated zinc, cadmium, and lead concentrations. Flow was estimated at 1 L/s. Flow decreased following freshet, but constituent concentrations were relatively constant. The constituent load associated with this flow was not detected in Camp Creek or False Canyon Creek at any time during the summer, suggesting attenuation along the flow path.

The 1380 Portal drainage flows through the marble Main Zone waste rock dump immediately downstream of the portal. Flow within the waste rock dump is audible but difficult to locate and/or access, resulting in infrequent monitoring. The dissolution of the marble attenuates zinc, cadmium, and lead by precipitation of metal carbonates. This attenuation mechanism of drainage from MH-25 is considered to last in perpetuity. Station SDH-S2 located within the waste rock below the 1380 Portal characterizes concentrations after attenuation by the waste rock. MH-25 and SDH-S2 have similar sulphate levels, but the zinc concentration is approximately four times lower at SDH-S2 than at MH-25, the level of cadmium is approximately five times lower, and the level of lead is approximately 1.5 times lower. Geochemical modelling indicates that that precipitation of zinc, cadmium, and lead carbonates is the probable attenuation mechanism resulting from the interaction of MH-25 drainage with marble waste rock (Day and Bowles 2005).

After passing through the waste rock dump, the 1380 Portal drainage is further attenuated downstream as groundwater flows through the soils along the flow path to Camp Creek. Studies indicate that there may eventually be a loss of attenuation capacity in the soils. The groundwater flow discharges to surface as a spring near the headwaters of Camp Creek. The length of the flow path from the 1380 Portal to the spring near the headwaters of Camp Creek is approximately 900 m. The spring is relatively large and is located where the southern fork of Camp Creek originates which mixes about 100 m downstream with water from a second groundwater spring on the southwestern flank of Mt. Hundere. Camp Creek flows to the south and is a tributary to False Canyon Creek (Figure 1 and Figure 3).

Specific Issues

The objective of the AMP for the 1380 Portal drainage is to detect any deterioration in the portal drainage water quality within the waste rock dump and monitor for the potential loss of attenuation capacity of the soils upstream of Camp Creek. AMP monitoring locations include:

- Seepage monitoring at station SDH-S2 within the Main Zone waste rock dump,
- Groundwater monitoring at MW13-01 and MW13-13 located downgradient of SDH-S2 and upstream of Camp Creek, and
- Surface water monitoring at MH-04 in lower Camp Creek and MH-11 and MH-13 in upper False Canyon Creek

All the locations are shown in Figure 1 and Figure 3.

Any potential change in surface water quality in the receiving waters would be a function of reactive transport along the groundwater flowpath. Any changes are expected to be slow and would be detected by monitoring over time to establish statistically significant increasing trend.

2.2 Indicator Parameters

The surface water and groundwater monitoring programs for the North dam seepage, Burnick portal and 1380 portal are outlined in the WQMP and include monitoring of relevant downstream stations (Figure 1). Figure 3 shows a loading schematic of the sources and each water monitoring station to the loading sources. The AMP indicator parameters for the WQMP stations are zinc, lead, cadmium, and sulphate.

2.3 Thresholds

Exceedance of a threshold triggers action. There are two threshold levels.

A Level One threshold is a statistically significant increasing trend of zinc, cadmium, lead and/or sulphate concentrations at surface water or groundwater WQMP monitoring locations. Detecting an increasing concentration trend earlier will allow for sufficient time to reduce the likelihood of exceeding a Level 2 threshold.

A Level Two thresholds are the WUL limits at surface water monitoring stations MH-11 and MH-12. These are water quality compliance points for the site. These licence limits will be defined in the post-reclamation WUL. The locations of the surface water compliance points are shown on Figure 1 and their relationship to the loading sources is shown in Figure 2. MH-11 and MH-12 define the boundary where site-influenced water enters the receiving environment, and are proposed to be specified as such in the WUL.

Exceedance of the thresholds should occur sequentially from statistically significant increasing trends at monitoring locations most proximal to the loading sources (Level 1) that may eventually lead to an exceedance of limits at the two surface water compliance point monitoring stations (Level 2).

2.4 Evaluation of Monitoring Results

This section provides the details of how the data are evaluated in the context of Level 1 and Level 2 triggers.

2.4.1 Level 1

The Level 1 trigger is a statistically significant increasing trend in concentrations of zinc, cadmium, lead and/or sulphate at surface water or groundwater monitoring locations. Trends observed at multiple monitoring locations downgradient of a loading source provide more evidence than an increasing trend at a single location. Statistical significance of the trend will be tested using a Mann-Kendall test or other predetermined criteria to assess an increasing trend in the data will be used to evaluate water quality data for surface water and groundwater monitoring locations. The large existing dataset from 1991 to 2014 supports using trend analysis to identify statistically significant changes in water quality.

The Mann-Kendall test is a statistical test that used to evaluate a dataset to test for statistically significant trends in time series data. The test does not require data to have a normal distribution. This statistical test is commonly used in monitoring data analysis programs (Helsel and Hirsch 2002). There are a variety software packages, including the publically available ProUCL software from the United States Environmental Protection Agency (USEPA 2013) that can perform the test.

A statistically significant increasing trend in concentrations may trigger further action. The results of the statistical test from multiple stations will be used to assess the appropriate level of response. An upward trend for a single AMP indicator or compliance station will trigger a lower level of response than multiple stations showing upward trends. Similarly an upward trend that continues for multiple years will trigger a greater response than if the trend were observed in a single year. The details of the response will be defined during permitting.

2.4.2 Level 2

The Level 2 threshold is the exceedance of WUL limits for surface water stations MH-11 and MH-12. Water quality at MH-11 and MH-12 will be compared to the standards for lead, zinc and cadmium as indicated in the WUL.

2.5 Response and Actions

Action is triggered when thresholds are exceeded. When a Level 1 or Level 2 threshold is exceeded, a step-wise plan of responses and actions will be followed. The sections below describe the types of action that may be taken and are presented as a framework in order of escalating action, as presented in Figure 4.

Each level of action includes documentation of the steps undertaken and resulting recommendations and responses that would result in escalation to the next level of action, as appropriate. Each section notes the type of report and distribution.

2.5.1 Verification of Data

When a threshold (Level 1 or Level 2) is exceeded, the result needs to be verified. The first step includes confirmation of the result with the lab. If the result is confirmed, the subsequent step is to verify the initial result by resampling the site within 60 days. If resampling confirms the initial result and Level 1 or Level 2 thresholds are exceeded, then the nature and extent of the exceedance needs to be investigated (Section 2.5.2).

In the case of an exceedance of a Level 1 or Level 2 threshold, management will be notified in writing, including a summary of the outcome of the verification program and if escalation of action is warranted.

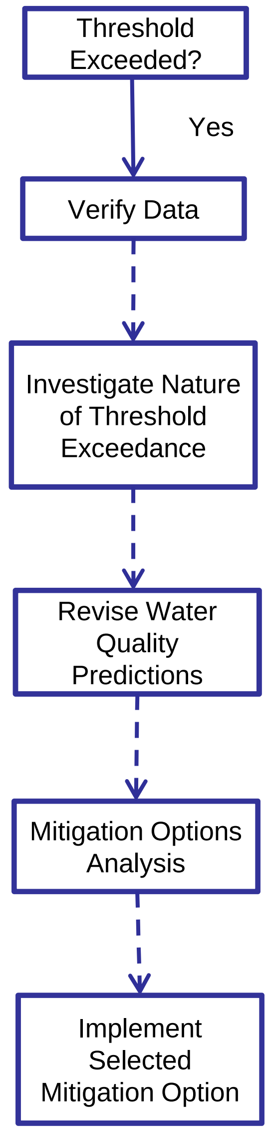
2.5.2 Investigate Nature and Extent of the Threshold Exceedance

Any threshold exceedance will be assessed and a monitoring plan created to investigate the nature and extent of the exceedance. The plan may include more frequent sampling of existing stations and/or the addition of new monitoring stations, and would take into consideration various factors, including but not limited to:

- Magnitude of threshold exceedance,
- Duration of an increasing trend for a Level 1 threshold,
- Number of stations within a source load flow path that have exceeded a threshold,
- Location of station that has exceeded a threshold (source load, groundwater, surface water, or compliance point),
- Which level of threshold has been exceeded (Level 1 or Level 2), and
- Results of biological monitoring

Depending on the findings of the investigation, the water quality model may be revised to re-evaluate potential changes to downstream water quality.

The Water Board would be notified in writing of any changes in monitoring and the outcome of the investigation.



Note: Dashed arrow denotes action escalates progressively based on recommendations from preceding response.

srk consulting	Teck	**Adaptive Management Plan**
		Framework of Escalating Responses and Actions
Job No: 1CT008.043 Filename: AdaptiveManagementPlanFigures_1CT008.043_Rev01_LMC_LNB.pptx	Sä Dena Hes	Date: October 2014 · Approved: LNB · Figure: 4

2.5.3 Revise Water Quality Predictions

As additional data become available from the increased monitoring, the data could be used to validate the water quality prediction model (SRK 2014b). Model validation may indicate the conceptual model for constituent loading be re-evalated and potentially revised. The loss of attenuation capacity or more rapid groundwater transport may warrant model revision. A revised model could then be used to reassess the situation and/or develop further action plans. This could include assessing if increasing constituent concentrations could impact aquatic life. Additional biological monitoring could also be undertaken. The results from additional monitoring could be used to verify if increasing concentrations are affecting aquatic life.

A report outlining the revised water quality predictions would be submitted to the Water Board.

2.5.4 Mitigation Options Assessment

If the revised water quality predictions indicate that water quality will exceed WUL water quality limits or suggest that there could be effects to the aquatic receiving environment a plan outlining mitigation will be developed. Potential mitigation measures would include source control, migration control and treatment options. These options will be based on data collected as part of the escalating response to increasing constituent concentration and are dependent on the magnitude, timing and potential impact of increasing concentrations.

A report outlining the mitigation options analysis with mitigation recommendations would be submitted to the Water Board.

2.5.5 Implement Mitigation

If mitigation is warranted, the preferred option recommended from the options analysis would be implemented. Any proposed mitigative actions, including any associated monitoring, would be documented and reported to the Water Board before works are undertaken.

3 Conclusion

The AMP describes how to use data collected by the WQMP to identify and evaluate increasing concentrations in sources and receiving water during post reclamation at the Sä Dena Hes mine. The AMP also provides a framework to develop plans for understanding the processes responsible for increasing concentrations, their potential impact and their mitigation if needed. Results of the AMP will be reported in the WUL annual report.

The AMP is living document and is expected to be revised as needed in response to any significant changes in water quality resulting from loading sources at the site. Additional detail will be added to the AMP as it becomes available. This may include new or revised conditions (e.g. WUL water quality limits) within the WUL. Implementing the AMP will ensure post reclamation water quality in receiving water downgradient of the Sä Dena Hes mine site is protected.

This report, Adaptive Management Plan, Sä Dena Hes Mine - DRAFT, was prepared by

"DRAFT"

Lee Christoffersen, EIT, GIT
Consultant (Environmental Engineering)

"DRAFT"

Lisa Barazzuol, PGeo
Senior Consultant (Geochemistry)

and reviewed by

"DRAFT"

Tom Sharp, PhD, PEng
Principal Consultant

All data used as source material plus the text, tables, figures, and attachments of this document have been reviewed and prepared in accordance with generally accepted professional engineering and environmental practices.

Disclaimer—SRK Consulting (Canada) Inc. has prepared this document for Teck Resources Ltd.. Any use or decisions by which a third party makes of this document are the responsibility of such third parties. In no circumstance does SRK accept any consequential liability arising from commercial decisions or actions resulting from the use of this report by a third party.

The opinions expressed in this report have been based on the information available to SRK at the time of preparation. SRK has exercised all due care in reviewing information supplied by others for use on this project. Whilst SRK has compared key supplied data with expected values, the accuracy of the results and conclusions from the review are entirely reliant on the accuracy and completeness of the supplied data. SRK does not accept responsibility for any errors or omissions in the supplied information, except to the extent that SRK was hired to verify the data.

4 References

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Attachment 1:

Sä Dena Hes Mine Post-Reclamation Water Quality Environmental Monitoring Plan

SRK Consulting (Canada) Inc.
2200–1066 West Hastings Street
Vancouver, BC V6E 3X2

T: +1.604.681.4196
F: +1.604.687.5532

vancouver@srk.com
www.srk.com

Memo

To:	Michelle Unger, Teck	**Client:**	Teck Resources Ltd.
From:	Saskia Nowicki Lisa Barazzuol Tom Sharp	**Project No:**	1CT008.043
		Date:	Revised October 16, 2014
Subject:	Sä Dena Hes Mine Post-Reclamation Water Quality Monitoring Plan - DRAFT		

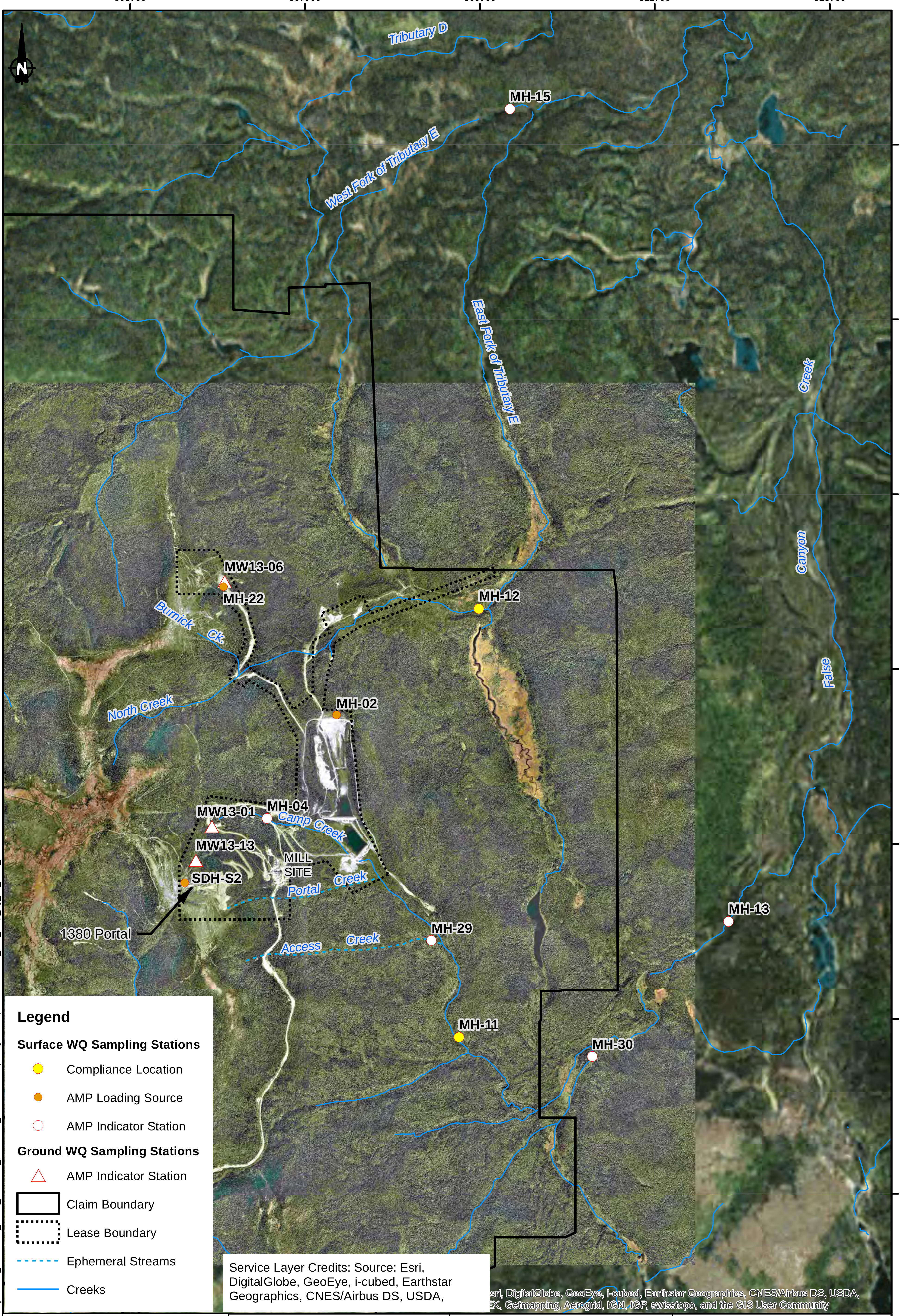
1 Introduction

This memorandum presents the post-reclamation water quality monitoring plan (WQMP) for the Sä Dena Hes (SDH) Mine property and immediate receiving environment. The WQMP collects surface water and groundwater quality data to be evaluated by Sä Dena Hes' water quality Adaptive Management Plan (AMP).

