

**Mount Nansen
Water Resources Investigations
Quarterly Report (Q4)
January - March 2015**

Prepared for:

Yukon

Energy Mines and Resources
Assessment and Abandoned Mines

Box 2703, K-419
Whitehorse, Yukon
Y1A 2C6

Prepared by:

EDI Environmental Dynamics Inc.
2195-2nd Avenue
Whitehorse, Yukon
Y1A 3T8

EDI Contact:

Meghan Marjanovic, R.P.Bio., P.Biol.
Jane Bachman, P. Geo.
867-393-4882

EDI Project No:

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EXECUTIVE SUMMARY

EDI Environmental Dynamics Inc. (EDI) was retained by Yukon Government, Assessment and Abandoned Mines (AAM) in 2014 to conduct the Water Resource Investigations 2014/15 program at the Mount Nansen Site. This program involves meteorological monitoring and surface water hydrometric and water quality monitoring at the Mount Nansen Site, including sites and stations on Dome Creek, Victoria Creek, Back Creek and Pony Creek. The data presented in this report comprises the fourth quarter of the program (Q4), from January 1 to March 31, 2015, which involved three monthly monitoring events: January 12-14, 2015, February 16-17, 2015, and March 16-18, 2015.

Daily and hourly **meteorological data** for the Q4 period is presented in this report. Overall, air temperatures during the period ranged from -31.9°C to 4.8°C at the ATM-ROAD AAM station. Snowfall was recorded throughout the Q4 period, with a cumulative snowfall of 51.6 cm by March 31, 2015. Of note snow depth data collected by the snow sensor is currently under review, based on erroneous data identified in October 2014. EDI continued to collect field snow depth measurements during each site visit to ground truth the snow sensor data, which appears to be overestimating snow depth.

Hydrometric monitoring was completed at up to 13 hydrometric stations during the three measurement events, five of these stations also collected continuous winter water level data to develop an understanding of hydrologic behaviour and timing in the winter; rating curves were not applied. Monitoring at each station included discharge measurements and water level surveys at continuous stations where conditions are suitable. Hydrometric results in this report include water level elevations, discharge measurements and hydrographs. During the Q4 period, hydrologic conditions declined to near-baseflow conditions. Ice at several locations was more extensive than in past years (e.g., H-VC-R, H-VC-UMN, H-BC and H-DC-M) and in some cases the ice caused channel conditions to become non-ideal for discharge measurements. In these cases, additional efforts were made to collect a successful measurement (*i.e.*, collection of both salt tracer and velocity-area measurements). The damaged water level logger located at Upper Victoria Creek (H-VC-U) was removed and will be replaced in Spring 2015. The ATM-DC4 and ATM-DC2 barometric loggers were removed and replaced with a new barologger at an improved location (ATM-VC5) near Victoria Creek for the 2015 season.

Water quality sampling was completed at the 23 regular water quality sites, if conditions allowed. Water samples were collected at each site along with *in situ* water quality parameters. Samples were analyzed for total and dissolved metals, anions and nutrients, routine parameters, and cyanides, in addition to a drinking water sample from Victoria Creek pump house well and a toxicity sample from the seepage pond discharge. Results presented in this report include a summary of parameters that exceed applicable water quality guidelines and standards. In general, water chemistry results for the Q4 period are similar to previous quarters. One exception is the WQ-SEEP site samples for Q4 exceeded the guideline for zinc, an unusual occurrence. Many sites had frozen to substrate during the Q3 period, including sites on Pony Creek, Dome Creek, Back Creek and the various seeps. During Q4, WQ-DC-DX+105 and WQ-DC-U were also frozen to substrate during the Q4 period. The four sites on Victoria Creek remained flowing through the Q4 period. The tailings pond, pit lake and seepage pond discharge were also sampled through all visits of Q4.



AUTHORSHIP

This report was prepared by EDI Environmental Dynamics Inc. The EDI staff who contributed to this project includes:

Jane Bachman, P.Geo. Author, Hydrology Sections

Brodie Smith, B.Sc..... Author, Meteorological Section, Water Quality Sections

Meghan Marjanovic, R.P.Bio, P.Biol. Author, Water Quality Section, Project Manager

Field work was completed by the following staff:

Meghan Marjanovic

Dawn Hansen

Brodie Smith

Brett Pagacz

Danny Skookum



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1 INTRODUCTION

Yukon Government Assessment and Abandoned Mines (AAM) retained the services of EDI Environmental Dynamics Inc. (EDI) in 2014 to conduct the Water Resource Investigations 2014/15 program at the Mount Nansen Site. This program involves three monitoring components: surface water hydrology, surface water quality, and meteorology. Data is reported on a quarterly basis. This report presents the data for the fourth quarter (Q4) of the program, from January 1, 2015 to March 31, 2015.

The Q4 period consisted of three monthly monitoring events during the winter period:

- January 12-14 2015
- February 16-17, 2015
- March 16-18, 2015

This report outlines the methodology used for all program components, presents the results for each monitoring event and provides recommendations to implement within the program. The data included in this report for each component is summarized in Table 1, below.

Table 1. Summary of meteorology, hydrology and water quality data included in this report.

Monitoring Component	Data Included	Section
Meteorology	• Summary of daily meteorological data • Hourly meteorological plots	• 3.1, APPENDIX F • APPENDIX F
Hydrology	• Monthly discharge values • Rating curve data summary tables • Database tables • Stage-discharge and hydrographs	• 3.2, APPENDIX D • 3.2 • APPENDIX D • APPENDIX D
Water Quality	• Summary of guideline/standard exceedances • In situ water quality data summary tables • Lab result figures • Lab results table and QA/QC analysis	• 3.3, APPENDIX E • 3.3 • APPENDIX E • APPENDIX E



