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.

505700 507700 509700 511700 513700

6718000 6716000 6714000 6712000 6710000 6708000 6706000

N

Tributary D

MH-15

West Fork of Tributary E

East Fork of Tributary E

Creek

MW13-06

MH-22

Burnick Ck.

MH-12

Canyon

False

North Creek

MH-02

MW13-01

MH-04

Camp Creek

MW13-13

MILL SITE

SDH-S2

Portal Creek

1380 Portal

Access Creek

MH-29

MH-13

MH-11

MH-30

Legend

Surface WQ Sampling Stations

- Compliance Location
- AMP Loading Source
- AMP Indicator Station

Ground WQ Sampling Stations

- AMP Indicator Station
- Claim Boundary
- Lease Boundary
- Ephemeral Streams
- Creeks

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA,

0 0.8 1.6 Kilometers

srk consulting

Job No: 1CT008.043

Filename: 1CT008.043_sdh_emp_fig_01_mon_stns

Teck

Sä Dena Hes Mine

Water Quality Monitoring Plan

Post-Reclamation Water Quality AMP Monitoring Stations

Date:	Approved:	Figure:
September 2014	LNB	1

\\van-svr0.van.na.srk.ad\Projects\01_SITES\Sa_Dena_Hes\020_Site-Wide_Data\GIS\Maps\Figure Maps\1CT008.043_sdh_emp_fig_01_mon_stns.mxd

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

\\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]

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)

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.