Surface water and groundwater quality monitoring is discussed in Section 2 – including sampling locations and frequency, field measurements, and laboratory analyses. Section 3 discusses the integration of the water quality monitoring program within the context of the AMP.

2 Water Quality Sampling

Figure 1 presents the post-closure surface water and groundwater monitoring locations that are within the scope of the AMP. The surface water and groundwater sampling programs are discussed separately because there are variations in the monitoring requirements.



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srk consulting

Teck

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Sä Dena Hes Mine

Water Quality Monitoring Plan

Post-Reclamation Water Quality AMP Monitoring Stations

Date:	Approved:	Figure:
September 2014	LNB	1

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2.1 Surface Water Sampling

2.1.1 Stations

Table 1 lists the location and purpose of the surface water monitoring stations.

There are three categories of surface water monitoring stations, which are described as follows:

1. Compliance Points: These locations define the boundary of where site-influenced water enters the receiving environment, and would be specified as such in the WUL. Water quality at these stations will be compared to the standards indicated in the WUL. Two stations, MH-11, and MH-12 are the proposed compliance point stations.

2. AMP Loading Source: These stations are surface water monitoring locations most proximal to the identified mine site loadings sources (SRK 2014). These three stations monitor the seepage from the North Dam (MH-02) and drainage from the Burnick Portal (MH-22) and 1380 Portal (SDH-S2).

3. AMP Indicator: These stations are downstream of the mine site loading sources and are not permitted compliance points. The objective of monitoring at stations MH-04, MH-13 and MH-15 is to provide data for evaluation by the AMP to evaluate if water quality has or is changing. Water quality data collected at MH-29 and other biological monitoring locations support the biological monitoring program of the AMP, however the data will be evaluated as described in the AMP water quality data assessment process.

Table 1: Surface Water Quality Sampling Stations

Station Category	Station ID	Coordinates		Station Description
		Northing	Easting	
Compliance Point	MH-11	509460	6707788	Upper False Canyon Creek
	MH-12	509688	6712755	East Fork of Tributary E
AMP Loading Source	MH-02	508060	6711477	North Dam seepage
	MH-22	506767	6712946	Burnick 1200 Portal discharge
	SDH-S2	506325	6709558	Drainage from the 1380 Portal, present as a seep in the downslope waste rock dump
AMP Indicator	MH-04	507267	6710292	Camp Creek
	MH-13	512541	6709113	False Canyon Creek main channel
	MH-15	510041	6718408	West Fork of Tributary E
	MH-29*	509146	6708895	Access Creek Upstream of Camp Creek
	MH-30*	510985	6707568	Unnamed Tributary Upstream of False Canyon Creek

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Notes:
*Denotes biological AMP station but the associated water quality data will be interpreted as part of the AMP.

2.1.2 Surface Water Sampling Frequency

For the first five years of post-reclamation, from 2016 to 2020, surface water sampling will be conducted semi-annually to capture freshet flow (June to July) and baseflow (September or October). In 2014, the South and Reclaim dams were removed and Camp Creek channel reconstructed. Sampling during the freshet in the first five years is proposed to monitor for erosion of the channel or runoff from these reclaimed areas, which is most likely to occur during freshet.

After this initial five year period, surface water quality data will be evaluated to determine if annual sampling would be appropriate in the following years. It is anticipated that monitoring will demonstrate that water quality will be stable and annual monitoring would be appropriate. The potential effects of groundwater discharge on surface water quality are most observable during baseflow when groundwater contributes a larger portion to the flow than surface water runoff. The loading source migration pathways that can potentially impact surface water are via groundwater, so surface water would be monitored annually during baseflow after the first five years.

After 10 years of post-reclamation water quality monitoring, the data would be further assessed to determine if further reductions in the sampling frequency, e.g. every second year, are warranted.

2.1.3 Field Measurements

The following field measurements will be taken at each surface water station:

- Temperature,
- pH,
- Specific conductivity,
- Oxidation-Reduction Potential (ORP),
- Turbidity, and
- Flow rate.

2.1.4 QA/QC Program

Each sampling event will include the following QA/QC samples:

- 10% sample duplicates;
- 1 field blank; and
- 1 travel blank.

The QA/QC program for the surface water sampling can be combined with the groundwater program if conducted at the same time.

2.1.5 Laboratory Analytical Requirements

For each surface water station and QA/QC sample, multiple sample bottles will be collected and shipped to a laboratory to be analysed for general parameters, anions and nutrients, total elements and dissolved elements. Details of the analyses are provided in Table 2.

Table 2: List of Laboratory Analyses for Surface Water Stations

Category	Parameter	Method of Analysis
General Parameters	pH	Electrode
	Conductivity	
	Acidity	Potentiometric Titration
	Alkalinity	Titration
	Total Organic Carbon	Combustion
	Dissolved Organic Carbon	Combustion
	Total Dissolved Solids	Gravimetric
	Total Suspended Solids	Gravimetric
	Turbidity	Nephlometer
Anions and Nutrients	Chloride	Ion Chromatography
	Fluoride	
	Nitrite	
	Nitrate	
	Sulphate	
	Bromide	
Trace Elements	Total Concentrations	Inductively Coupled Plasma Mass Spectrometry (ICP-MS)
	Dissolved Concentrations	

\\VAN-SVR0\Projects\01_SITES\Sa_Dena_Hes\1CT008.043_Sa Dena Hes Water Licence Support 2014\Post-Closure AMP & EMP\EMP\[SDH_EMP_Tables_rev00_sjn.xlsx]

2.2 Groundwater Sampling Program

There are two post-reclamation groundwater monitoring programs for SDH. The scope of the EMP program is to monitor the groundwater downstream of the mine-influenced loading sources presented in Table 1. These data will be evaluated by the AMP. Golder (2014) also outlines a groundwater monitoring program, however the scope of monitoring is in the context of a closed contaminated site.

2.2.1 Stations

Table 3 lists the location and purpose of the groundwater monitoring stations. All groundwater stations are AMP indicator stations in that they monitor downgradient flow from the AMP loading sources identified in Table 1 and the purpose is to evaluate the data collected as described in the AMP.

Table 3: Groundwater Quality Sampling Stations

Station Category	Station ID	Station Description
AMP Indicator	MW13-06	Adjacent to Burnick Portal
	MW13-01 MW13-13	Downstream of 1380 Portal

2.2.2 Sampling Frequency

Groundwater sampling will be conducted during baseflow groundwater periods (August to September). The limited sulphate data suggest that there is dilution during freshet when there is increased groundwater flow and that concentrations are slightly higher during baseflow. Furthermore, the loading source migration pathways that can potentially impact surface water are via groundwater. The potential effects of groundwater discharge on surface water quality are most observable during baseflow when groundwater contributes a larger portion to the flow than surface water runoff.

The long-term sampling scheduling is parallel to the surface water quality monitoring program, specifically annual sampling for the first ten years of post-reclamation, after which the data would be further assessed to determine if further reductions in the sampling frequency, e.g. every second year, are warranted.

2.2.3 Field Measurements

The following field measurements will be taken at each groundwater station after purging three times the well volume:

- Temperature,
- pH,
- Specific conductivity,

- Oxygen-reduction potential,
- Turbidity, and
- Water level.

2.2.4 QA/QC Program

Each sampling event will include the following QA/QC samples:

- 10% sample duplicates;
- 1 field blank; and
- 1 travel blank.

The QA/QC program for the groundwater sampling can be combined with the surface water program if conducted at the same time.

2.2.5 Laboratory Analytical Requirements

For each groundwater station and after purging three times the well volume, multiple sample bottles will be collected and shipped to a laboratory to be analysed for general parameters, anions and nutrients, and dissolved elements. The analytical suite for the QA/QC program will be the same. Details of the analyses are provided in Table 4. The list of required analyses outlined in Table 4 differs slightly from the historical groundwater monitoring conducted by Golder.

Table 4: List of Laboratory Analyses for AMP Groundwater Stations

Category	Parameter	Method of Analysis
General Parameters	pH	Electrode
	Conductivity	
	Acidity	Potentiometric Titration
	Alkalinity	Colourimetry
	Total Dissolved Solids	Gravimetric
	Turbidity	Nephlometer
Anions and Nutrients	Chloride	Ion Chromatography
	Fluoride	
	Nitrite	
	Nitrate	
	Sulphate	
	Bromide	
Trace Elements	Dissolved Concentrations	ICP-MS

3 Integration with the Adaptive Management Plan

Surface water and groundwater quality data collected as part of the EMP will be analyzed using the methods outlined in the AMP. The sampling locations and frequencies discussed herein are subject to change based on specifications presented in Sä Dena Hes' AMP. The AMP specifies various thresholds for water quality that if exceeded, would result in the re-evaluation of the EMP in the context of the management issue identified.

4 References

Golder 2014. Long Term Groundwater Monitoring Plan, Sa Dena Hes Mine, Yukon Territory. Technical memorandum prepared for Teck Metals Ltd. By Golder Associates, July 18, 2014.

SRK 2014. Post-Reclamation Surface Water Quality Predictions. Technical Report prepared for Teck Resources Ltd. by SRK Consulting (Canada) Inc., September 2014.

SRK Consulting (Canada) Inc.

"DRAFT"

Saskia Nowicki, BSc
Staff Consultant

"DRAFT"

Lisa Barazzuol, P.Geo.
Senior Consultant (Geochemistry)

Reviewed by:

"DRAFT"

Tom Sharp, P.Eng.
Principal Consultant (Water Management)

APPENDIX B

Long Term Groundwater Monitoring Plan SDH Mine
(Golder Associates, 2015)

July 8, 2015 Project No. 1210210006-032-L-Rev0

Michelle Unger, B.Sc.
Teck Resources Ltd.
Bag 2000
Kimberley, BC
V1A 3E1

LONG TERM GROUNDWATER MONITORING PLAN, SÄ DENA HES MINE, YUKON TERRITORY

Dear Michelle;

Golder Associates Ltd. (Golder), on behalf of Kēyeh Nejéh Golder Corporation, is pleased to present this plan for long term groundwater monitoring to Teck Resources Limited (Teck) for the Sä Dena Hes Mine (the "Site"), located approximately 70 km by road from Watson Lake, Yukon.

1.0 BACKGROUND

The Sä Dena Hes mine operated as a lead-zinc mine for a 16 month period between August 1991 and December 1992, by Curragh Resources. A decline in zinc prices, in December 1992, forced a temporary closure of the mine. The Sä Dena Hes Operating Corporation purchased the mine in April 1994. However, the mine has remained closed since December 1992 due to low demands in the zinc market. Teck Resources Limited (Teck) is an operating partner of the mine.

Sä Dena Hes mine is permitted under a Yukon Quartz Mining Act Production License and a Type A Water Use License. Both permits are to expire on December 31, 2015. The conditions of both licenses allow for "Temporary Closure" of the mine, as it has resided since 1992; however, this status expired on January 28, 2013, and the mine has now entered a "Permanent Closure" phase.

In 2012, a Phase I and II Environmental Site Assessment (ESA) for the Site was completed by Golder on behalf of Kēyeh Nejéh Golder Corporation (KNG) and Teck. The results of the Phase II ESA identified eight Areas of Environmental Concern (AECs) at the Site. Four of the AECs (Jewelbox Hill, Burnick, Mill Site, and the Tailings and Reclaim ponds) identified indicated a potential for impact to groundwater. Based on the results of the Phase II ESA, in 2013 a groundwater evaluation was completed to assess the concentrations of the contaminants of concern at:

- each of the four AECs;
- in other areas for coverage across the site; and
- in background areas.

The monitoring well network is shown on Figure 1, attached.

In 2014, Golder also completed a Phase II ESA of the Site landfill, including an evaluation of groundwater quality. An assessment of the groundwater quality at the landfill was considered warranted based on the observation of sheen on surface water in the landfill vicinity, analytical results for surface water samples that were analyzed, and concerns from the local community. The results of the landfill assessment are documented in Golder's letter report entitled "*Environmental Site Assessment – Site Landfill, Sä Dena Hes Mine, Yukon Territory*" (dated December 18, 2014). Monitoring well locations completed as part of the landfill assessment are also shown on Figure 1 (MW14-01 to MW14-04).

2.0 REGULATORY FRAMEWORK

It is our understanding that Teck met with representative of Yukon Energy Mines and Resources and Environment Yukon on May 23, 2013 to determine which department would take a lead on the closure of the mine. Based on the outcome of this meeting it was determined that Yukon Energy Mines and Resources would be the lead government department for the closure work and that a technical advisory committee, that includes a representative from Environment Yukon, would be set up to review the project.

The Yukon Contaminated Sites Regulation (CSR) contains standards to ensure that the quality of water at a site, or which flows from a site, is suitable for direct use and is protective of water uses on adjacent properties. The CSR contains standards based on the following four types of water use:

- Aquatic Life water use standards apply to water used as a habitat for components of the freshwater or marine ecosystem;
- Drinking Water use standards apply to water used for consumption by humans;
- Irrigation water use standards apply to water used to produce agricultural products; and
- Livestock water use standards apply to water used for consumption by livestock.

The standards for a variety of contaminants in water for each of these uses are listed in Schedule 3 of the CSR. Drinking water, irrigation and livestock water use standards are not applicable to the site because these water uses are not currently being used, and the absence of a reasonable probability of them being used in the future, on site or in the vicinity of the site. Aquatic Life standards are applicable at the Site as freshwater aquatic environments are present within 1.5 km of the mineral surface lease boundary.

Special Waste Regulations (SWR) will also apply to contaminated water.

3.0 CONSIDERATIONS FOR ON-GOING MONITORING

On-going groundwater monitoring is recommended in specific locations at the Site to:

- Continue to assess potential source locations at the identified AECs and/or along potential pathways;
- Monitor temporal changes in groundwater quality at the Site landfill; and
- Monitor groundwater prior to discharge into the down-gradient receptors.

3.1 Source Locations

The following locations and AECs were identified at the Site in the 2012 Phase I and II ESA completed by Golder and in subsequent investigations, as having concentrations of petroleum hydrocarbons and metals in soil in excess of the Yukon CSR standards included:

- Jewelbox Hill (AEC 1);
- Burnick (AEC 2);
- Mill Site (AEC 3); and
- Tailings and Reclaim ponds (AEC 8).

In addition, the Main Zone Portal has been added as an AEC and metals concentrations in groundwater are being assessed along with surface water by SRK Consulting.

3.2 Site Landfill

A landfill was constructed near the former North Creek pump house, as part of the overall decommissioning of the Site. The landfill contains demolition debris from the Mill Site, former camp and office buildings and miscellaneous Site debris.