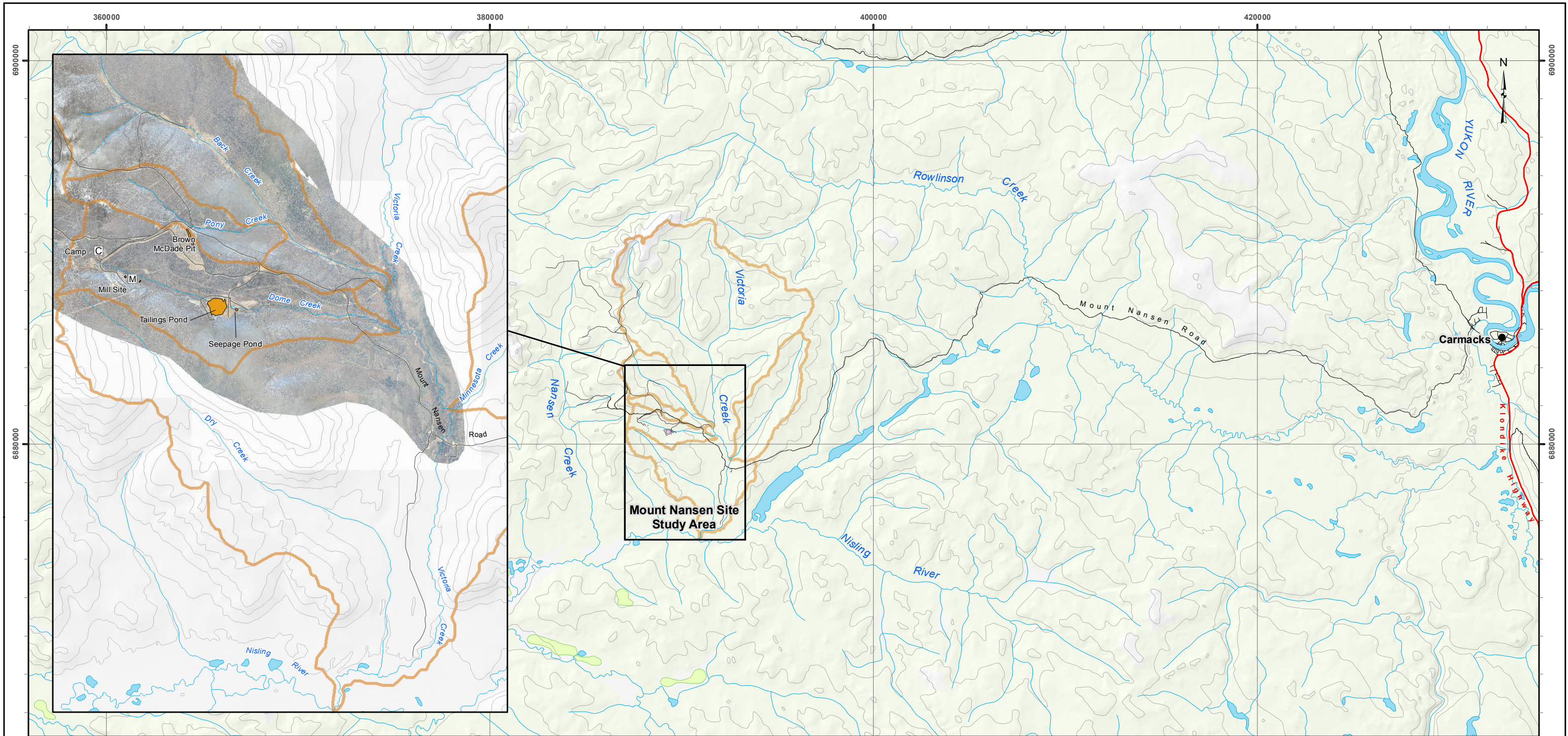
1.1 Monitoring Network Description

The Mount Nansen Site lies within the Victoria Creek drainage which is a tributary to the Nisling River. Several smaller watercourses drain the mine site area, including Dome Creek and Pony Creek. Dome Creek is a tributary to Victoria Creek and originates upstream of the mill, flows through the valley and is diverted around the tailings pond. Pony Creek lies within the northern portion of the mine site area to the north of the Brown-McDade pit lake. Pony Creek is a tributary to Back Creek, which flows into Victoria Creek upstream of the Dome Creek confluence. Minnesota Creek flows into Victoria Creek downstream of the Dome Creek confluence. See Figure 1 and Figure 2 for a regional overview of the watersheds present within the study area as well as water resources investigation site and station locations.

The 2014/15 project scope has some differences from the previous year's programs (2013/14, 2012/13), particularly the addition of several surface water quality sites, including the three Dome Creek east slope seeps, the WQ-CH-P-13-01 seep, and WQ-LW-SEEP-01 seep. The list of water quality sites and hydrometric stations that were part of the Q4 investigation period are presented below (Table 2). Refer to Section 2.2 and 2.3 for coordinates.

Table 2. List of surface water monitoring sites/stations at the Mount Nansen Site investigated during Q4.

Station / Site Name	Hydrology	Water Quality	Station / Site ID
Upper Pony Creek	✓	✓	H/WQ-PC-U
Pony Creek Downstream of Pit	✓	✓	H-PC-DSP/WQ-PC-D
Dome Creek at DX	-	✓	WQ-DC-DX
Dome Creek at DX+105	✓	✓	H/WQ-DC-DX+105
Dome Creek at D1b	✓	✓	H/WQ-DC-D1b
Diversion Channel at Bridge	✓	✓	H/WQ-DC-B
Middle Dome Creek	✓	✓	H-DC-M WP/WQ-DC-U
Dome Creek at Road	✓	✓	H/WQ-DC-R
Seepage Pond Outflow	✓	✓	H/WQ-SEEP
Tailings Pond	✓	✓	H/WQ-TP
Brown-McDade Pit Lake	-	✓	WQ-PIT-1,2,3
Mill Site Seep 08	-	✓	WQ-MS-S-08
Back Creek	✓	✓	H/WQ-BC
Upper Victoria Creek	✓	✓	H/WQ-VC-U
Victoria Creek Downstream of Back Creek	✓	✓	H/WQ-VC-DBC
Victoria Creek Upstream of Minnesota Creek	✓	✓	H/WQ-VC-UMN
Victoria Creek at Road	✓	✓	H/WQ-VC-R
Pump House Well	-	✓	WQ-PW
Dome East Slope Seep 01	-	✓	WQ-DESS-01
Dome East Slope Seep 02	-	✓	WQ-DESS-02
Dome East Slope Seep 03	-	✓	WQ-DESS-03
CH-P-13-01	-	✓	WQ-CH-P-13-01
Lower West Toe of Waste Rock Dump Seep 01	-	✓	WQ-LW-SEEP-01



Regional Overview Map of Mount Nansen Site Area

Legend

- | | |
|---------------------|------------------------|
| Secondary Road | Waterbody |
| Highway | Wetland Area |
| Topographic Contour | Drainage Areas (Local) |
| Watercourse | |

1:50,000 and 1:250,000 Topographic Spatial Data courtesy of Her Majesty the Queen in Right of Canada, Department of Natural Resources. All Rights Reserved.

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

Watercourse, drainage areas and Mount Nansen Road layers digitized / modified by EDI (2011) using orthophotos provided by Yukon Government, Energy, Mines and Resources (2011).

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



Map Scale = 1:200,000 (printed on 11 x 17)
Map Projection: North American Datum 1983 UTM Zone 8N

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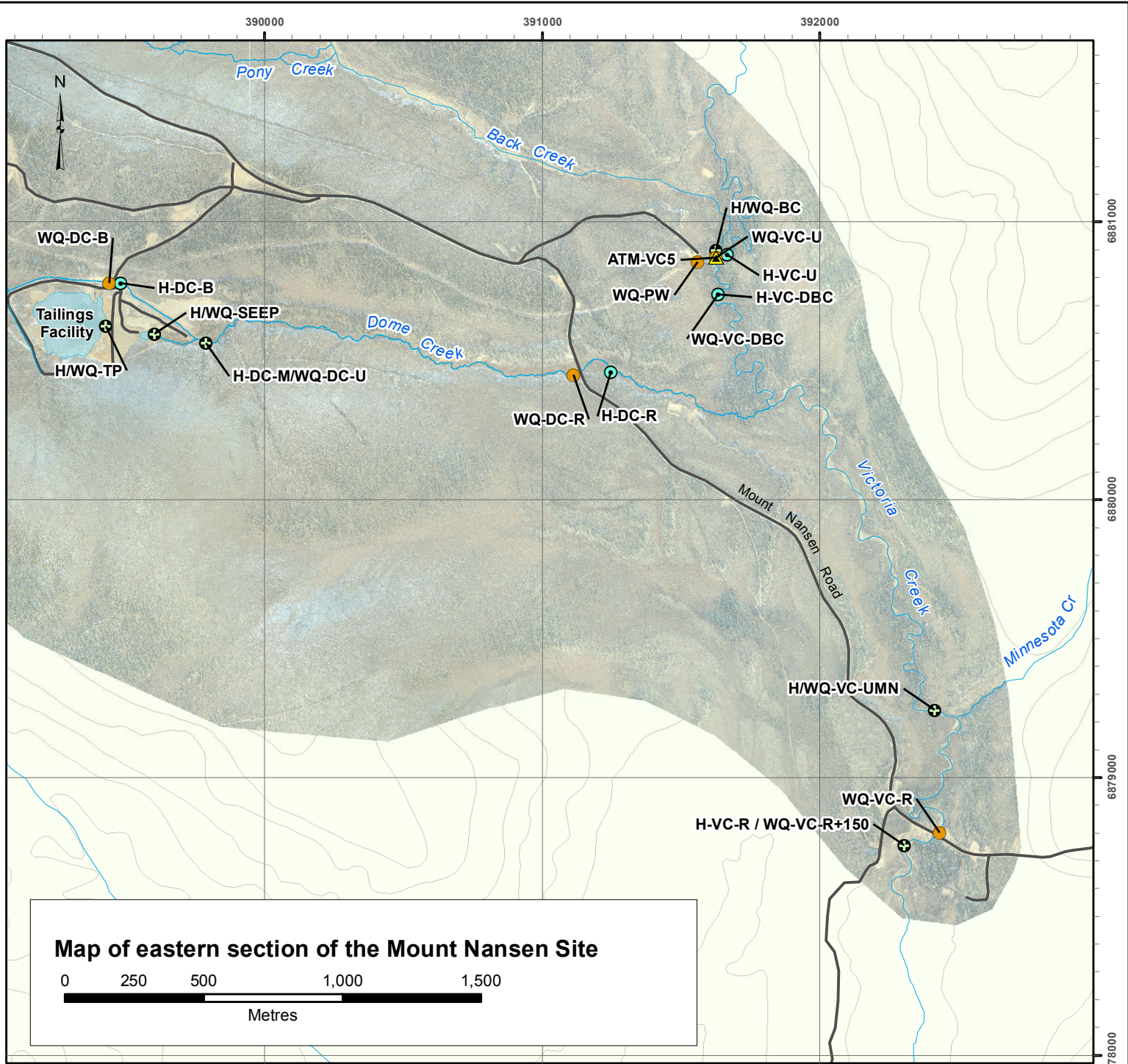
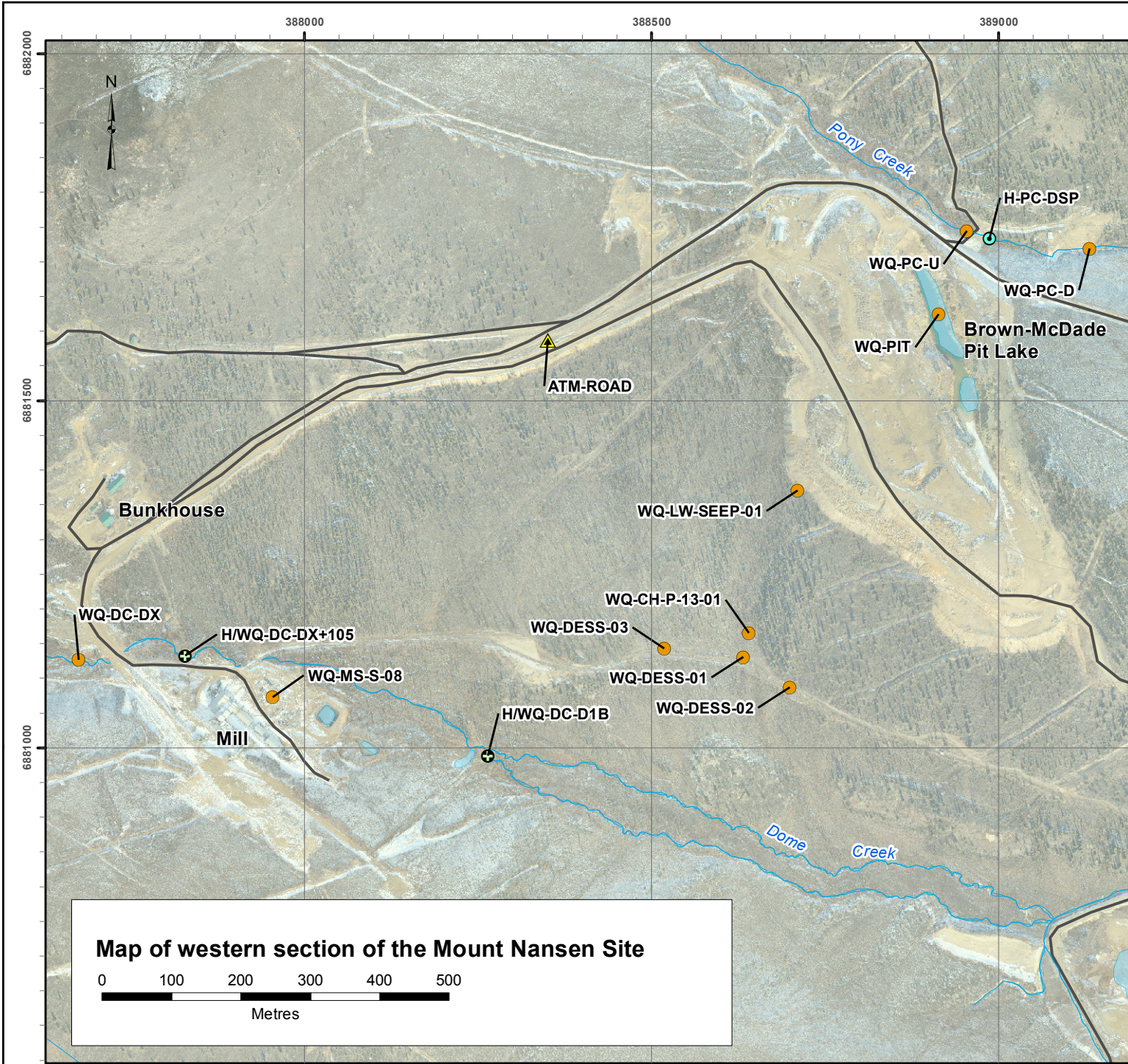
FIGURE 1

Date: 20/03/2014



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Mount Nansen Site: Hydrometric Stations and Water Quality Sites

Legend

-  Atmospheric Station (label e.g. ATM-ROAD)
-  Hydrometric Station and Water Quality Site (label e.g. H/WQ-VC-UMN)
-  Hydrometric Station (label e.g. H-VC-R)
-  Water Quality Site (label e.g. WQ-PC-U)
-  Unpaved Road/Access

Notes:

1:50,000 and 1:250,000 Topographic Spatial Data provided by Geomatics - Yukon Government via online source (Corporate Spatial Warehouse) www.geomaticsyukon.ca.