It is inferred that groundwater in the vicinity of the landfill occurs within a shallow, unconfined aquifer composed primarily of unconsolidated sand with silt, gravel, and cobbles. Based on existing data for the landfill, groundwater flow direction is inferred to be to the east and groundwater is inferred to discharge into North Creek.

3.3 Down-gradient Receptors

The groundwater conceptual site model indicates that groundwater flows from Jewelbox Hill to the Reclaim Pond. The overburden thickness at Jewelbox, and the area between Jewelbox and the Mill site, is less than a few metres and groundwater was encountered within fractured bedrock. Between the Mill site and the Reclaim Pond, the water table is within unconsolidated sediments consisting of a silty sand layer between the thin Sand and Gravel unit and the bedrock. Groundwater discharges to surface water at the Reclaim Pond, which is part of Camp Creek. Therefore groundwater from Jewelbox Hill and the Mill Site flow towards and discharges at Camp Creek, which flows towards the southeast.

There is a groundwater flow divide on the Site. The groundwater flow divide is located between the North Dam and former South Dam, and groundwater in this area flows towards the north and south. The groundwater flow direction north of the North Dam is north towards North Creek. The groundwater flow direction from Burnick is to the northeast and east towards the West Fork of Tributary E and southeast towards North Creek, and east along North Creek.

Based on the groundwater conceptual site model, Camp Creek is the surface water receptor for groundwater originating at Jewelbox, the Mill Site and the Reclaim Pond. North Creek is the surface water receptor for groundwater originating at Burnick, the Tailings Pond, and the Site landfill.

4.0 RECOMMENDED MONITORING LOCATIONS AND FREQUENCY

Based on the groundwater conceptual site model developed for the site we recommend:

- To monitor annually groundwater flow and quality originating from Jewelbox: monitor wells MW13-01 and MW13-05 to assess groundwater quality prior to it reaching Camp Creek from the north and east directions;
- The Mill Site is located between Jewelbox and Camp Creek in the northeast direction: monitor annually groundwater flow and quality originating from either source location at monitoring well location MW13-10;
- To monitor annually groundwater flow direction and quality from Burnick towards North Creek and the landfill area: monitor MW14-04;
- To monitor annually groundwater flow direction and quality the tailings pond area: monitor MW13-07; and
- To monitor groundwater quality in the landfill area: monitor MW14-01, MW14-02, and MW14-03, (in addition to MW14-04, above) semi-annually.

It is assumed with this plan that surface water will also be sampled at Camp Creek, North Creek and West Fork of Tributary E (the receptor locations). Groundwater is currently being monitored and sampled twice per year during spring freshet, and in the fall prior to winter conditions in order to capture the annual high and low groundwater periods. Going forward it is recommended that groundwater be sampled annually at low groundwater periods (approximately September) to coincide with the long term plan for surface water sampling so that trends and interactions can be compared. Water quality results will be reviewed upon receipt and a trend analysis completed with the previous data. If concentrations are observed to be increasing and approaching an applicable standard, additional sampling will be recommended for that year to confirm the results.

The estimated groundwater flow velocity through the overburden from the Mill Site to Camp Creek was measured to be 80 m/yr. The distance between the Mill Site and Camp Creek is approximately 800 m and using the estimated groundwater velocity, contamination that originated at the Mill Site would arrive at Camp Creek within 10 years. We recomend to monitor the groundwater wells for a period of 10 years considering that any discharges from the Mill Site would have occurred between twenty two years ago and up to 2014 when contamination was removed. It is likely that if any contamination had reached groundwater it would already be detected in previous sampling rounds, however the additional ten years is being proposed as a conservative measure. Sampling will be conducted annually for four years, then biennially in years six, eight and ten. This frequency will be reviewed following the evaluation of each data set and assumes that there is no change in conditions. A review of concentrations and trends following the receipt of data in year ten will determine if the groundwater sampling program should continue.

The estimated groundwater flow velocity at the Site landfill was measured to be approximately 60 m/yr, towards the east, based on data collected in September, 2014. Based on the distance from the eastern limit of the landfill to the intersection with North Creek (inferred to be in the vicinity of historical well locations TH91-09 and TH91-10), it is estimated that groundwater would discharge to the creek after a period of approximately 2 to 3 years. It is recommended that sampling be conducted on a semi-annual basis for two years, following which the data will be reviewed to document any changes in groundwater conditions. The frequency of monitoring may be revised following two years of additional data collection, depending on the monitoring results.

5.0 METHODOLOGY

During the groundwater monitoring program, groundwater samples should be collected using consistent methods and procedures. The depth to groundwater at each well would be measured prior to sampling to calculate the volume of water in the well. Due to the depth to water in the majority of the wells a dedicated disposable bailer has been used to purge and sample water from each well. Approximately three well volumes should be removed with the bailer. Water is collected from the outflow at regular intervals and parameters consisting of pH, temperature and electrical conductivity are measured using a handheld meter. Once more than three well volumes have been removed and the parameters have stabilized (i.e., changes in pH, temperature and electrical conductivity measurements between three successive readings were less than 10%), samples should be collected in pre-cleaned containers supplied by the laboratory. Samples from monitoring wells MW13-01, MW13-04, MW13-05, and MW13-10 will be analyzed for Benzene, Toluene, Ethylbenzene, Xylenes (BTEX), Volatile Petroleum Hydrocarbons (VPHw), Light and Heavy Extractable Petroleum Hydrocarbons (LEPHw/HEPH), Polycyclic Aromatic Hydrocarbons (PAH), and dissolved metals and anions. The sample from MW13-07 will be analyzed for dissolved metals and anions. Groundwater samples at the Site landfill should be monitored for BTEX, VPHw, LEPHw/HEPH, PAHs, anions and nutrients, and dissolved metals.

During each sampling round, a field duplicate of one of the samples will be collected for each parameter for Quality Assurance and Quality Control purposes. In addition, a trip blank for the volatile parameters will travel with the samples. The collected samples are to be stored in coolers with ice and shipped to the laboratory within the required hold times under standard Chain-of-Custody procedures.

6.0 CLOSURE

We trust that the information contained in this work plan is sufficient for your current needs. If you require any further information, please do not hesitate to contact Tamra Reynolds at 867-633-6076.

Yours very truly,

GOLDER ASSOCIATES LTD.

Tamra Reynolds, M.Sc., P.Geo.
Senior Hydrogeologist

Gary Hamilton, P.Geo.
Principal, Project Director

TR/GJH/ch

Attachments: Figure 1 Monitoring Well and Test Hole Locations

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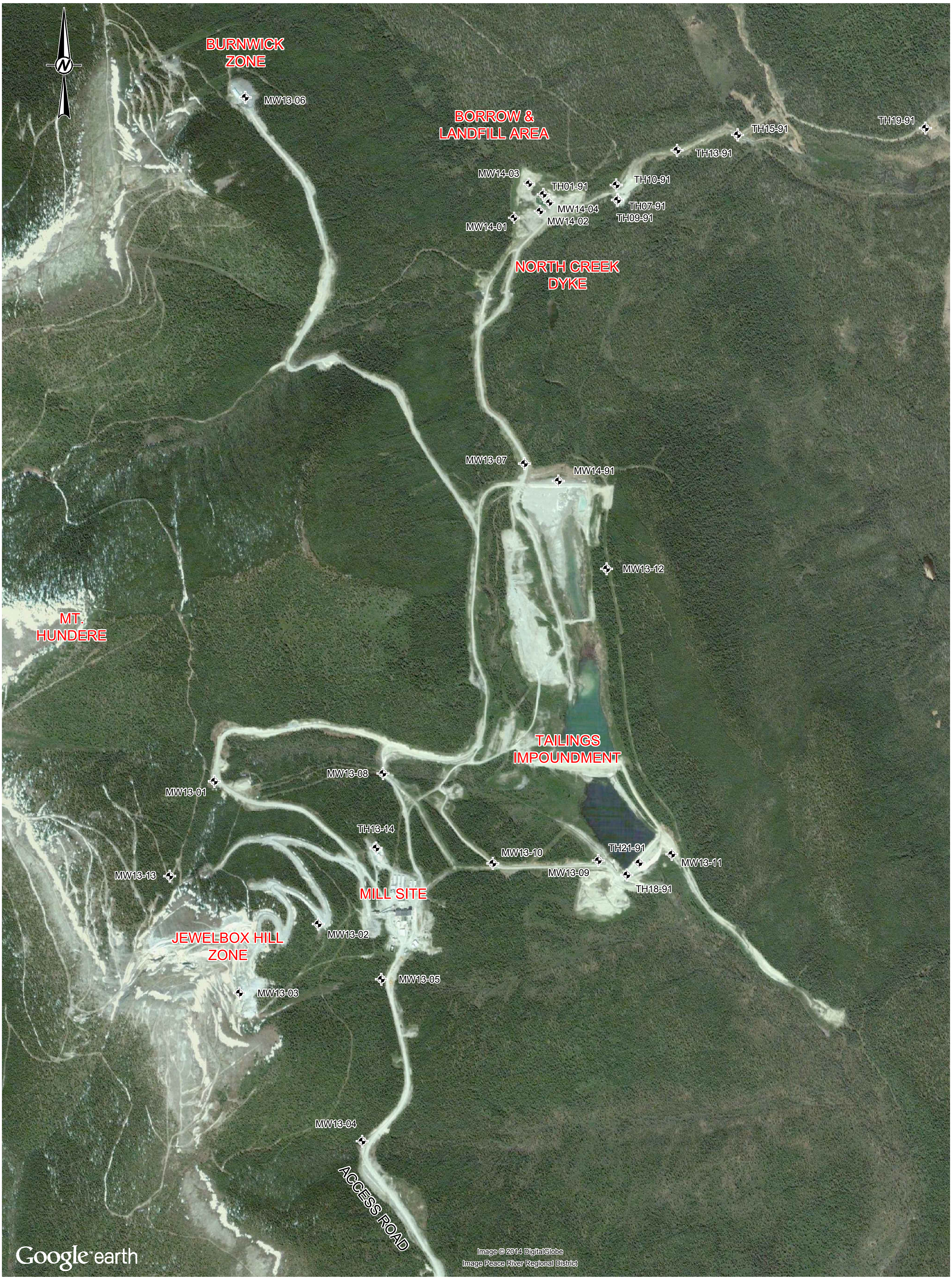

LEGEND

SDH MW WELL LOCATION

REFERENCE

All units are in metres unless otherwise noted.
Base imagery obtained from Google Earth Pro under licence.
Google Earth Imagery date June 12th, 2006.
Google Earth Image is to be used for surrounding detail reference only.
Datum: NAD 83 Projection: UTM Zone 9

0 300 600 900
SCALE METRES

PROJECT

TECK METALS
SA DENA HES HYDROGEOLOGICAL ASSESSMENT
SA DENA HES MINE, YUKON TERRITORY

TITLE

MONITORING WELL & TESTHOLE LOCATIONS

Golder Associates

PROJECT No.	12-1021-0006-7000		FILE No.	1210210006-7000-01
DESIGN	TR	2013-12-03	SCALE	AS SHOWN
CADD	LYT	2013-12-03	FIGURE	
CHECK	TR	2014-03-24		FIGURE 1
REVIEW	HG	2014-03-24		

APPENDIX C

Proposed Methodologies for Aquatic Resources Monitoring
(ACG 2014)

1 Proposed Methodologies for Benthic Invertebrate, Stream Sediment and Fisheries Monitoring

1.1 Proposed Benthic Invertebrate Monitoring Methodology

The Canadian Aquatic Biomonitoring Network (CABIN) protocol is designed to assess changes in the benthic invertebrate communities at multiple long-term monitoring locations. CABIN uses the Reference Condition Approach (RCA) for assessing the overall health of the biological community (in this case benthic invertebrates) at the test sites being monitored. A bioassessment model is developed from the available reference site data, and this model defines the range of biological communities that should be found at a site if the site is not affected by human activities. Test sites are assessed against reference sites using the bioassessment model and the divergence between the benthic macroinvertebrate communities at reference sites and a test site indicate the extent of potential impairment. Habitat and stream characteristic data from the test site are combined with GIS and climate information for the area to determine the appropriate group of reference locations for comparing to the test location. All of this information, along with the taxonomy data, is entered into the CABIN database (ec.gc.ca/rcba-cabin) where users also have access to analytical tools for interpreting the data and preparing reports for each test site.

The standard protocol dictates that benthic invertebrate samples are collected over a three minute period of time using a kick net (Environment Canada 2012). A zigzag sampling pattern is used across the stream to integrate benthic invertebrates from various stream microhabitats within the erosional zone (for example, areas around large boulders, riffle, runs, bank overhang) in proportion to their occurrence in a sample reach.

The following is a description of the collection, transfer, and preservation of benthic invertebrates specific to CABIN:

- Ensure that you are in the correct location (using a GPS) for the targeted station. Define the kick area and path in the erosional zone of the sampling reach (calculated as 6 times the estimated bankfull width) before entering the stream. Inform field team members so that this area is not disturbed. At least 2 people are required; one kick-netter and one observer/timer.
- Use a 400 um triangular net designed for this purpose
- Use a watch to time the amount of time that the bottom is being actively disturbed for 3 minutes. If you have to stop or move locations in the event of impediment by roots or falls, the observer will pause the timer; re-position yourself in the stream, start again and re-start the clock.
- Start sampling at the downstream end of the kick area, place the kick net downstream of the sampler, flat side of the triangle resting on the substrate of the stream.
- Walk backward in an upstream zigzag direction, dragging the net along the bottom of the stream while walking.
- Kick the substrate to disturb it to a depth of ~5 to 10 cm if possible. For large cobble, turn over and rub your foot over the surface to dislodge macro-invertebrates clinging to the interstitial spaces. Brush the surface of large boulders with your hand or foot.

- The net should always be held close to the area that is being disturbed to ensure that most of the disturbed substrate and organisms are swept into the net by the current.
- Continuously zigzag over the stream bottom from bank to bank in an upstream direction. Stop once you have reached 3 minutes of kick time.
- Remember that if the sampler needs to stop to get around an obstruction, take a rest, or remove large cobbles from net, the timer must stop timing while the sampler lifts the mouth of the net from the water. The stopwatch is restarted when the sampler is ready to continue sampling.
- It is the responsibility of the timer to spot the sampler and alerts them of any upcoming obstructions while the sampler is traveling backwards and can't always see where they are going.
- Splash the side of the net in the river to transfer all material to the collection cup at the end of the net (ensure that the mouth of the net is out of the water).
- Remove the collection cup attached to the end of the net and empty the contents directly into a wide-mouth plastic sample jar, pail or sieve. Always work over a pail or tray in case of an accidental spill.
- Wash any material remaining in the cup/net into the sample jar/pail/sieve using a squeeze bottle and forceps to remove any clinging animals.
- Carefully rinse and discard any stones and large green leaves that have fallen into river and are not invertebrate habitat.
- Transfer sample from pail/sieve (if using) to one or more sample jars, depending on sample volume. Check pail/sieve to ensure that no organisms remain. The total volume of the sample should not exceed 50% of the volume of the sampling container to ensure there is enough space for the addition of a 10% formalin solution (Environment Canada, 2012a); use additional jars if more space is needed.
- Preserve the sample by adding buffered formalin to quickly fix the samples for future identification. Seal the jars well and circle the lids with electrical tape to prevent leakage of formalin, especially during shipping.
- Package and seal the benthic samples in a cooler or similarly sturdy transport container; advise the lab that the samples are on their way and ship with a completed chain-of-custody form.