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

Watercourse, drainage areas and Mount Nansen Road layers digitized / modified by EDI (2011) using orthophotos provided by Yukon Government, Energy, Mines and Resources (2011).

Imagery provided by Yukon Government - Energy, Mines and Resources - Abandoned Mines Branch.

Project data displayed is site specific. Data collected by EDI Environmental Dynamics Inc. (2014) was obtained using Garmin GPS technology.

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

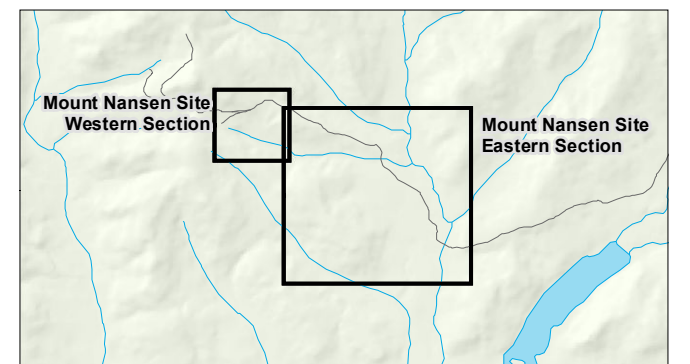
Map Projection: North American Datum 1983 UTM Zone 8N

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FIGURE 1

Date: 28/04/2015



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1.2 Site Conditions

Site conditions during the Q4 period were typical of the winter period, with low water levels, ice cover, and snow. Air temperatures were relatively mild for the quarter with minimal snow cover. The following specific observations were made during each trip to the Mount Nansen Site:

- **January 12-14, 2015** – Air temperatures during the trip ranged from -6°C to -1°C . Weather conditions ranged from partly cloudy and calm to overcast with heavy snowfall. Water levels at most stations and sites were low, typical of winter period. All waterbodies and creeks had ice cover to some extent and many sites and stations were frozen to substrate or dry, including sites and stations on Dome Creek, Pony Creek, Back Creek, and the Dome Creek diversion channel. Aufeis conditions were continuing to develop in lower and upper Dome Creek, with thick layers of ice across the valley floor. Of note, the area between the H/WQ-SEEP and H-DC-M WP station had significant overflow ice, engulfing the area up and downstream of the weir pond with no water flowing freely through the weir notch. The older H-DC-M stilling well and WQ-DC-U site downstream were not affected by the overflow ice upstream. Conditions had changed significant at Back Creek from the last trip, with water seeping through layers of ice and slush at nearly-bankfull levels (not suitable for sampling). The site had been dry during the December 2014 trip with a very small area of standing water. Overflow conditions were observed up and downstream of the Victoria Creek road crossing, in the vicinity of WQ/H-VC-R. Due to these conditions, the water quality samples continue to be collected from the winter sampling location at WQ-VC-R+150 (downstream of the road crossing ~ 150 m). Denison Environmental Services (DES) was conducting dredging of the ice in the diversion channel on January 12 and 13, 2015.
- **February 16-17, 2015** – Air temperatures during the trip ranged from -10°C to 0°C . Weather conditions were mostly overcast with light to no winds. Discharge conditions were very low across the Site, typical of the late-winter period. All waterbodies and watercourses had ice cover to some extent and many sites and stations were frozen to bed or dry. Aufeis conditions continue to develop in the middle Dome Creek area, with more ice accumulating up and downstream of the weir pond in addition to extending now further downstream to the WQ-DC-U sample site and the old H-DC-M stilling well, preventing water sample collection. Conditions in Back Creek were similar to last trip (January 2015), with overflow ice and slush filling the channel, nearly covering the stilling well (not suitable for sampling). The diversion channel had not been dredged recently, and the channel had overflow ice building up. Water levels at the H/WQ-DC-DX+105 site were very low with little to no flow.
- **March 16-18, 2015** – Air temperatures during the trip ranged from -8°C to -1°C . Weather conditions were mostly sunny with light to no winds. Discharge conditions continue to be very low, and typical of the late-winter period. Of note, the H/WQ-DC-DX+105 channel was frozen to substrate. Aufeis conditions continue to develop in the middle Dome Creek area, with both the old stilling well and weir pond stilling well almost buried in ice. Water levels in the seepage pond were also observed to be quite high. The diversion channel remained frozen to substrate at



H/WQ-DC-B and DES was dredging a portion of the channel upstream of this site. Overflow ice conditions in Back Creek have breached the channel banks and ice has now formed across the forest floor on either side of the creek (the stilling well was completely buried). The ice has extended to Victoria Creek in the vicinity of the WQ-VC-U site.



2 METHODOLOGY

The Mount Nansen surface water and meteorological monitoring program consists of several discrete components: meteorology, surface water hydrology and surface water quality. The following sub-sections include descriptions of site/station locations and general program methodology for each component. Detailed methodology has been included in APPENDIX A for reference.

2.1 Meteorology

A Campbell Scientific meteorological station (ATM-ROAD AAM) was established at the Mount Nansen Site in October 2011. The station is located adjacent to the Mount Nansen Road, east of the camp (Figure 2). The ATM-ROAD AAM station is administered by Northern Avcom and data is accessible through an internet download. EDI is responsible for downloading and compiling these raw data into a database. A copy of the updated database is provided with this report. A basic quality control/quality assurance review is completed upon data retrieval; however, EDI is not responsible for meteorological station instrumentation maintenance or sensor calibration. The ATM-ROAD station records air and ground temperature, humidity, rainfall, snow depth, net shortwave and longwave radiation, total radiation, wind speed, wind direction and battery voltage (Table 3). There is also a barometric logger, which collects barometric pressure and air temperature for use in the hydrometric program (Section 2.2).