1.2 PROPOSED STREAM SEDIMENT QUALITY MONITORING METHODOLOGY

A hand-held bilge-pump (Guzzler method) should be used to collect sediment samples from stream habitat as part of the long-term monitoring plan for Camp Creek and False Canyon Creek. This method is ideal for moderate to high gradient streams where there are few if any true depositional areas. Large grain size substrate (i.e., sand or coarser) has low metals concentrations because of the small surface to volume ratio and the low surface area to which benthic invertebrates are exposed. The Guzzler method uses suction to pump fine sediments from interstitial spaces within the gravel/cobble substrate of the stream. Sediments are preferentially collected from the middle of the stream, away from the edges or bottom of the stream bank to avoid 'bank material' and to target fine sediment within the hyporheic zone, below the gravel.

Below is an outline of the step-by-step sampling procedure:

- At the downstream edge of the sampling station, select a location where there is suitable gravel/cobble substrate in riffle or runs where fines are expected to occur. Avoid sampling in areas that are excessively steep where there may be very large material and a paucity of fine material.
- Use a clean pump to suction sediment and water from the substrate into one or two pre-cleaned 20-L buckets. Use short pump strokes to reduce the amount of water and maximize sediment volume recovered. Push intake end of pump into the substrate, dislodging gravel and cobble while pumping the fines that are dislodged. Limit the depth of penetration of the pump tip to the upper 2 to 3 cm the stream surface and avoid pockets of accumulated fines that may have been deposited from the adjacent bank. Continue moving upstream and pumping from the thalweg of the stream until the bucket is full of water/sediment. A distance of 10 – 15 m of stream is typically covered. Collect a second bucket if you do not feel that you acquired a decent enough sample of fine sediment … usually about 0.5 L.
- Using your arm or a clean stainless steel spoon, completely re-suspend the sediment in the bucket, stirring for 15 seconds.
- Let sit for 10 seconds, gently pour off or decant the water with suspended fines into a second bucket, leaving the coarse material (sand, gravel) at the bottom of the first bucket. Be careful to pour off only the silt size material or smaller
- Stow the buckets someplace where they will be moved as little as possible for a minimum of 30 to 60 minutes. This will allow fine material to settle out. Be careful not to disturb this material while allowing to settle. The longer the settling period the better. You can choose to leave overnight if you wish; to minimize differences due to sampling methodology, leave all buckets to settle for a similar amount of time.
- At the end of the settling period, carefully pour off and discard as much of the overlying water as possible from each bucket. Avoid re-suspending or losing any of the sediment that has settled at the bottom of the bucket. Retain as little water as possible
- Use a spoon to move the top layers of sediments from each bucket into a stainless steel bowl and homogenize the sediment. Avoid any sand at the bottom of the bucket when removing the fines. Using the spoon, put sediment into 2 x 250 ml glass jars supplied by the laboratory. One jar is for analysis of grain size and the other for total metals and total organic carbon.
- Determine from the analytical lab(s) the minimum acceptable sample volume or mass. If you have less than 250 ml per jar, that is probably fine. While the lab can get away with much less, it is important that you collect sufficient sediment to be representative of what is in the stream.
- Sediment samples should be kept cool in coolers with ice packs. Samples are shipped on ice to the laboratory for analysis of metals, total organic carbon (TOC), and particle size. The laboratory must be instructed to homogenize the contents of each sampling jars for a given replicate, prior to any analyses and prior to sending out any subsamples that are subcontracted (e.g., particle size and TOC). Metals analysis is conducted on the < 2 mm fraction of the sediment unless the laboratory is specified otherwise.

1.3 Proposed Fisheries Monitoring Methodology

It is proposed that the methodology that has been employed in the water use licence monitoring program (EEM) be continued for continuity in the post-reclamation period. This includes electroshocking with consistent effort to collect number, species, sex and size of fish captured. Fish tissue collection could be initiated should a response to an AMP trigger dictate.

APPENDIX D

SA DENA HES MINE SITE LONG-TERM MONITORING PLAN FOR TERRESTRIAL ENVIRONMENT RELATED TO HUMAN HEALTH AND ECOLOGICAL RISKS (AZIMUTH, 2016)

Azimuth Consulting Group Partnership

218-2902 West Broadway
Vancouver, BC
Canada V6K 2G8

Phone: 604-730-1220
Fax: 604-739-8511
www.azimuthgroup.ca

Technical Memorandum

Date:	**June 27, 2016**
To:	**Michelle Unger, Teck Resources Limited**
From:	**Cheryl Mackintosh, Norm Healey, Beth Power, Randy Baker**
Our File:	**Teck 16-02.3**

RE: Sä Dena Hes Mine Site Long-term Monitoring Plan for the Terrestrial Environment Related to Human Health and Ecological Risks

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Contents

1 Background 3
2 Objectives 3
3 Long-term Monitoring Guidance 4
4 Summary of Risk Assessment Findings 5
4.1 TERA Findings 5
4.2 HHRA Findings 8
4.3 DDRP Closure Measures 10
5 Long-term Monitoring Plan 14
5.1 Overview 14
5.2 Land Use 15
5.3 Soil Cover Integrity 15
5.4 Metals Chemistry in Remediated Areas - TERA 16
5.5 Metals Chemistry in Residual Areas - TERA 17
5.6 Metals Chemistry - HHRA (Optional) 18

5.7 Vegetation and Wildlife Habitat Monitoring 18
6 LTM Reporting 27
7 References 27
8 Use and Limitations of this Memorandum 28

Figures

Figure 1: Sä Dena Hes Mine Site - Areas of Environmental Concern (AECs) and Soil Cover Boundaries 11
Figure 2: Sä Dena Hes Mine Site Areas for TERA Long-term Monitoring 20
Figure 3: Sä Dena Hes Mine Site - HHRA Land Use 21
Figure 4: Sä Dena Hes Mine Site – Areas for HHRA Long-term Monitoring 22

Tables

Table 1: Summary of TERA conclusions for the Sä Dena Hes Mine Site, under post-closure conditions. 12
Table 2: Summary of Human Health Risk Assessment Conclusions for the Sä Dena Hes Mine Site. 13
Table 3: Information to support design of the terrestrial LMP for the Sä Dena Hes TERA and HHRA. 23
Table 4: Summary of guiding decision rules[1] for the Sä Dena Hes terrestrial LMP supporting the TERA and HHRA. 25

1 Background

Azimuth conducted terrestrial and aquatic Ecological Risk Assessments (TERA and AERA, respectively) and a Human Health Risk Assessment (HHRA), for the Sä Dena Hes Mine Site (the Site) on behalf of Teck from 2013 - 2015. The goal of this work was to support mine closure, including providing feedback to Teck over the course of mine remediation and reclamation. A series of risk assessment reports were prepared for the Site (Azimuth 2013, 2014a,b,c,d,e, and 2015a,b,c,d) alongside site investigation, engagement with local First Nations, and site closure activities (2013-2015). All the risk assessments and the final *Detailed Decommissioning and Reclamation Plan* (DDRP) guiding closure (Teck 2015) have been submitted to the regulatory agencies. An Adaptive Management Plan [AMP] is under preparation and permitting related to the Water Licence and the Quartz Mining Licence [QML] is in progress, anticipated to be completed in 2016.

As part of Site closure, on-going risks to people and wildlife will be minimized through risk management and monitoring programs being developed as described by the Sa Dena Hes DDRP (Teck 2015). For the aquatic environment, recommendations based on the AERA will be incorporated into the water licence/AMP, which will specify aquatic monitoring requirements for the former mine site. For the terrestrial environment, a Long-term Monitoring Plan (LMP) is presented here. Results of the various monitoring programs will be evaluated in light of the risk assessment findings, to verify that risk predictions for the site remain valid and confirm that exposure to contaminants in receiving environment soil, water, plants and animals is diminished. This LMP supports a larger "Sä Dena Hes Environmental Monitoring, Surveillance and Reporting Plan" (Environmental Monitoring Plan) for the overall Mine Site that is being prepared by Teck. The Environmental Monitoring Plan will cover various other components of long-term monitoring and site management, such as public safety, geotechnical, and monitoring stemming from risk management.

2 Objectives

The overarching goal of this terrestrial LMP is to ensure that risk management of the site is consistent with the assumptions in the TERA and HHRA and remains protective of human health and ecological receptors. Specific objectives are to:

1. Support long-term environmental management of the Sä Dena Hes Mine Site,
2. Confirm that specific assumptions of the TERA remain valid, i.e.,
    a. Soil covers remain intact and act as a barrier to wildlife exposure to elevated COPCs in soils and tissues (i.e., invertebrates and small mammals).
    b. Application of soil covers would result in soil and tissue (except plants) concentrations in reclaimed areas that are consistent with local "background/reference"[1] concentrations.

[1] Background/reference was determined based on sampling three reference areas (FF-1, FF-2 and NC-Ref); see Azimuth 2014a and 2014e for details.

   c. COPC concentrations and spatial extent of contamination in residual areas (e.g., 1380 Gully, and toe of waste rock piles) are assumed to be stable or improving in the future.
   d. Revegetation at the Site occurs as expected based on the DDRP.
3. Confirm that the site and land-use conditions remain consistent with the assumptions and recommendations of the HHRA; specifically:
   a. Ensure that remediation covers remain intact and act as a barrier to prevent human contact with the underlying contaminated soil.
   b. Confirm that the efficacy of administrative and engineered controls to restrict public access or restrict the harvesting of plants and small animals for human consumption.
   c. Verify that concentrations of metals in water, berries or other environmental media that may be consumed by humans are sufficiently low that they do not present an unacceptable exposure risk.

The LMP provides a framework for collecting and evaluating monitoring data for the terrestrial environment and a process for adapting the LMP, based on trends and findings. This memorandum summarizes the TERA and HHRA findings, as well as high level information on closure/risk management measures taken to address risks, to provide context for the LMP. Readers are referred to Teck's DDRP (Teck 2015) for more information on closure/risk management activities.

3 Long-term Monitoring Guidance

As risk assessment and management become more widely used, so do long-term monitoring requirements. In recent years, various jurisdictions have been developing approaches to monitoring but guidance is not widely available, rather monitoring plans are developed site-specifically. While not directly applicable to the Sä Dena Hes Site, Environment Canada (EC) has recently developed Long-term Monitoring Planning Guidance for federal contaminated sites as part of the Federal Contaminated Sites Action Plan (FCSAP LTM Guidance; EC 2013). This guidance is typically required at federal sites relying on "elimination of contaminant transport pathways to receptors rather than physical removal or treatment of contaminants". This Sä Dena Hes terrestrial LMP has three general components/activities/objectives that are consistent with the FCSAP guidance:

- Evaluate risk assessment and/or risk management assumptions (i.e., collect data to ensure that exposure pathways, contaminants, and receptors have not changed and the site continues to meet risk assessment criteria).
- Inspect stabilized structures such as soil covers and successful revegetation.
- Confirm institutional and administrative controls (e.g., fencing, signage, site access barriers.)

The Sä Dena Hes terrestrial LMP is also consistent with the process outlined in the FCSAP LTM guidance (i.e., six-step process based on US EPA 2004; initial steps are covered in this memorandum; latter steps would be part of implementing the LMP):

Steps for LMP	TERA	HHRA
1. Identify monitoring plan objectives	Section 2	Section 2
2. Develop monitoring plan hypotheses	Section 5 and Table 4	Section 5 and Table 4
3. Formulate monitoring decision rules	Guiding decision-rules provided in Table 4	Guiding decision-rules provided in Table 4
4. Design the monitoring plan	Section 5 and Figure 2 (as well as planning phase prior to sampling)	Section 5 and Figure 3 (as well as planning phase prior to sampling)
5. Conduct monitoring analyses and characterize results	Future activity during implementation of LMP	Future activity during implementation of LMP
6. Establish the management decision	Future activity during implementation of LMP	Future activity during implementation of LMP

4 Summary of Risk Assessment Findings

4.1 TERA Findings

The TERA for the Sä Dena Hes Mine evaluated risks to terrestrial ecological receptors from exposure to metal-contaminated soils, water and other media (i.e., food sources such as plants, invertebrates and small mammal prey that may have accumulated higher levels of metals from areas with contaminated soil). Readers are referred to more detailed information in various TERA reports (e.g., most up-dated information can be found in the TERA Addendum; Azimuth 2015b). Key information on the TERA is as follows:

- Contaminants of potential concern (COPCs) in Site soils included antimony, arsenic, cadmium, copper, lead, molybdenum, nickel, selenium, silver, vanadium, and zinc. Lead and zinc were considered priority COPCs based on the risk assessment findings.
- Hydrocarbon contamination was present in deeper soils in some areas; these areas were covered with a 60 cm soil cover), so pathways to plants and animals were closed. Based on site assessment work, hydrocarbons have not impacted groundwater. A groundwater monitoring plan addresses hydrocarbons (Golder, 2015a) and will be part of the Water Licence monitoring.
- Ecological receptors evaluated in the TERA were microbial communities, terrestrial plant communities, terrestrial invertebrate communities, birds (17

species, e.g., Wilson's warbler, American kestrel and boreal chickadee), mammals (16 species, e.g., common shrew, hoary marmot, and moose) and terrestrial amphibians[2] (i.e., Western toad). The wildlife selection process targeted species that are both common and rare or endangered ("listed"), to cover a spectrum of species with different diets (e.g., herbivorous, omnivorous, carnivorous) and foraging strategies.

- Based on Golder 2015b, the Areas of Environmental Contamination (AECs) that were investigated in the TERA included (**Figure 1**):
  - AEC 1: Jewelbox Hill[3]
  - AEC 2: Burnick, including AEC 2.1: Burnick Waste Rock Pile and AEC 2.4: 1300 Portal
  - AEC 3: Mill Site
  - AEC 5: Boneyard
  - AEC 8: Tailings and Reclaim Ponds
  - AEC 9: Main Zone, including AEC 9.1: Waste Rock Dump, AEC 9.2: 1250 Portal, and AEC 9.4: 1380 Gully
- The TERA provided a risk and uncertainty rating under post-closure conditions for each receptor group and AEC. Risks were categorized as "negligible", "low", "moderate" or "high", based on the totality of available data.
- The post-closure scenario assumed site conditions and habitats 25 years after mine closure completion. This included capping of the Tailings Management Facility and Mill Site, recontouring and reclaiming the Burnick areas [not capping], and recontouring and partially covering the Jewelbox/Main Zone areas).
- In the post-closure scenario, it was assumed that application of soil covers would result in soil and tissue (except plants) concentrations in reclaimed areas that are consistent with local "background/reference" concentrations.
- COPC concentrations and spatial extent of contamination in residual areas (e.g., 1380 Gully and toe of waste rock piles) are assumed to be stable or improving in the future.

Overall findings for the TERA are summarized by AEC in **Table 1** below.

Observations regarding post-closure risk conclusions (uncertainty ratings varied by receptor group and AEC) are provided below for context:

- Risks to microbial, plant and invertebrate communities are considered negligible or low in all AECs.
- Overall, risks to mammals and birds with large home ranges and/or plant-based diets are generally considered negligible or low. The exceptions were willdlife with small home ranges and carnivorous diets in AEC 1/9 and 2 (see below).

[2] Potential risks to amphibians were reported in the AERA; however, terrestrial amphibians (or lifestages) are considered in this LMP.

[3] AEC 1 and AEC 9 were evaluated together in the TERA because locations were overlapping/adjoining.

- Potential risks to amphibians in most AECs were considered negligible or low, with the exception of the Jewelbox/Main Zone AEC (see below).
- Reclamation/remediation actions such as applying soil covers reduced risk ratings for many receptors under post-closure conditions.
- When elevated risks (i.e., moderate to high) were predicted for birds and mammals under post-closure conditions, they tended to be driven by incidental ingestion of soil, as well as ingestion of ground invertebrates and small mammal prey (but not vegetation).
- After regrading the Burnick/1300 Portal area (AEC 2) in 2014, zinc in soils (which were not capped) and invertebrate tissues still resulted in potentially elevated risks to birds. However, the Burnick area is small (3.35 ha) and unlikely to provide enough food or habitat to support populations of common species, or many individual listed birds. Based on a wildlife analysis, two listed bird species (i.e., yellow-bellied flycatcher and white throated sparrow) are likely to have 1 to 3 individuals exposed to contamination at Burnick at any one time. Based on the literature, potential consequences for these birds include mortality and substantial reductions in growth and reproduction.
- Because applying a soil cover to the Jewelbox/Main Zone (AEC 1/9) waste rock area was not initially planned, the initial post-closure risk predictions in this area were based on characterization of 2014 conditions (i.e., after regrading but before the cover was added [see next bullet]). Under these conditions, lead and zinc concentrations were sufficiently high in soils and tissues to pose high risks (with high uncertainty) to several wildlife species, including:
    - Arctic ground squirrel and common nighthawk are common species with 50% of the local mine site population exposed to AEC 1/9, and
    - Six listed bird species (yellow-bellied flycatcher, American kestrel, white-throated sparrow, American redstart, Townsend's warbler, and golden-crowned kinglet) were estimated to have 1 to 10 individual birds exposed.
    - Western toad (listed amphibian) based on soil toxicity thresholds from the literature; however presence and abundance of the toad were not evaluated.

  Based on the literature, potential effects (pre-cover) include mortality and substantial reductions in growth and reproduction.
- Based on the above risk predictions in Jewelbox Hill/Main Zone AEC 1/9, Teck applied a 0.20 m soil cover on the re-contoured waste rock and bench. The soil cover on the re-contoured bench is expected to reduce exposure of birds and mammals to elevated metals in soils and prey items, as well as reduce the number of birds and mammals exposed, given a smaller contamination footprint. However, primarily due to residual areas of contamination beyond the cover footprint, potential risks to some birds and mammals are predicted to remain and are uncertain.

4.2 HHRA Findings

A HHRA was prepared for the Sä Dena Hes mine site in April 2014 and later updated in November 2015 to reflect post-closure conditions at the site. The HHRA identified a number of sources of metals exposure that exceeded the maximum permissible human health risks under the YT CSR.

Samples of soil, water, berries, and key plants used as traditional medicines (caribou weed and Labrador tea) were collected from various areas of the mine site. Members of the LFN assisted in sample collection and elders were consulted to identify plants and animals that might be used from the site as country foods or traditional medicines. The samples were analyzed for metal concentrations.

In a series of meetings and site visits, LFN elders advised Teck and Azimuth how they might use the site after the mine is closed. This is important because the amount of exposure people can have to environmental contamination at the site depends on how much time they will spend at the site and what kind of activities they are doing there. This information was used to estimate exposure to metal concentrations from spending time at the mine or consuming country foods or traditional medicines from the mine following closure. Azimuth compared these estimates to the maximum levels of human exposure allowed under Yukon environmental regulations.

The following summarizes findings for post-closure conditions:

Soil

Lead is a well-known contaminant and is one of the potentially more harmful metals present in environmental media at the site. Consequently, the HHRA focused on this metal and remediating the site to make it safe from exposure to lead would also make it safe from exposure to other metals, such as copper or zinc. During the mine closure process, it was identified that high concentrations of lead in soil at the Mill Site, Tailings Management Facilities, Jewelbox/Main Zone mining areas, Burnick ore zone, and the 1380 Gully are elevated sufficiently that they could present a health risk to public that visit these areas. Therefore, as described in the DDRP, soil covers were placed in the more accessible areas where lead concentrations are greater than 400 ppm[4]. While these remediation covers are an effective remedial option to manage potential human exposures from direct contact with the underlying contaminated soil, the cover may not mitigate human health risks from the consumption of plants or small animals living in or on the cover that have bioaccumulated metals from the underlying contaminated soil. In addition, there are less accessible areas of the site with residual lead concentrations greater than 400 ppm, which means that other risk management measures for the site are necessary. As discussed with regulatory agencies and First Nations, these measures include signage, road decommissioning and physical barriers to restrict public access. Another reason to restrict access to the Jewelbox area is that there are physical hazards related

[4] The YT CSR standard residential soil standard for lead for protection of human health is 500 ppm, but Teck chose to use 400 ppm to be consistent with the recently amended BC CSR standard and in recognition that some agencies are reviewing and revising their environmental standards for lead.

to areas of potential subsidence and steep terrain (with drop-offs);Teck has installed specific signage to discourage access to these areas.

Water

Current water testing shows that, the majority of the time, water quality in Camp Creek (the main stream that flows through the site) is below the Guidelines for Canadian Drinking Water Quality for all metals. Intermittently, there have been water samples that exceed some of those guidelines. Putting aside the potential for naturally occurring microbial pathogens, such as the microorganism that causes “beaver fever”, this does not necessarily mean that the water is unsafe to drink. In order for the water to be potentially harmful for drinking, guidelines must be exceeded for an extended time period, conditions that are not observed in Camp Creek. To track water quality, post-reclamation water quality monitoring will occur. People should not use the water from on or near the site as a long-term source for drinking water unless there is regular testing to confirm that it meets the Guidelines for Canadian Drinking Water Quality. Aside from concerns such as beaver fever, occasionally drinking water from the site (e.g., filling a water bottle from a creek) is not a health risk.

*Country Fo*ods

Berries from most areas of the mine site are safe for human consumption. However, human consumption of berries collected from some areas of the Jewelbox Hill, 1380 Gully, Mill Site, and a small area just north of the tailings pond could result in exposure to more lead than is permitted under Yukon environmental regulations. Testing has not been done for any other types of plants or animals that people may consume as food and consumption of small animals or other types of plant material from these same areas of the site may also be a risk. Although they haven’t been tested, larger animals like moose and deer are expected to be safe for humans to eat because they don’t spend a lot of time at the site. Access to these areas will be limited as the majority of the on-site roads will be deactivated and warning signage will discourage public use.

Remediation covers were placed over contaminated soil at the former North Tailings Pond, South Tailings Pond, and Reclaim Pond. Over the long term plants that grow in the remediation covers in these areas may bioaccumulate metals from the underlying contaminated soil. Therefore, risk management measures to prevent human consumption of plants and small animals as food or traditional medicines are recommended for these areas until such time as future monitoring data show that these potential risks are acceptable.

Traditional Medicines

Herbal teas made from samples of caribou weed and Labrador tea from the mine site were tested. The levels of metals in herbal teas made from Labrador tea leaves were all below the maximum levels allowed under Yukon environmental regulations. The levels of metals in herbal teas made from caribou weed leaves were also below the maximum levels allowed under Yukon environmental regulations for all areas of the mine site except for Jewelbox Hill.

Based on the results of the human health risk assessment, **Table 2** below summarizes conclusions for the mine site related to the need for risk management.

4.3 DDRP Closure Measures

Closure measures undertaken by Teck to address risks at the Site are summarized at a high level in **Table 1**; more detailed information is provided in Teck (2015).

Legend

- River/Creek
- Ephemeral stream
- Area of Environmental Concern (AEC; Golder 2015b)
- Recontoured Areas
- Remediation Cover Areas 2015
- Remediation Cover Areas 2014

0 200 400 600
Metres

Projection: UTM Zone 9 NAD83

Data Sources:
Natural Resources Canada, GeoBase®
Teck Metals Ltd.
Azimuth Consulting Group

Figure 1: Areas of Environmental Concern (AECs) and Soil Cover Boundaries, Sä Dena Hes, Yukon Territory.

Sä Dena Hes

Prepared for: AZIMUTH

By: CASLYS CONSULTING

June 27, 2016

Table 1: Summary of TERA conclusions for the Sä Dena Hes Mine Site, under post-closure conditions. (See Azimuth 2015b for further details).

Area	Microbial Communities	Plant Communities	Terrestrial Invertebrate Communities	Birds	Mammals	Terrestrial Amphibians	Notes on Closure/Remediation (see Teck 2015 for details)
AEC 1/9 Jewelbox/Main Zone	✓	✓	✓	✗	✗	✗	Partial remediation in 2015 (soil cover of 0.20 m over part of waste rock) may reduce exposure/risks.
AEC 2 Burnick	✓	✓	✓	✗	✓	✓	Area recontoured in 2014.
AEC 3 Mill Site	✓	✓	✓	✓	✓	✓	Soil cover (0.20 - 1.0 m) applied over disturbed footprint in 2014/2015.
AEC 8 Tailings Facility	✓	✓	✓	✓	✓	✓	Soil cover of at least 0.5 m applied in 2014.

Legend:

✓ Risks to ecological receptor group are considered negligible or low under post-closure conditions.

✗ Risks to ecological receptor group are considered moderate or high under post-closure conditions (based on organism-level effects); specific wildlife species and approximate number of individuals are described in TERA.

Table 2: Summary of Human Health Risk Assessment Conclusions for the Sä Dena Hes Mine Site.

Area	Direct contact with residual contaminated soil	Consumption of plants and small animals[1,2]
Jewelbox Hill & 1380 Gully	✘	✘
1250 Portal & Waste Rock	✘	✓
Burnick Portal & Waste Rock	✘	✓
1300 Portal & Waste Rock	✘	✓
Mill Site	✘	?
Boneyard	✓	✓
North Tailings Pond	✓	?
North of North Tailings Pond Dam	✘	✘
West of North Tailings Pond	✘	✓
South Tailings Pond	✓	?
Reclaim Pond	✓	?
West of Reclaim Pond	✓	✓

✘ Human health risks in excess of those allowed under the YT CSR - risk management measures required

? Potential human health risks in excess of those allowed under the YT CSR - risk management measures may be required, depending on future conditions

✓ Human health risks within those allowed under the YT CSR - risk management measures not required

1 Plants includes mushrooms and small animals includes marmots and ground squirrels

2 Although they were not tested, the HHRA concluded that larger animals, such as lynx, deer and moose, are likely safe for humans to eat because these animals don’t spend enough time at the Site to build-up contaminants to levels that would present a potential human health risk.

*Risks from future long-term consumption of surface water or groundwater as drinking water are unknown because the future water quality is uncertain. Occasional consumption of small quantities of water, such as filling a water bottle from a creek, are not expected to present a health risks from exposure to metals, but consumption of untreated surface water may present a risk to health from exposure to naturally occurring microbial pathogens, such as *Giardia lamblia* (i.e., the protozoa responsible for "beaver fever").

5 Long-term Monitoring Plan

5.1 Overview

The LMP recommends six monitoring components to confirm that assumptions of the TERA and HHRA remain valid. The six components of the terrestrial LMP are:

1. Land use monitoring for HHRA (**Section 5.2**)
2. Monitoring soil cover integrity (HHRA and TERA; **Section 5.3**)
3. Monitoring metals chemistry in remediated areas for the TERA (**Section 5.4**)
4. Monitoring metals chemistry in areas with residual contamination for the TERA (**Section 5.5**)
5. Monitoring metals chemistry for the HHRA (**Section 5.6**)
6. Monitoring revegetation and wildlife habitats for the TERA (**Section 5.7**)

Table 3 describes information to support design of the terrestrial LMP program (e.g., details on areas, parameters and timing) for each of the six monitoring components. **Figure 2** shows specific AECs, or portions of AECs, which are targeted for monitoring for the TERA, including:

- Jewelbox/Main Zone Waste Rock Pile/Bench; part of AEC 1
- Tailings Management Facility (TMF); AEC 8
- Mill Site; AEC 3
- Toe of Jewelbox 1408 Waste Rock Pile (1408 WR); part of AEC 1
- 1380 Gully; AEC 9.4
- Reference areas; it is recommended that at least two reference areas (e.g., FF-Ref1, FF-Ref2, NC-Ref) be sampled with the main program to provide concurrent reference data.

Figure 3 shows HHRA restricted areas described in **Table 2** that should be monitored for land use (see **Section 5.2** below). **Figure 4** shows areas for HHRA-related metals chemistry monitoring (see **Section 5.6** below).

Prior to each monitoring event, a study design phase is recommended to ensure monitoring objectives are met and sampling is in line with the best practice at that time. The scope of the terrestrial monitoring program will be re-evaluated at periodic intervals to assess site performance against the assumptions of the TERA and HHRA. Based on the findings, various management actions may be triggered. The monitoring program and "working" decision rules for adapting the program are described in **Table 4** for initial stages of the LMP (next 10-20 years).

The LMP described in this memorandum is based on current information and site understanding. However, should site conditions change or new information with potential to change risk conclusions become available, the terrestrial LMP may need to be re-evaluated and adapted.

5.2 Land Use

Monitoring is required to confirm effective restriction of public access to the following areas of the site: Jewelbox Hill, 1380 Gully, 1250 Portal and Waste Rock, Burnick Portal and Waste Rock, 1300 Portal and Waste Rock, Mill Site, and the area to the north of the North Tailings Pond dam (TPN) and the forested strip to the west of the North Tailings Pond. These areas are indicated by the red polygons on **Figure 3**.

Monitoring is required to ensure that humans are not harvesting plants, including berries, and small animals for consumption from the following areas of the site: areas where human access is restricted (see above), the North Tailings Pond, the South Tailings Pond, and the Reclaim Pond. These areas are indicated by the yellow polygon on **Figure 3**.

Surface water or groundwater from the Site must be tested and monitored to ensure that it meets the Guidelines for Canadian Drinking Water Quality before being used as a source of human drinking water. Water monitoring will be conducted under the Water License.

Land use monitoring may include:

- Inspection of signs,
- Inspection for indicators of human access and use,
- Assessment of awareness of land use restrictions among local community and First Nations. This may include meetings or interviews with community members to gauge their awareness of the potential environmental hazards at the former mine site and the risk management measures in place to mitigate exposure to these hazards.

We understand that Teck will be conducting an annual formal inspection and will include sign inspection and observations of human access.

5.3 Soil Cover Integrity

Monitoring of soil cover integrity will confirm the stability and physical integrity of soil covers placed over various areas on-Site. This aspect of site performance is important because HHRA and TERA risk predictions may be invalid if soil cover integrity is compromised. The key areas to cover for the HHRA and TERA risk perspectives are: (1) JBX WR bench; (2) TMF (i.e., North Tailings Pond, South Tailings Pond and Reclaim Pond); and (3) Mill Site.

Monitoring will be coordinated by Teck/consultants as part of annual physical/geotechnical site inspection work. The proposed decision-rule for this component is presented in **Table 4**.

5.4 Metals Chemistry in Remediated Areas - TERA

Monitoring of terrestrial media in remediated areas will confirm post-closure assumptions from the TERA and targets areas that underwent remediation to address risks identified in the TERA (or HHRA). Specifically, soil covers were placed over the (1) JBX WR bench, (2) TMF and (3) Mill Site of the site to reduce exposure by wildlife and humans to elevated concentrations of contaminants such as lead and zinc. In the TERA, it was assumed that application of soil covers would result in soil and tissue (except plants) concentrations consistent with local background/reference concentrations. Given there is some uncertainty regarding the actual decrease in contaminant exposure and potential risks under post-closure conditions, concentrations of metals in soil and various biological tissues will be monitored as shown in **Table 3**. The rationale for including (or excluding) various media in the program is described below:

- Soil – Incidental soil exposure was one of the key drivers of elevated exposures and risks to birds, mammals and terrestrial amphibians. Once established in areas with soil covers, it is recommended that the top humic layer of soil be monitored over time to confirm post-closure assumptions in the TERA.
- Plants[5] (willow and alder twigs) – Plants were generally not driving risks in the TERA (even with elevated concentrations of COPCs in willow/alder in some areas of the Site). However, collection of plant tissues are considered useful for comparing pre and post-closure conditions (they integrate soil concentrations, are easy to collect and provide additional point of comparison). These data will provide a better understanding post-closure site conditions in general.
- Berries – Berries were generally not drivers of risk to ecological receptors. However, we note that one berry sample collected in 2015 from disturbed soils at the Mill Site had very elevated concentrations of lead, zinc and other metals, far outside the range of concentrations used in the TERA. While we expect this sample will not reflect post-closure conditions, follow-up monitoring of berries is recommended at the Mill Site.
- Soil invertebrates – Ingestion of soil invertebrates was one of the main exposure pathways driving potential risks to birds and mammals in the TERA. It is recommended that, once habitat is established in these reclaimed areas, ground invertebrates be monitored to confirm post-closure assumptions made in the TERA.
- Small mammals – Ingestion of small mammals was a driver of exposure and potential risks for some carnivorous wildlife in the TERA (in AEC 1/9 in particular). However, COPC concentrations in soil invertebrates tended to be higher than small mammals, and therefore soil invertebrates serve as a surrogate in this monitoring program. If other media (soils, invertebrates) show higher than expected post-closure concentrations, small mammal sampling could be added at a later time.