Table 3. Summary of weather data parameters collected at Mount Nansen Meteorological Station (ATM-ROAD AAM)

Meteorological Parameter Daily Collection	Units	Notes
Air Temperature Maximum	°C	Measured every 5 minutes; Daily maximum value is reported
Air Temperature Minimum	°C	Measured every 5 minutes; Daily minimum value is reported
Humidity Maximum	%	Measured every 5 minutes; Daily maximum value is reported
Humidity Minimum	%	Measured every 5 minutes; Daily minimum value is reported
Snow Depth	cm	Reports the depth of snow at the end of the day
Battery Voltage	Volts	Measured every 5 minutes; Daily minimum value is reported
Hourly Collection		
Net Shortwave	W/m ²	Measured every 5 minutes; Hourly average is reported
Net Longwave	W/m ²	Measured every 5 minutes; Hourly average is reported
Net Total Radiation	W/m ²	Measured every 5 minutes; Hourly average is reported
Wind Speed	m/s	Measured every 5 minutes; Hourly average is reported
Wind Direction	degrees	Measured every 5 minutes; Hourly average is reported
Rainfall	mm	Total hourly rainfall
Snow Depth	cm	Hourly sample recorded
Air Temperature	°C	Measured every 5 minutes; Hourly average is reported
Humidity	%	Measured every 5 minutes; Hourly average is reported
Ground Temperature Surface	°C	Hourly sample recorded
Barometric Pressure	mbar	Hourly sample recorded



2.2 Hydrology

The Mount Nansen hydrometric program includes collecting discharge and/or stage data at 13 different hydrometric stations either continuously with water level loggers or instantaneously during each site visit depending on field conditions. There are ten combined continuous/instantaneous hydrometric stations and four instantaneous hydrometric stations in the program (Table 4). During the winter months, half of the continuous loggers are removed because channel conditions are not appropriate for continuous winter stage measurements. Pressure transducers at five hydrometric stations (H-DC-M WP, H-VC-U, H-VC-DBC, H-VC-UMN and H-VC-R) remained active through the winter 2014/15 period (Q3 and Q4) and the continuous records and field observations were used to determine if the data logger was frozen to the bed. Depending on freeze-up and winter channel conditions, several of the data loggers may freeze to bed thus no longer collect useful information. During each monitoring event, instantaneous discharge measurements were made at all sites (continuous/instantaneous) as long as channel conditions allowed. Instantaneous discharge measurements and concurrent water surface elevations are used to develop a stage-discharge rating curve equation for the open-water season that is used to convert the continuous stage data to discharge values. During the winter, the continuous record of stage is not converted to discharge.

In addition to the 13 hydrometric stations, there are atmospheric stations with barometric loggers that collect atmospheric pressure to be used in compensating water level logger data. In Q4, the atmospheric stations within the Dome Creek diversion channel were removed (ATM-DC2 and ATM-DC4) and a new station was established on Victoria Creek (ATM-VC5). This new location is closer to the majority of the continuous water level loggers located in the Victoria Creek Valley (H-VC-U, H-VC-DBC, H-BC, H-DC-R, H-VC-UMN and H-VC-R).

The hydrometric station characteristics that comprise the monitoring network at the Mount Nansen site are summarized (Table 4). A detailed description of each hydrometric station is found in APPENDIX D.

Methods employed for discharge measurement in Q4 included:

- the velocity-area mid-section method, and
- salt dilution gauging (brine salt slug injection) methods.

Volumetric measurements were not possible during Q4, due to ice conditions. The velocity-area mid-section method is standardized by British Columbia's Resources Information Standards Committee (RISC 2009), however many of the channels at the Site are inappropriate for using this method (*i.e.*, too shallow, too narrow or low discharge). In such cases, alternative methods including salt-dilution gauging and volumetric measurements are used. Typically, an elevation survey is completed during each hydrometric station visit where there are continuous data loggers installed; however, no hydrometric levelling surveys were completed during Q4 due to winter conditions. Stations will be surveyed again in the spring during the 2015/16 program. Surveys are used to monitor shifts in benchmarks, station, and staff gauge elevations.

Given the small channel sizes and relatively low discharge at many stations, the minimum reportable discharge is set to 0.001 m³/s or 1 L/s; this value is lower than what is typically reported for other



hydrometric programs (e.g., Water Survey of Canada uses $\pm 0.01 \text{ m}^3/\text{s}$ for open water conditions). Field methods used at Mount Nansen can accommodate this higher resolution of discharge under ideal conditions, however measurement uncertainty for each method should be considered when interpreting results. Measurement uncertainty is partly based on instrument accuracy (APPENDIX D, Table D-1). Discharges calculated for several stations were less than $0.001 \text{ m}^3/\text{s}$ and reported as $0.000 \text{ m}^3/\text{s}$, below reportable confidence limits.

All velocity-area measurements of stream discharge used the Sontek Acoustic Doppler Velocimeter (ADV). The ADV is advantageous to the hydrometric program because it has the ability to collect velocity measurements in two dimensions and thus compensate for measurement error associated with velocity angles. The ADV also provides a variety of quality control and assurance assessments in real-time, reducing field measurement error. The absence of moving parts on the acoustic sensor also decreases measurement error during winter conditions.

For more detailed explanation of methodology used for discharge measurements, hydrometric levelling surveys, hydrometric validation and QA/QC, rating curve development, continuous stage and discharge and overall data management see APPENDIX A.

Table 4. Mount Nansen hydrometric and atmospheric station information.

HID ¹	Hydrometric Station Name	Type ²	Location ³		Drainage Area (km ²)	Elevation ⁴ (m)
			Easting	Northing		
ATM-VC5	Barometric at Upper Victoria Creek	ATM	391626	6880872	-	1019
ATM-DC2	Barometric at Diversion Channel (Back-Up)	ATM	389476	6880792	-	1099
ATM-DC4	Barometric at Diversion Channel	ATM	389476	6880792	-	1100
H-PC-DSP	Pony Creek Downstream of Pit	C	388986	6881734	1.0	1191
H-DC-DX+105	Dome Creek at DX+105	I	387820	6881150	0.9	1204
H-DC-D1b	Dome Creek at D1b	I	388262	6881000	1.4	1156
H-DC-B	Diversion Channel at Bridge	C	389480	6880780	3.0	1095
H-DC-M / H-DC-M WP	Middle Dome Creek/ Weir Pond	C/CW	389788	6880565	3.3	1065
H-TP	Tailings Pond	I	389427	6880625	-	1093
H-SEEP	Seepage Pond Outflow	I	389604	6880598	-	1072
H-DC-R	Dome Creek at Road	C	392540	6879249	4.5	1020
H-BC	Back Creek	C	391626	6880901	10.4	1021
H-VC-U	Upper Victoria Creek	C/CW	391667	6880882	64.6	1019



HID ¹	Hydrometric Station Name	Type ²	Location ³		Drainage Area (km ²)	Elevation ⁴ (m)
			Easting	Northing		
H-VC-DBC	Victoria Creek Downstream of Back Creek	C/CW	391627	6880840	75.0	1017
H-VC-UMN	Victoria Creek Upstream of Minnesota Creek	C/CW	392413	6879244	83.4	986
H-VC-R	Victoria Creek at Road	C/CW	392305	6878755	97.7	975

Notes: – on the following page.

1 - HID = unique station identifier that corresponds with hydrometric database tables.

2 - Station Type: ATM = atmospheric pressure monitoring; C = continuous water level monitoring with instantaneous discharge rating measurements; I = instantaneous discharge measurement; CW = continuous winter water level monitoring with instantaneous discharge rating measurements.

3 - NAD 83, UTM Zone 8.

4 - Elevations for hydrometric stations are estimates based on field data collected by handheld Garmin GPS units.

2.3 Water Quality

Water quality sampling occurred on a monthly basis during the Q4 period. There are 23 water quality sites included in the scope of the 2014/15 investigations (Table 5). Since the Q4 period represents the late-winter season, many sites had already frozen to substrate, such as sites on Pony Creek, most of Dome Creek, Back Creek and many of the seep sites. As such the winter program through Q4 includes a reduced number of sites remaining active through the winter period, including four sites on Victoria Creek, the pump house well, two sites on Dome Creek which are not typically affected by aufeis conditions, and the tailings pond, seepage pond discharge, and pit lake. During the January 2015 trip, ten sites were sampled, while nine sites were sampled during the February 2015 trip and eight sites were sampled during the March 2015 trip (APPENDIX C). During each trip, water samples were collected at each site depending on suitable conditions, along with *in situ* data, photo documentation, and general site comments during each field visit.

The sampling frequency varies by site, as some sites are sampled monthly, seasonally or only three times per year. Samples are submitted for analysis to ALS in Whitehorse, YT under chain of custody documentation. A 'standard site package' includes lab analysis of cyanides, routine physical tests, anions and nutrients, total metals, and dissolved metals. The 'pit lake package' is similar to the standard package, but excludes cyanides. The 'drinking water package' includes physical tests, anions and nutrients, total metals and bacteriological tests (total coliforms and *E. coli*). A toxicity test for rainbow trout (LT50) is completed for one sample at one site (WQ-SEEP) every second month. The *in situ* water quality data that is collected includes water temperature, specific conductivity, pH and turbidity. A list of sampling sites, coordinates and sampling information is provided in Table 5.

The water quality field program also includes collection of QA/QC samples including: replicate samples, field blanks, and travel blanks. Details on the specific field methodologies, laboratory analysis, QA/QC program, and data analysis are provided for reference in APPENDIX A. Once both the *in situ* and laboratory data have been reviewed for QA/QC, they are entered into the project database (Microsoft Access).



Lab data is analyzed and compared to the Canadian Council of Ministers of the Environment (CCME) guidelines for the protection of freshwater aquatic life (CCME-AL; CCME 2014) as well as the Mount Nansen Effluent Quality Standards (EQS) outlined in Yukon Water Board Water license No. QZ94-004, issued to BYG Natural Resources Inc. on February 13, 1996. The drinking water sample results are compared to the applicable Guidelines for Canadian Drinking Water Quality (Health Canada 2012). See APPENDIX A for applicable guideline and standard values.

Table 5. Mount Nansen water quality site and sampling information.

Water Quality Site Name	Site ID	Site Location ¹		Sampling Frequency	Parameters Included in Lab Analysis ²
		Easting	Northing		
Pony Creek upstream	WQ-PC-U	388955	6881745	Monthly	Standard Package
Pony Creek downstream	WQ-PC-D	389131	6881719	Monthly	Standard Package
Pit Lake (3 samples)	WQ-PIT-1,2,3	388913	6881625	Monthly	Pit Lake Package
Dome Creek at DX	WQ-DC-DX	387674	6881127	Monthly	Standard Package
Dome Creek at DX+105	WQ-DC-DX+105	387820	6881150	Monthly	Standard Package
Dome Creek at D1b	WQ-DC-D1b	388264	6880989	Monthly	Standard Package
Diversion Channel at Bridge	WQ-DC-B	389439	6880781	Monthly	Standard Package
Upper Dome Creek	WQ-DC-U	389788	6880565	Monthly	Standard Package
Dome Creek at Road	WQ-DC-R	391111	6880449	Monthly	Standard Package
Tailings Pond	WQ-TP	389427	6880625	Monthly	Standard Package
Seepage Pond Outlet Pipe	WQ-SEEP	389604	6880598	Variable ³	Standard Package, LT50
Mill Site Seep 08	WQ-MS-S-08	387954	6881073	3X Per Year	Standard Package
Back Creek	WQ-BC	391626	6880901	Monthly	Standard Package
Upper Victoria Creek	WQ-VC-U	391626	6880872	Monthly	Standard Package
Victoria Creek downstream Back Creek	WQ-VC-DBC	391633	6880740	Monthly	Standard Package
Victoria upstream of Minnesota	WQ-VC-UMN	392413	6879244	Monthly	Standard Package
Victoria Creek at Road	WQ-VC-R	392431	6878802	Monthly	Standard Package
Victoria Creek at Road (winter location)	WQ-VC-R+150	392305	6878755	Monthly	Standard Package



Water Quality Site Name	Site ID	Site Location ¹		Sampling Frequency	Parameters Included in Lab Analysis ²
		Easting	Northing		
Pump House Well	WQ-PW	391558	6880856	Monthly	Drinking Water Package
Dome East Slope Seep 01	WQ-DESS-01	388632	6881131	Seasonal ⁴	Standard Package
Dome East Slope Seep 02	WQ-DESS-02	388699	6881087	Seasonal ⁴	Standard Package
Dome East Slope Seep 03	WQ-DESS-03	388518	6881143	Seasonal ⁴	Standard Package
Upwelling near CH-P-13-01	WQ-CH-P-13-01	388640	6881165	Monthly	Standard Package
Lower West Toe of Waste Rock Pile Seep	WQ-LW-Seep-01	388711	6881371	Seasonal ⁴	Standard Package

Notes:

1 - NAD 83, UTM Zone 8.

2 - Parameters included in various sampling packages are explained in greater detail in Appendix A.

3 - Sampling frequency for this site was variable as the WQ-SEEP site is sampled on a monthly basis for the standard package samples and every second month for the LT50 samples.

4 - Sampling frequency for these sites is seasonal as these seeps are to be sampled during freshet and every three months thereafter.



3 RESULTS

Results are separated into the three program components in the sections below: meteorology, hydrology, and water quality. The description and discussion of the results presented in this document is limited to the data collected in the Q4 period, unless otherwise noted. Data can also be found in the following appendices:

- Select field photographs for the period and for each site and station are provided in APPENDIX B;
- A record of which sites were sampled during each field visit during the period is available in APPENDIX C;
- Hydrometric data is provided in APPENDIX D;
- Water quality data is provided in APPENDIX E; and
- Meteorological data is provided in APPENDIX F.