Details on the proposed chemistry sampling program (e.g., sampling locations, parameters, number of samples, and monitoring frequency) are provided in **Table 3**.

[5] It is recommended that willow and alder twigs be collected for long-term monitoring to be consistent with plant tissues that were collected for the TERA. Other plant tissues (leaves/grasses) could be added to the program if there is rationale at the time of monitoring.

Sampling methods should generally follow procedures documented in the Data Report (Azimuth 2014a) and Volume 2A TERA Addendum (Azimuth 2015b). In terms of frequency, it is expected that it will take approximately ten years (or more)[6] for plant root systems to develop sufficiently to penetrate the cap layer and reach contaminated soils[7]. Revegetation will be the first step in recolonization of these areas with other biota (see additional revegetation monitoring in point 4 below). Thus, sampling of terrestrial media from the three areas described above will be conducted in approximately 2025. Timing of this program may be adjusted based on reclamation monitoring information collected by Teck (see **Section 5.7** below).

Future concentrations will be compared to concentrations measured during the TERA in each AEC and, most importantly, to background/reference conditions to determine whether site conditions meet TERA assumptions. The proposed decision-rules are based on the outcomes of these comparisons as described in **Table 4**.

5.5 Metals Chemistry in Residual Areas - TERA

This monitoring will assess post-closure conditions and recovery (if any) in areas that were not physically remediated but are downgradient of mine sources that were remediated. The objective of this sampling is to confirm that conditions are stable or improving.

Areas that were key risk drivers in the TERA will be targeted, specifically, the 1408 WR and 1380 Gully[8]. Other areas with 'residual' contamination (e.g., TPN, JBX WR[9]) are not considered priorities because concentrations were only moderately elevated (relative to 1408 WR and 1380 Gully) and were not key risk drivers in the TERA.

Limited follow-up monitoring (approximately two cycles) of these areas is recommended. This program will include sampling soil, plants (willow and alder twigs), ground invertebrates for comparison of future versus pre-closure chemistry. Small mammals could be added to the program if concentrations in other media are higher than expected). Further details on the proposed program are provided in **Table 3**, using methods described in Azimuth (2014, 2015), and timing to coincide with the program for remediated areas (**Section 5.4**). Follow-up monitoring beyond this time frame will be considered based on the results of the initial two events, with proposed decision rules shown in **Table 4**.

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[6] Plant root depths could be measured after approximately 5 years and compared to soil cover depths to help inform timing for initiating the terrestrial LMP.

[7] Vegetation concentrations measured during the TERA were not driving risks to ecological receptors; so the soil covers are not required to serve as a barrier to plant root uptake of metals.

[8] Information supporting the TERA indicated that natural background contamination was likely a source of metals in the 1380 Gully, with additional contributions from the mine site not ruled out. This may be important to consider when designing the monitoring program (i.e., locations) and interpreting monitoring data.

[9] Concentrations in JBX WR station were quite elevated, but not as high as 1408 WR and 1380 Gully; these latter areas are targeted as priorities.

5.6 *Metals Chemistry - HHRA (Optional)*

Pending decisions about increasing access to some areas of the former mine site, monitoring of terrestrial media in specific areas is recommended to confirm post-closure conditions for the HHRA. There would be two components to this optional program:

- ***Soil -*** There are currently insufficient samples to calculate a representative estimate of the average concentration of lead in soil in the forested strip to the west of the North Tailings Pond (TPN West-berm and nearby areas) and the area just north of the North Tailings Pond dam (TPN) (see pink polygons on **Figure 4**). The recommended public access restrictions for these areas can be removed if representative soil samples are collected and subsequent analysis shows that human health risks are acceptable.

  This soil sampling would involve a one-time program designed to meet the requirements for calculating HHRA risk estimates. Sampling procedures should generally follow those conducted for the HHRA (see Azimuth 2014a,b). There are no constraints on the timing of this soil sampling – it can be conducted at any time that it is efficient to do so.

- ***Plants & Small Animals -*** The remediation covers placed on the TMF (specifically the North Tailings Pond, South Tailings Pond, and Reclaim Pond; see blue polygons on **Figure 4**) are expected to mitigate the bioaccumulation of contaminants by plants and animals living in these areas. However, data are required to verify this expectation. The recommended harvesting restrictions for these areas may be removed if tissue samples are collected and subsequent analysis shows that human health risks are acceptable.

  Plant and small animal tissue monitoring supporting the HHRA could have a similar scope (i.e., targeting berries, and small animals) and same frequency (i.e., approximately 10 year cycles beginning in 2025) as the TERA program documented in **Section 5.4**. The data would be analyzed to determine whether human health risk based standards are met. Further details on the proposed program are provided in **Table 3**, using methods described in Azimuth (2014a). Monitoring would continue until the vegetation community has reached its climax successional stage and there is sufficient evidence to establish that contaminant concentrations in biota are stable or improving (i.e., not increasing over time).

5.7 *Vegetation and Wildlife Habitat Monitoring*

Vegetation and wildlife habitat monitoring consists of two components:

- ***Reclamation monitoring:*** Assessments of the revegetation program will be conducted Teck/ consultants in midsummer for a minimum of five years. The main focus of the monitoring will be to ensure that the prescriptions applied to the disturbed sites on the mine are successful. The assessments will be made on seedling survival and height growth, seeded germination success, composition and natural succession, with observations of bird and mammal usage. In year 5, plant root depths could be measured and compared to soil cover depths in the various AECs. The information collected may be useful for updating the wildlife habitat assessment (4b below) and determining timing of the terrestrial monitoring (**Section 5.4** above). The reclamation monitoring is part of Teck's Environmental Monitoring Plan.

- **Updated wildlife habitat assessment:** The distribution and type of vegetation that establishes across the Mine Site over time will influence how wildlife species forage and may be exposed to COPCs. Depending on the outcome of chemistry sampling program (see decision rules specified in point 2 above), re-assessment of wildlife habitats may be conducted by an experienced wildlife biologist, to confirm post-closure conditions in the reclaimed habitats. Essentially, if future concentrations do not meet TERA assumptions, updating habitat units in restored areas may be necessary to re-evaluate risk predictions in the TERA (i.e., re-run food chain model).

The monitoring program described in this memorandum is based on current information and site understanding. However, should site conditions change or new information with potential to change risk conclusions become available, the terrestrial LMP may need to be re-evaluated and adapted.

Legend

- River/Creek
- Ephemeral stream
- Monitoring in Reference Areas (TERA)
- Monitoring in Residual Areas (TERA)
- Monitoring in Remediated Areas (TERA)

0 200 400 600
Metres

Projection: UTM Zone 9 NAD83

Data Sources:
Natural Resources Canada, GeoBase®
Teck Metals Ltd.
Gebauer & Associates Ltd.
Azimuth Consulting Group

Figure 2:
Mine Site Areas for TERA Long-term Monitoring, Sä Dena Hes Mine, Yukon Territory.

Sä Dena Hes

Prepared for: AZIMUTH

By: CASLYS CONSULTING

June 27, 2016

Legend

- River/Creek
- Ephemeral stream
- Restricted harvesting of plants and small animals for human consumption
- Restricted public access of plants and small animals for human consumption

0 200 400 600

Metres

Projection: UTM Zone 9 NAD83

Data Sources:
Natural Resources Canada, GeoBase®
Teck Metals Ltd.
Azimuth Consulting Group

Figure 3: HHRA Land Use, Sä Dena Hes, Yukon Territory.

Sä Dena Hes

Prepared for: AZIMUTH

By: CASLYS CONSULTING

June 27, 2016

Legend

- River/Creek
- Ephemeral stream
- Soil Chemistry Sampling (HHRA) – Optional
- Plants and Small Animals Chemistry Sampling (HHRA) – Optional

0 200 400 600

Metres

Projection: UTM Zone 9 NAD83

Data Sources:
Natural Resources Canada, GeoBase®
Teck Metals Ltd.
Azimuth Consulting Group

Figure 4: Mine Site Areas for HHRA Long-term Monitoring Sä Dena Hes, Yukon Territory.

Sä Dena Hes

Prepared for: AZIMUTH

By: CASLYS CONSULTING

June 27, 2016

Table 3: Information to support design of the terrestrial LMP for the Sä Dena Hes TERA and HHRA.

Study Component	Areas[1] and Sample Information	Parameters	Timing/Frequency
I. Land Use (Section 5.2)			
Land Use - Restricted Access & Restricted Harvesting	Jewelbox Hill; 1380 Gully; 1250 Portal; Burnick 1200; Burnick 1300; Mill Site; TPN; forested strip west of the North Tailings Pond.	--- (Teck described separately) ---	
Land Use - Restricted Harvesting	North Tailings Pond; South Tailings Pond; Reclaim Pond	--- (Teck described separately) ---	
II. Soil Cover Integrity (Section 5.3)			
Soil Cover Integrity	JBX WR bench; TMF (including North Tailings Pond, South Tailings Pond and Reclaim Pond); Mill Site	--- (Teck described separately) ---	
III. Metals Chemistry in Remediated Areas - TERA (Section 5.4)			
Soil chemistry	JBX WR bench; TMF; Mill Site Humic (and some inorganic) soils, all areas, synoptic with tissues	Total metals, TOC, grain size, pH	Ten year cycle after remediation (2025, 2035, then to be re-evaluated)
Berry chemistry	Mill Site; Three spatially independent samples over the soil cover footprint	Total metals, moisture content	Ten years after remediation (2025) then to be re-evaluated
Plant twigs[2] (alder/willow) chemistry	JBX WR bench; TMF; Mill Site; One composite sample from each area (or subdivided area)	Total metals, moisture content	Ten year cycle after remediation (2025, 2035, then to be re-evaluated)
Ground invertebrate chemistry	JBX WR bench; TMF; Mill Site; One composite sample from each area (or subdivided area)	Total metals, moisture content	Ten year cycle after remediation (2025, 2035, then to be re-evaluated)
Small mammal chemistry *[conditional on findings from other monitoring; see text]*	JBX WR bench; TMF; Mill Site; Three-five individuals from each area (or subdivided area)	Total metals, moisture content	Conditional; to be considered if metals concentrations in other tissue types are higher than expected (see Table 4)

Table 3: Information to support design of the terrestrial LMP for the Sä Dena Hes TERA and HHRA.

Study Component	Areas[1] and Sample Information	Parameters	Timing/Frequency
IV. Metals Chemistry in Residual Areas - TERA (Section 5.5)			
Soil chemistry	1408 WR; 1380 Gully Humic (and some inorganic) soils, all areas, synoptic with tissues	Total metals, TOC, grain size, pH	Ten year cycle after remediation, (2025, 2035, then to be re-evaluated)
Plant twigs[2] (alder/willow) chemistry	1408 WR; 1380 Gully One composite sample from each area (or subdivided area)	Total metals, moisture content	Ten year cycle after remediation, (2025, 2035, then to be re-evaluated)
Ground invertebrate chemistry	1408 WR; 1380 Gully One composite sample from each area (or subdivided area)	Total metals, moisture content	Ten year cycle after remediation, (2025, 2035, then to be re-evaluated)
Small mammal chemistry *[conditional on findings from other monitoring; see text]*	1408 WR; 1380 Gully Three-five individuals from each area (or subdivided area)	Total metals, moisture content	Conditional; to be considered if metals concentrations in other tissue types are higher than expected (see Table 4)
V. Metals Chemistry - HHRA *[OPTIONAL; see text Section 5.6]*			
Soil chemistry	Forested strip west of the North Tailings Pond (TPN West-berm and nearby areas); north of the North Tailings Pond dam (TPN) Designed to support HHRA exposure estimates (i.e., as per HHRA methods) ; sufficient sample numbers that areas of elevated metals are delineated and representative average metals concentrations can be calculated	Total metals, TOC, grain size, pH	Optional, see text Section 5.6. No time constraints; one-time event
Berry chemistry	North Tailings Pond; South Tailings Pond; Reclaim Pond; at least three samples of each berry species present	Total metals, moisture content	Optional, see text Section 5.6. Ten year cycle after remediation, (2025, 2035, then to be re-evaluated)
Small mammal chemistry	North Tailings Pond; South Tailings Pond; Reclaim Pond; at least three samples of each species	Total metals, moisture content	Optional, see text Section 5.6. Ten year cycle after remediation, (2025, 2035, then to be re-evaluated)
VI. Vegetation & Wildlife Habitat Assessment (pending; see text Section 5.7)			
Reclamation (revegetation)	Reclaimed areas throughout mine site property	--- (Teck described separately) ---	Annually for minimum of five years
Wildlife habitat assessment	Entire mine site property	Update habitat polygons, list of receptors, habitat ratings for receptors	Pending, see text Section 5.7; to be considered if metals concentrations are higher than expected (see Table 4)

Notes

[1] It is expected that areas will be subdivided into smaller sampling locations within the AEC.

[2] Willow and alder twigs are recommended to be collected for sampling to be consistent with the TERA; other plant tissue types may be added with rationale at the time of monitoring.

Table 4: Summary of guiding decision rules[1] for the Sä Dena Hes terrestrial LMP supporting the TERA and HHRA.

	Finding	Implication	Action
1. Land Use Monitoring (Section 5.2)			
a)	Restricted use following HHRA recommendations	Meets HHRA assumptions	Maintain regular inspections
b)	Signs of site use are inconsistent with HHRA recommendations	May not meet HHRA assumptions; implications for site management to be evaluated	To be determined
2. Monitoring Soil Cover Integrity (Section 5.3)			
a)	Soil cover remains intact	Meets TERA/HHRA assumptions	No additional monitoring triggered
b)	Soil cover integrity compromised (significantly[2])	AEC may not meet TERA/HHRA assumptions; implications for risk conclusions and site management to be evaluated	Sample soil chemistry; consideration sampling other media; risk assessor to make recommendations on monitoring program (see decision rules based on chemistry in #3 below)
3. Metals Chemistry Monitoring of Remediated Areas - TERA (Section 5.4)			
a)	Future concentrations equivalent to or lower than reference concentrations	Meets TERA assumptions	Monitor at regular cycle; cease monitoring once stable conditions confirmed
b)	Future concentrations between reference and pre-closure AEC concentrations	AEC may not meet TERA assumptions; implications for risk conclusions and site management to be evaluated	Depending on magnitude of concentrations, continue monitoring but consider increased frequency to confirm trends/conditions; consider monitoring additional media; consider updating wildlife habitat assessment; evaluate implications for TERA and site management; cease monitoring once stable conditions confirmed
c)	Future concentrations above pre-closure AEC concentrations	AEC does not meet TERA assumptions; implications for risk conclusions and site management to be evaluated	Actions as per 3b above with higher alert and recommended increased monitoring frequency

Table 4: Summary of guiding decision rules[1] for the Sä Dena Hes terrestrial LMP supporting the TERA and HHRA.