All raw data is provided in the corresponding Microsoft Access databases submitted with this report.

- EDI_14Y0455_Meteorological_Database_2014-2015.accdb
- EDI_14Y0455_Hydrology_Database_2014-2015.accdb
- EDI_14Y0455_Water_Quality_Database_2014-2015.accdb

3.1 Meteorology

Meteorological data from the ATM-ROAD AAM station is summarized below for the Q4 period with comparison to values from the Q1, Q2 and Q3 periods for applicable parameters. Select summary statistics are described for air and ground temperature, precipitation, wind direction and wind speed, short and long-wave radiation and relative humidity. All relevant data from the ATM-ROAD AAM station is plotted in APPENDIX F (Figures F-1 to F-8). Daily summary statistics for the Q4 period from the meteorological station are provided in APPENDIX F (Table F-1).

3.1.1 Air and Ground Temperature

Air temperatures at the Mount Nansen site fluctuated from January to March 2015, including periods above zero Celsius (APPENDIX F: Figure F-1). Mean daily temperatures remained below zero, with the exception of three days (February 17, 22 and 23, 2015). The mean monthly temperature for January 2015 was -11.8°C, -10.3°C for February, and -7.0°C for March 2015.

The minimum hourly air temperature recorded at the ATM-ROAD AAM station for the Q4 period was -31.9°C on February 7, 2015. Temperature inversions were recorded at the Mount Nansen site during the Q4 period, resulting in colder temperatures in the valley bottoms than at higher elevations. For example, the air temperature recorded at the ATM-DC-4 station, which is located along the Dome Creek diversion channel, reached a minimum temperature of -37.0°C on February 7, 2015 (APPENDIX F: Figure F-2). The maximum air temperature recorded at the ATM-ROAD AAM station during the Q4 period was 4.8°C on February 23, 2015 (APPENDIX F: Figure F-1).



Ground temperatures showed a similar trend to air temperatures during the Q4 period, fluctuating throughout the period (APPENDIX F: Figure F-1). Monthly means ranged from -5.2°C in January 2015, -5.5°C in February 2015, to -3.8°C in March 2015. Maximum hourly ground temperature recorded for the Q4 period was -1.6°C on March 31, 2015 with a minimum hourly ground temperature of -12.4°C recorded on February 8, 2015.

3.1.2 Precipitation

The ATM-ROAD AAM station recorded 11.6 mm of rainfall in February 2015, and 2.1 mm of rainfall in March 2015. The periods of recorded rainfall coincide with the periods of above zero Celsius.

Precipitation measured as snowfall occurred throughout the Q4 period; however, EDI observed potential errors in the snow sensor data on October 17, 2014. Based on a review of summer data from the sensor (snow free period), snow depth values were recorded ranging from -1.0 cm to +3.5 cm. These values are assumed to be measurement error associated with the uneven barren ground surface. EDI recommended that snow depth measurements be collected in the field during the monthly water resources investigations starting in November 2014, to ground truth the snow depth collected by the sensor data at ATM-ROAD AAM station. For the Q4 period, EDI collected a snow depth measurement adjacent to the meteorological station using a ruler during each visit. These values were compared to the snow depths recorded by the snow sensor for the same date and time (Table 6). On average the snow sensor snow depths were 9.8 cm higher than the field measured values (Table 6).

The potential overestimation of snow depth by the snow sensor is still being investigated into 2015, but must be taken into account when reviewing snow data for the meteorological station for Q4. As of the end of the Q4 period (March 31, 2015), the snow sensor recorded a maximum of 51.6 cm depth (APPENDIX F: Figure F-4). For comparison to the previous year's data for this period, the snow depth by April 9, 2014 was 149.2 cm (no snow depth data is available for March 31, 2014 due to station maintenance and calibrations).

Table 6. Snow depth comparisons between the snow sensor reading and the reading collected from field measurement.

Date / Time	Snow Depth (cm)		Difference in Readings
	Field Reading	Snow Sensor Reading	
January 12, 2015 13:20 pm	31.0	39.8	8.8
February 16, 2015 12:45 pm	41.0	51.9	10.9
March 17, 2015 15:15 pm	43.0	52.6	9.6
		Average	9.8



3.1.3 Wind

Dominant wind directions at the Mount Nansen Site during the Q4 period were southwest and northeast (APPENDIX F: Figure F-5). The maximum wind speed during the Q4 period was 9.2 m/s (33.1 km/hr); somewhat higher than the maximum recorded winds speed during the Q3 period at 7.4 m/s (26.7 km/hr), and similar to the maximum wind speed recorded during the Q1 to Q2 period at 9.9 m/s (35.7 km/hr) (APPENDIX F: Figure F-6). However, similar to the Q3 period, wind speeds were generally low during the Q4 period with an average wind speed of 1.98 m/s (7.13 km/hr) for the Q4 period.

3.1.4 Shortwave and Longwave Radiation

Net radiation is the balance of shortwave radiation emitted from the sun and longwave radiation reflected or re-emitted from the earth's surface. This balance of radiative fluxes produces the seasonal patterns typical in northern latitudes. As ground surface contributes to change (*i.e.*, the accumulation and disappearance of snow) and solar insolation angles shift in the spring and fall, the net solar radiation swings from $\sim 0 \text{ W/m}^2$ (spring and fall) to over 600 W/m^2 (summer). Net radiation exhibits a diurnal cycle associated with increases and decreases in the amount of received solar insolation. In other words, low net radiation values are due to reduced solar insolation and tilt away from the sun, whereas high net radiation values are due to greater solar insolation or tilt towards the sun.

From the Q1 to Q3 period, net radiation values gradually decreased (APPENDIX F: Figure F-7). Since the beginning of the Q4 period, net radiation values began to gradually increase again; however, compared to the mean net radiation from Q1 to Q3 (56.303 W/m^2), the mean net radiation for Q4 still remained low at -13.65 W/m^2 . The decrease in mean net radiation is due to reduced solar insolation and tilt away from the sun during the winter months.

There was more fluctuation of short and longwave radiation during the Q1 to Q3 periods than the Q4 period. From Q1 to Q3, shortwave radiation fluctuated from -19.500 W/m^2 to 782.200 W/m^2 and longwave radiation fluctuated from -156.800 W/m^2 to 22.980 W/m^2 . During the Q4 period the shortwave radiation fluctuated from -11.030 W/m^2 to 178.600 W/m^2 and the longwave radiation fluctuated from -86.000 W/m^2 to 25.950 W/m^2 .

3.1.5 Relative Humidity

During the Q4 period, relative humidity at Mount Nansen remained above 23.6%, with a mean of 72.3% and fluctuated up to 98.4% (APPENDIX F: Figure F-8). This is comparable to relative humidity found during the Q1, Q2 and Q3 periods.