	Finding	Implication	Action
4. Metals Chemistry Monitoring of Residual Areas - TERA (Section 5.5)			
a)	Future concentrations equivalent to or lower than pre-closure AEC concentrations	Conditions stable or improving	Monitor for approximately two cycles; cease monitoring once stable conditions confirmed
b)	Future concentrations above pre-closure AEC concentrations	Unexpected increase in concentration; implications for risk conclusions and site management to be evaluated	Depending on magnitude of concentrations, continue monitoring but consider increased frequency to confirm trends/conditions; evaluate implications for TERA and site management; cease monitoring once stable conditions confirmed
5. Metals Chemistry Monitoring - HHRA (Section 5.6)			
a)	Future concentrations meet human health risk-based standards	Meets human health risk-based standards	Land-use restrictions could be removed; for plants and small animals may require monitoring at regular cycle until stable conditions confirmed
b)	Future concentrations do not meet human health risk-based standards	Does not meet human health risk-based standards	Maintain land-use restrictions
6. Reclamation Monitoring (Section 5.7)			
a)	Revegetation monitoring - use to inform timing of metals chemistry monitoring (#3 and #5 above)		
b)	Updating the wildlife habitat assessment - dependent on findings of metals chemistry monitoring (#3 above)		

Notes:

[1] Decision rules to consider each media/tissue at each AEC for lead and zinc. Specific methods and interpretation of categories are not defined here and could range from qualitative comparisons to statistical analysis; to be determined during planning/monitoring.

[2] The degree to which the soil cover integrity is comprimised will affect whether TERA or HHRA assumptions are invalidated. "Significance" will be based on professional judgement of site managers and risk assessors and will consider information such as the size of area that is compromised, the depth of perturbation, the number of areas that are compromised, chemical concentrations, etc.

6 LTM Reporting

Upon completion of each terrestrial LMP program, a technical report will be prepared that documents findings of each monitoring task relative to assumptions made in the TERA and HHRA and previous data. Specifically, the report will evaluate whether concentrations have changed as expected (e.g., decreased in remediated areas; area meets human health risk-based standards), or whether unexpected conditions are present. The guiding decision rules (**Table 4**) will be applied to modify monitoring as needed. The technical reports will also assess the implications of the future chemistry data on risk predictions and site management (as needed), and provide recommendations as appropriate. Human health and ecological risk assessors will be involved in preparing and reviewing these technical reports.

7 References

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8 Use and Limitations of this Memorandum

This memorandum has been prepared by Azimuth Consulting Group Partnership (Azimuth) for the use of Teck Resources Limited (Teck; the Client), the Liard First Nation and their reviewers, and the Yukon Government (Ministries of Energy Mines and Resources [EMR] and Environment Yukon [EY]). This memorandum is intended to provide information to Teck to assist with making decisions regarding long-term monitoring of the Sä Dena Hes Mine terrestrial environment. The Client has been party to the development of the scope of work for the subject project and understands its limitations.

In providing this memorandum and performing the services in preparation of this memorandum Azimuth accepts no responsibility in respect of the Site described in this memorandum or for any business decisions relating to the Site, including decisions in respect of the management, purchase, sale or investment in the Site.

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In addition, the conclusions and recommendations of this memorandum are based upon applicable legislation existing at the time the memorandum was drafted. Changes to legislation, such as an alteration in acceptable limits of contamination, may alter conclusions and recommendations.

This memorandum is time-sensitive and pertains to a specific site and a specific scope of work. It is not applicable to any other site, development or remediation other than that to which it specifically refers. Any change in the Site, remediation or proposed development may necessitate a supplementary investigation and assessment.

APPENDIX E

PROPOSED POST RECLAMATION GEOTECHNICAL MONITORING PROGRAM (SRK, 2014)

SRK Consulting (Canada) Inc.
2200–1066 West Hastings Street
Vancouver, BC V6E 3X2

T: +1.604.681.4196
F: +1.604.687.5532

vancouver@srk.com
www.srk.com

Memo

To:	Michelle Unger,	**Client:**	Teck Resources
From:	Peter Healey	**Project No:**	1CT005.046
Cc:	Gerry Murdoch	**Date:**	September 11, 2014
Subject:	Proposed Post Reclamation Geotechnical Monitoring Program		

1 Introduction

SRK Consulting (Canada) Inc has been requested by Teck Resources Limited (Teck) to prepare this post-closure Geotechnical Monitoring Program for structures and features that would form part of the closed Sa Dena Hes mine located near Watson Lake, Yukon. This memo provides a description of each of the mine components, the type of inspections, reviews and plans that would be completed and their frequency over the years following closure of the mine.

Annual inspections would be completed for a number of years, post-closure of the mine site including the remaining tailings embankment, spillways, soil covers, diversions and waste rock dumps. Details of frequency and who would carry out the inspections are provided in the sections to follow. During the inspection, the structures will be inspected to identify conditions that could potentially adversely impact the long-term performance of structures during the post closure period. Annual inspection reports will be prepared and submitted to the Yukon Water Board.

A review of Canadian Dam Association, Dam Classification category of the North Dam would be carried out as part of the next annual geotechnical inspection. The scope would also include an update to the Operations, Maintenance and Surveillance Manual (OMS) and the Environmental Preparedness Plan (EPP).

Figure 1 shows a general location map of the mine site and identifies the components that will be inspected.

2 Inspections, Reviews and Plans

2.1 Annual Inspections

Teck shall ensure that an annual inspection of the mine site be carried out by a qualified geotechnical engineer. The focus of the inspections would be the North Dam, the Sediment retaining structure (SRS) and spillway, soil covers, diversions and waste rock dumps. The findings of the inspection should be formalized in a report, which includes an evaluation of the annually measured piezometer levels and settlement readings at the North Dam. The inspection should take place as soon as possible after the snow has melted. This would allow any necessary remedial work to be completed prior to the rainy season.

Extra ordinary inspections should be carried out after any significant storm or seismic events. The triggers for these inspections would be no less than a 50 year flood event and a seismic event equivalent to a Modified Mercalli Intensity scale of IV (Moderate) as felt in Watson Lake.

Specific details of the annual inspections for each of the mine components are provided in Section 3.

After the first 5 years following closure, the annual inspection would be carried out by a qualified professional engineer.

After 5 years annual inspection would be carried out by an appropriate representative of the owner responsible for the safety of the tailings storage facility, supplemented by inspections every 5 years by qualified professional engineer.

A report would be prepared after each inspection.

2.2 Dam Safety Review

The last DSR was carried out in 2009 by Golder Associates. The CDA Dam Classification for the North Dam reported in the 2009 review was *Significant* and consequently a review frequency of every ten years would be required. However, under post closure conditions, the North Dam could be downgraded to a *low* consequence category (as it was in the 2003 Klohn review) and as such no future DSR's would be required. A review of the consequence classification would be carried out during the next formal annual inspection and written up as a separate report.

2.3 Operations, Maintenance and Surveillance

The last OMS Manual was prepared by SRK in 2004. The manual was prepared in accordance with a requirement under Section 74 of the mine's current Water Licence #QZ99-045. The Mining Association of Canada's (MAC) publications: Developing an Operation, Maintenance and Surveillance Manual for Tailings and Water Management Facilities (September 2002) as well as the Canadian Dam Association's (CDA) "Dam Safety Guideline" were used to develop the framework for the manual.

The manual was intended to provide procedures required to operate, monitor the performance of, and maintain the TMF and associated water management facilities to ensure that they function in accordance with their design, meet regulatory and corporate policy obligations, and link to the emergency preparedness and response plan.

An update to the 2004 OMS manual should be completed in 2015 and would focus on the maintenance and surveillance of the following components: the North Dam, the soil covers, the SRS and spillway, the waste rock dumps and the diversion channels. The plan should be updated every ten years. However annual updates to the contact information should be made, as required.

2.4 Emergency Preparedness

The last Mine Emergency and Response Plan (MERP) was prepared by SRK as part of the 2004 OMS. The plan was directed mainly at the tailings management facility including the three dams, the spillways and the diversion ditches. Under future closure conditions, the emergency contact information in the EPP should be updated in 2015 and the MERP should be reviewed and revised in 2015 to reflect the closure conditions. The MERP should outline the response procedures and preventive measures that would be required for effective and timely management of an emergency situation.

3 Mine Components

3.1 North Dam

After final closure of the mine, the North Dam will be the only remaining embankment on site. This dam will continue to retain tailings at the northern end of the original tailings management facility. The piezometers and settlement gauges within the dam are still intact and functional.

A site plan of the North Dam is presented on Figure 2 and a typical section through the dam is shown in Figure 3. The North Dam is approximately 15 m high, with a crest elevation of 1098 m, a crest length of about 260m and a crest width of 10 m. Based on the original tailings storage curve (SRK, 1990b), the total storage for the overall impoundment would be about 1 million m^3 at an assumed elevation of 1097 m. As part of the closure conditions, a 0.5m soil cover will be placed over the tailings with no ponded water.

The cover will be graded to provide positive drainage of surface runoff away from the dam.

Standpipe piezometers are located within the crest of the dam. Settlement gauges, which were installed during construction of the dam, can also be found on the crest of the dam.

The piezometric levels in the piezometers will be recorded during the annual water quality monitoring program as part of the Adaptive Management plan.

This structure would be inspected in accordance with the guidelines outlined in section 2.1 above.

3.2 Sediment Retaining Structure and Spillway

The SRS shown on Figure 4 would be constructed by leaving in place a portion of the South Dam fill along the upstream toe of the dam. A spillway would be built through the SRS to accommodate the 1,000 year runoff event. The peak inflow for this event, 5.4 m^3/s, was recently updated by SRK in the 2013 update to the Detailed Decommissioning and Reclamation Plan (DDRP) (Appendix D).

The SRS would have a crest elevation of 1,087.7 m and the spillway through the dyke would have a finished invert elevation of 1,086.0 m. The upstream face would be built with a 2H:1V slope. The downstream slope would be constructed to 2.5H:1V.

The spillway and dyke would be inspected as part of the annual geotechnical inspection to ensure the stability of the dyke and the integrity of the spillway to safely discharge the design flow.

Annual maintenance would include:

- Clearing of any debris in the channel;
- Repairing of cavitation or eroded aprons; and
- Removal of any vegetation.

3.3 Drainage Channels

Three drainage channels would be constructed as part of the decommissioning of the TMF. One channel would be built from the outfall of the SRS to a convergence with the realigned Camp Creek channel. The second would be built from a point upstream of the existing Camp Creek Diversion in the original Camp Creek channel as shown on Drawing SDH-DR-09 (Appendix A). The start point of this channel would be determined in the field. The third (the North Channel) would be built along the east side of the tailings area as shown on Figure 4.

The following design criteria were used for design of the channels:

- The design inflow is based on the 1,000 year runoff event,
- The embankments would be built to minimize long term erosion, and
- Drainage channels should conform to the natural topography.

Similar inspection and maintenance checks as specified above for the SRS spillway would be carried out.

3.4 Soil Covers

In accordance with the current reclamation plan, the exposed tailings would be capped with soil to prevent wind erosion, to minimize the impact of dust, and to provide growth medium for vegetation. The cap is also required to reduce ecological and human health risks. The cap is not designed as a low infiltration barrier. The cover, however, would reduce surface ponding and promote runoff of non-contact water.

Several other areas requiring revegetation were identified throughout the property. Some of these areas would be scarified and seeded (access roads), while others would require capping to provide a growth medium for vegetation. The tailings cap would be constructed by placing material excavated from the South and Reclaim dams. The soil would be placed in a single lift to a depth of between 0.4 to 0.5 m. The cap surface would be re-contoured to a minimum grade of 2% to promote runoff and prevent ponding. The edges of the cover would be terminated flush with the crest of the North Dam, or where downgradient terrain is encountered, it would be graded to no steeper than 2H:1V.

The cap would be revegetated by seeding and tree and shrub planting as soon as possible after placement. Local vegetation would be favoured and the density would be limited initially to allow the colonization by local volunteer species to be established from the areas surrounding the caps.

The soil capping of the areas other than the tailings would be constructed in a similar manner and contoured to blend in with the natural terrain where possible.

The covers would be inspected during the annual geotechnical inspections.

The covers will be visually inspected annually for signs of erosion, sloughing, geotechnical and hydraulic instability, and vegetation success. The inspections will determine if and where repairs are required, whether reseeding, replanting or maintenance fertilizer is required, and will monitor natural regeneration and invasion of native species.

Reclamation assessments will be conducted to identify the areas that have achieved or are progressing towards land capability objectives, and those that require additional work. The frequency of assessments for each reclamation site will depend on its age. For example, a newly reclaimed site will be assessed annually for three years, then assessed every five years until the site is mature at which time the assessment will be every ten years. Some reclaimed sites will already contain mature shrubs and trees at closure so will be assessed every ten years until they are determined to be self-sustaining.

Annual inspections and reclamation assessments will cease for sites that have reached a sustainable state.

3.5 Portals and Drainages

3.5.1 Portals

The 1408, 1250, 1380 portals at the Jewelbox and Main zone areas, and the 1200 and 1300 portals at the Burnick zone will be sealed off using coarse site waste rock to at least 5m into the portal beyond the entrance. Within the tunnel, the waste rock fill will be placed as close to the top of the tunnel as possible to help stabilize the collar of the portal. At surface the waste rock will be sloped from above the top of the portal to the base of the portal at a stable slope and will be contoured to tie into the surrounding terrain for aesthetic purposes. The seals will include two minimum 4 inch diameter pipes (high density polyethylene pipe or equivalent so they don't corrode). The purpose of the pipes is to prevent air from pressurizing within the mine and to provide a conduit for mine water drainage if required. The pipes will be installed at slightly different elevations and one of the two pipes is a backup in case the other becomes plugged. The ground at portal entrance will be sloped away from the portal to ensure precipitation can drain away to prevent ponding of water up against the seal.

An inspection of these portals will be carried out during the annual inspections. Figures 5 and 6 show the location of the portals. The inspection would ensure no blockage of the drainage pipes and that the backfill material has remained stable.

3.5.2 Ventilation Raises

Both ventilation raises at the Jewelbox/Main Zone area will be sealed using an engineered concrete seal in a manner that is in accordance with Mine Safety Regulations. The seals will provide the physical barrier to eliminate the potential for the public or wildlife to access the mine through ventilation raises. In addition, the seals will prevent water and significant airflow from entering the mine workings (the seals will contain a small pipe to allow some airflow through the seal) through these openings.

An inspection of these portals will be carried out during the annual inspections. The inspection would look for possible deterioration or damage of the concrete seal and air pipes by vandals. Observation of any subsidence or ground movement would also be noted.

3.5.3 Open Pits (Jewelbox and Main Zone)

The pit walls will be stabilized by re-sloping and if required by blasting or importing additional fill material. Re-sloping will partially fill the pit. Fill at the base of the pit will consist of coarse waste rock so that it will function like a French drain to ensure that water continues to have a route to discharge out of the pit.

An inspection of these backfilled pits will be carried out during the annual inspections. The inspection would look for any signs of blockage of the drains and instability of the backfill.

3.6 Waste Rock Dumps

3.6.1 Jewelbox

At closure the crest of the waste dumps below the 1408 Portal will be pulled back and rounded for aesthetic purposes and to improve stability. The waste rock dump benches will be recontoured to provide positive drainage away from the hillside.

The waste rock in the Jewelbox Pit dump on the ridge between the Pit and 1408 Portal will be pushed into the Jewelbox Pit.

All safety berms along the access roads will be removed either with an excavator or by dozer and drainage patterns re-established.

An inspection of these dumps will be carried out during the annual inspections. The inspections will look for any tension cracks in the dump slope or top surface, bulging in the slope and any subsidence.

3.6.2 Main Zone

The crest of the waste dump below the 1380 Portal will be pulled back and rounded for aesthetic purposes and to improve stability.

An inspection of these dumps will be carried out during the annual inspections. The inspections will look for any tension cracks in the dump slope or top surface, bulging in the slope and any subsidence.

3.6.3 Burnick

At closure, the crest of the Burnick dump (see Figure 6) will be pulled back to further reduce loading on the crest to improve stability. The bench of the dump will be recontoured to provide positive drainage away from the hillside.

An inspection of these dumps will be carried out during the annual inspections. The inspections will look for any tension cracks in the dump slope or top surface, bulging in the slope and any subsidence.

3.7 North Creek Crossings

At closure the North Creek Dyke and culverts will be removed, the area re-contoured and the drainage channel armoured to ensure it is stable. The culvert at the second crossing will be removed.

The channel would be inspected as part of the annual geotechnical inspection to ensure the integrity of the riprapped channel to safely discharge the design flow.

Annual maintenance would include:

- Clearing of any debris in the channel
- Repairing of cavitation or eroded aprons and
- Removal of any vegetation

Figures

NOTES

1. Topographic contour data and aerial photos were obtained from McElhanney and are based on August 15, 2012 LiDAR survey. Coordinate system is UTM NAD 83CSRS zone 9V.

0 100 200 300 400 500
Scale in Metres
CONTOUR INTERVAL=10m

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Vicinity Map

SRK JOB NO.: 1CT008.046
FILE NAME: 1CT008046_Fig1.dwg

Sa Dena Hes

DATE: August 29,2014 | APPROVED: PH | FIGURE: 1

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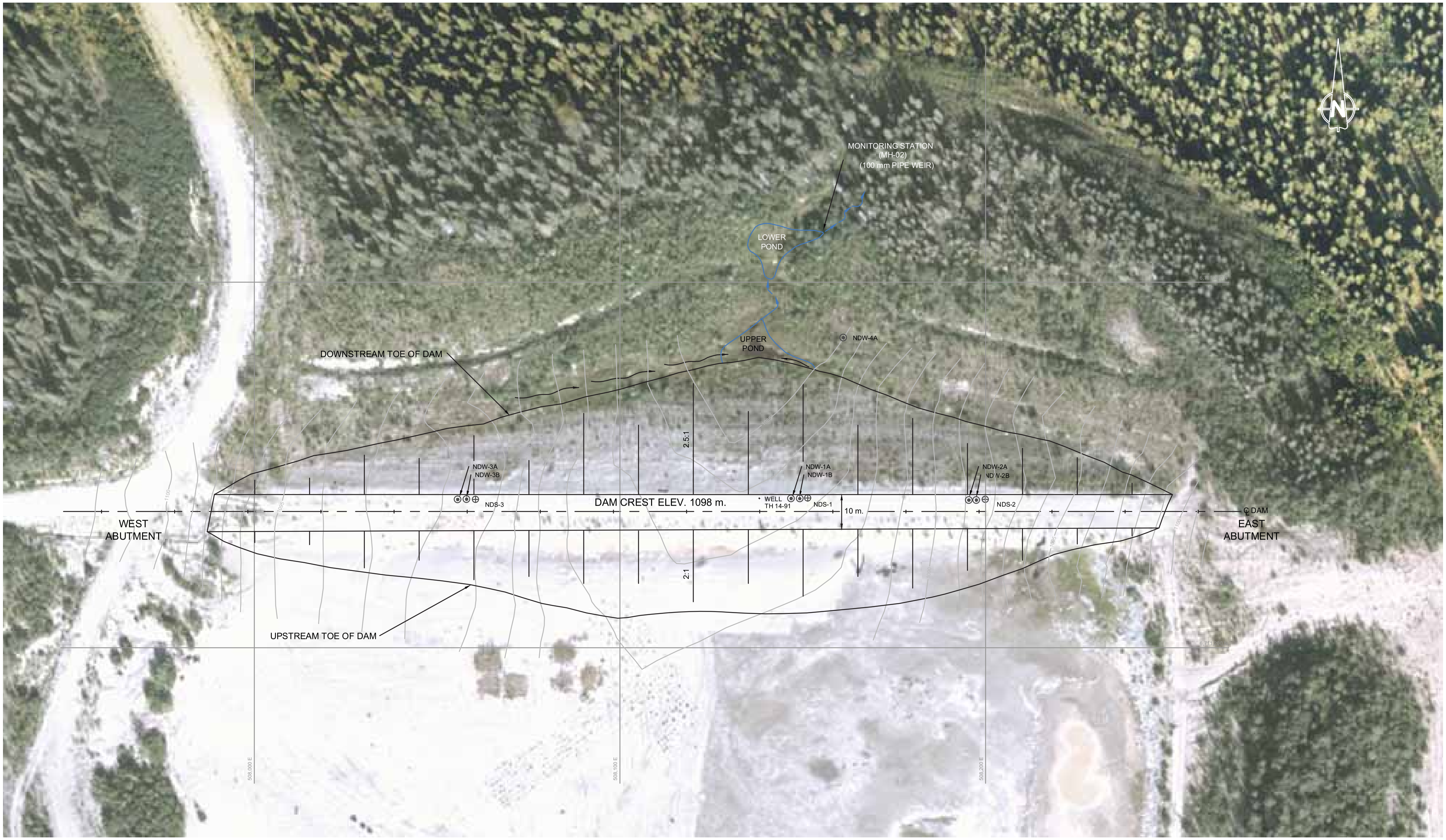

KEY

- NDW-1 ⊙ PIEZOMETERS INSTALLED (NOV., 1991)
- NDS-1 ⊕ SETTLEMENT GAUGE INSTALLED (NOV., 1991)
- SEEPAGE

NOTES:

1. TOPOGRAPHIC DATA REPRESENTS ORIGINAL GROUND (PRE-STRIPPING).
2. FOOTPRINT DATA IS BASED ON STAKING IN THE FIELD (POST-STRIPPING).
3. SEEPAGE MAPPED DURING JULY 1997.
4. BASE TOPOGRAPHY FROM NORTH AMERICAN DATUM 1983 ALL SURFACE FACILITIES AND BOUNDARIES HAVE BEEN ADJUSTED FROM NAD 1927.

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Geotechnical Monitoring Program

North Dam
Site Plan

SRK JOB NO.: 1CT008.046
FILE NAME: 1CT008046_Fig2.dwg

Sa Dena Hes Mine

DATE:	APPROVED:	FIGURE:
August 2014	P.M.H.	2

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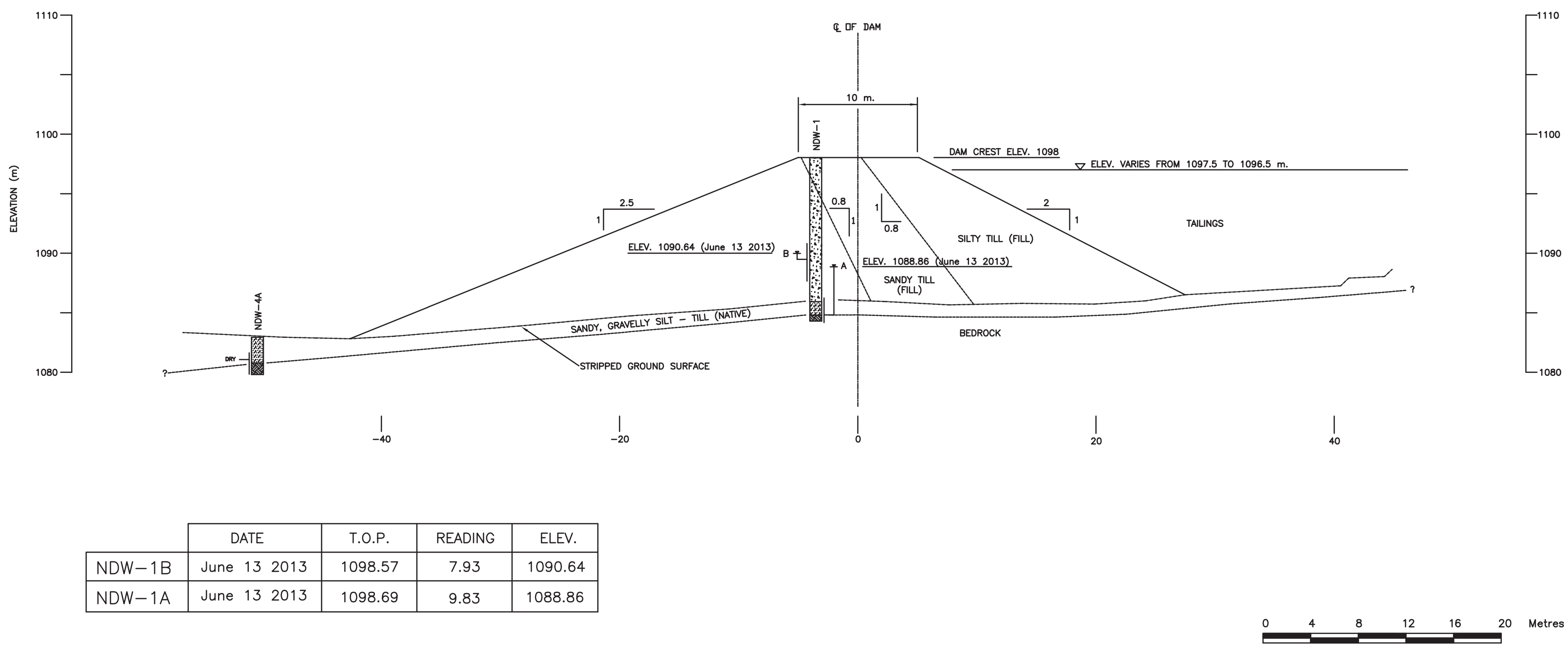

	DATE	T.O.P.	READING	ELEV.
NDW-1B	June 13 2013	1098.57	7.93	1090.64
NDW-1A	June 13 2013	1098.69	9.83	1088.86

KEY

- SANDY TILL (FILL)
- SILTY TILL (FILL)
- SAND & GRAVEL (FILL)
- SILTY SAND (TILL)
- GRAVELLY SILTY SAND (TILL)
- SAND & GRAVEL (NATIVE)
- BEDROCK
- PIEZOMETERIC HEAD FOR FILTER ZONE INDICATED

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SRK JOB NO.: 1CT008.046

FILE NAME: 1CT008046_Fig3.dwg

Teck

Sa Dena Hes Mine

Geotechnical Monitoring Program

Section 0+400
North Dam

DATE: Nov. 28 2013 | APPROVED: P.M.H. | FIGURE: 3

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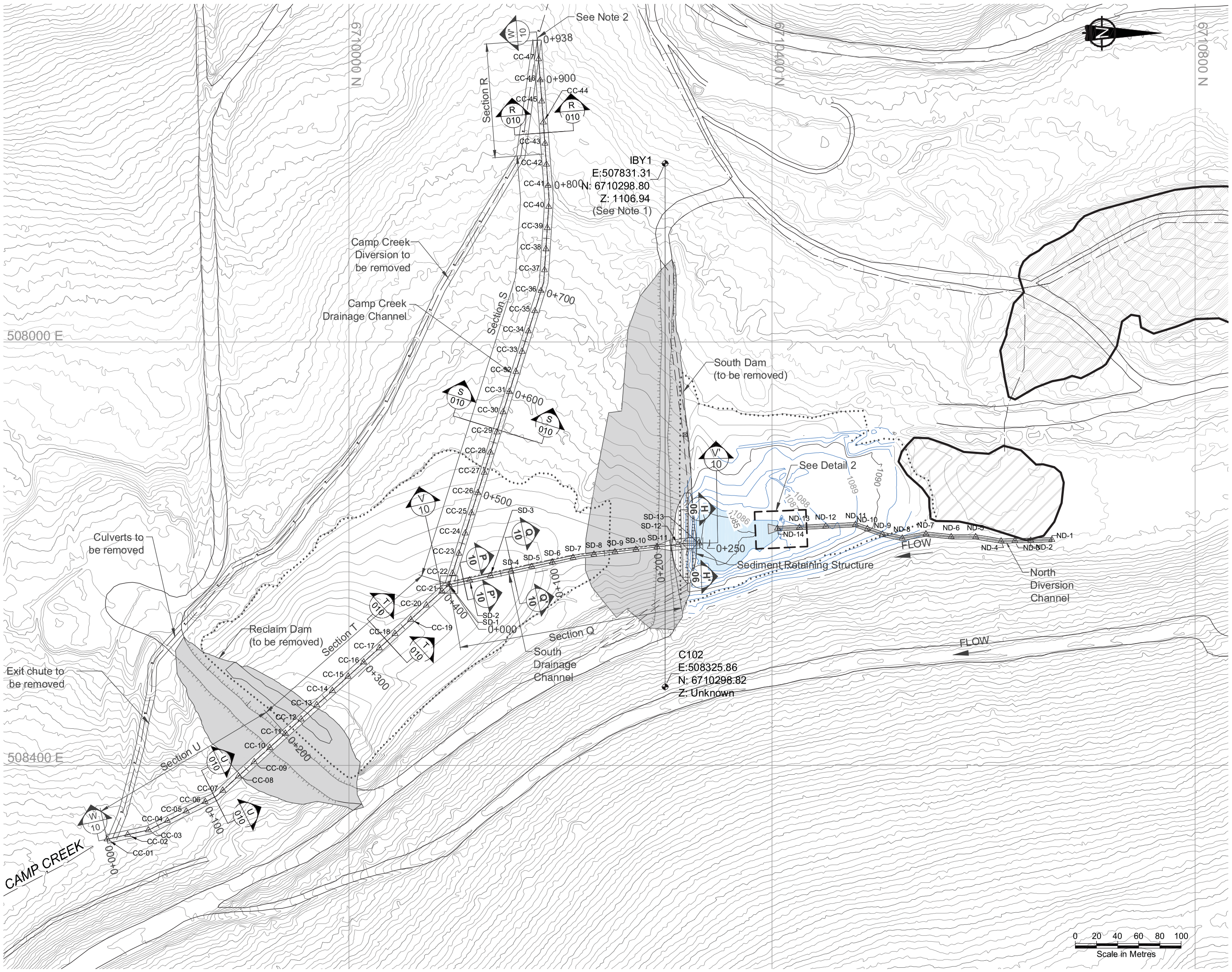

LEGEND

- Covered Tailings
- Reclamation Area
- Rip-rap
- Sedimentation Pond
- Minor Contours (1m interval)
- Major Contours (5m interval)
- Existing Crest
- Proposed Crest
- Existing Edge of Road
- Proposed Edge of Road
- Creek
- Tailings Pipeline
- Drainage Channel
- Potential Tailings Cover Area
- ND-12 Stakeout Point

NOTES

1. This Benchmark datum is currently used to monitor settlement gauges on the dam and was used as the benchmark in construction of the dam. The elevation has been adjusted from 1103.54m to the current LiDAR Survey elevation.
2. The tie-in from the existing natural channel to the riprapped channel will be determined in the field as directed by the Engineer.
3. For Stakeout tables see SDH-DR-15

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SRK JOB NO.: 1CT008.046

FILE NAME: 1CT008046_Fig4.dwg

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Sa Dena Hes

Geotechnical Monitoring Program

Drainage Channel and SRS

DATE: August 2014 | APPROVED: DJ | FIGURE: 4

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		Main Zone and Jewelbox Zone Plan View
Job No: 1CT008.046 Filename: Figures 2 and 3.pptx	Sä Dena Hes	Date: August 2014 · Approved: PMH · Figure: 5

srk consulting	Teck	Geotechnical Monitoring Program
Job No: 1CT008.046	Sä Dena Hes	**Burnick Zone Plan View**
Filename: Figure 2 and 3.pptx		Date: August 2014 · Approved: PMH · Figure: 6