3.2 Hydrology

Three hydrologic measurement events occurred between January 1 and March 31, 2015 are included in this quarterly report. There were 13 hydrometric stations where instantaneous hydrologic measurements were obtained during this period; five of these stations also collected continuous water level data over the winter period to add to the continuous record of stage levels. Winter rating curves are not developed for this



project. The Q4 continuous hydrologic records appended to this report cover the period January 1 to March 17, 2015; the Q4 continuous record end date corresponds with the last download (March 17) prior to the data cut-off for Q4.

The existing data loggers on site require replacement as they are nearing the end of their life span; all water level loggers will be replaced in 2015 with Solinst Edge water level loggers.

Notable Q4 Winter Events:

- Barometric loggers ATM-DC2 (HOBO) and ATM-DC4 (Solinst) were originally located at a median elevation to facilitate compensating water level loggers throughout the project site. Over the years of monitoring the continuous water level loggers have been removed in the upper watershed for various reasons (e.g., channel instability, small channel size producing poor rating curves and placer mining activity in Pony Creek). The barometric loggers at the median elevation are no longer located at the median elevation of the remaining water level loggers. The barometric loggers ATM-DC2 and ATM-DC4 were removed on February 16, 2015 from their location near the diversion channel and a new Solinst Edge barologger (ATM-VC5) was relocated to a lower elevation, closer to the majority of the continuous water level loggers located in the Victoria Creek Valley. The back-up barologger for ATM-VC5 is the barologger located at the Mount Nansen AAM meteorological station located near the camp access road.
- Ice at several locations was more extensive than in past years (e.g., H-VC-R, H-VC-UMN, H-BC and H-DC-M) and in some cases the ice caused channel conditions to become non-ideal for discharge measurements.
- The hydrometric station on Victoria Creek at the site access road (H-VC-R) froze to the bed in the vicinity of the water level logger; the ice accumulation at the road embankment extended downstream past the station in Q4. It appears that both open water conditions (sediment accumulation near the station) and winter conditions (ice accumulations) have changed at this station such that it is no longer an ideal year-round monitoring location. There are better locations that have been identified approximately 90 m downstream; this continuous station will be relocated downstream in 2015 and renamed. While there are no tributaries between the old and the proposed new station location, it is possible that discharge varies between the two sites due to groundwater gains or losses. Measurement of groundwater contributions to a channel using surface water measurement tools (as opposed to groundwater monitoring wells) is best obtained during low flow periods (i.e., winter). Discharge is not expected to be significantly different between sites, however concurrent surface water measurements can be obtained to validate this prediction. Concurrent measurements will be attempted prior to freshet in early May 2015, however extensive ice formations at the current location will likely prohibit this. Measurements can also be made later in the year prior to ice formation to correlate the discharge at the two locations.



- At the Back Creek (H-BC) station, no usable measurements were obtained during Q4. This is typical for Back Creek; however, there was substantial ice accumulation in and around the Back Creek station that was greater than normal.
- At the H-DC-DX+105 station, no usable measurements were obtained during Q4, either the conditions were not suitable for measurement or the discharge values were lower than reporting limits (i.e., less than $0.001 \text{ m}^3/\text{s}$).
- Office based troubleshooting with the FlowTracker ADV in January 2015 (Q4 period) identified intermittent instrument malfunctions. During the Q4 period, a replacement ADV was used for all measurements and no issues with the instrument measurements occurred. The December 2014 discharge measurement was flagged in the Q3 report pending the instrument assessment in January 2015; the instantaneous value has now been determined to be unreliable and has been removed from the database and report tables.
- Review of the data from the Solinst pressure transducer from H-VC-U identified potential damage to the logger on December 9, 2014 (see EDI 2015b report for further details); the stilling well and data logger were removed from the site on February 17, 2015. This logger will be replaced and the station relocated approximately 10 m upstream for the 2015 open water season. The station will not be renamed because of the close proximity to the old station and the benchmarks will remain the same.
- The time change to Pacific Daylight Time (PDT) occurred on March 8, 2015; all loggers are collecting measurements with PDT time stamps.

The following sections describe the results from each gauging station. A summary of each hydrometric measurement event is presented in APPENDIX D, Table D-3 in addition to the measured discharge, river stage record and hydrographs are presented for each station. A copy of the updated hydrometric database containing all raw field data accompanies this report.

Hydrometric gauging and data collection at all stations is designed to meet the Grade A data standard defined by British Columbia's RISC (see RISC, 2009). The Grade A data standard is the highest level of data quality in the hierarchy of provincial standards and is similar to that in the National standards. Grade A criteria are met when instrumentation, stream channel conditions, field procedures, data calculation and assessment meet the requirements specified in RISC (2009). However, due to small channel sizes, discharge rating accuracy and challenging operating conditions at the site, data is considered to be on average Grade B. Uncertainties associated with the instruments used for hydrometric monitoring is presented in Table D-1 in APPENDIX D.

3.2.1 Dome Creek

Throughout the year, hydrometric stations in the upper reaches of the Dome Creek watershed have higher discharge measurement uncertainty due to the small size of the channel and environmental factors that complicate standard field measurement methods. These environmental factors included discharge below reportable confidence limits (i.e., $<0.001 \text{ m}^3/\text{s}$), excessive vegetation in the channel, and the presence and



accumulation of aufeis into spring. Professional judgement was used to assess the channel conditions for obtaining good quality discharge measurements and the appropriate measurement methods during the Q4 period.

3.2.1.1 H-DC-DX+105

Located 105 m downstream of WQ-DC-DX, station H-DC-DX+105 represents a drainage area of 0.52 km². The station receives groundwater contributions associated with the road and mill building pad cut out upstream of the station. The channel is poorly defined with a bed of predominantly sand and silts. Channel depth averages 0.60 m wide and 0.05 m deep and is generally unsuitable for cross-sectional area and salt dilution gauging methods. Discharge measurements were attempted during each of the three site visits during the monitoring period; however the channel conditions were generally unsuitable for measurement. A salt tracer measurement was successfully conducted on January 14, 2015; however, the resultant discharge value was less than 0.001 m³/s (<1 L/s) and were therefore below reporting limits. On February 16, 2015 the flow was very low (flow was less than 3 cm deep) and a suitable salt tracer reach could not be located. Channel conditions similar to February were observed in March 2015.

It is recommended that if future hydrologic monitoring is required at this station during summer and/or year round, that a small, temporary weir or flume structure is installed to confine flow so that a volumetric measurement can be obtained.

Station discharge measurements collected at H-DC-DX+105 are presented in APPENDIX D, Figure D-2.

3.2.1.2 H-DC-D1b

This station represents surface flows in Dome Creek downstream of the mill site and upstream of the diversion channel and tailings facility. There is also an older tailings pond upstream of the station. However, data from this station only represents a portion of the runoff contributions to the diversion channel and tailings facility given the morphology of the watershed.

The channel at H-DC-D1b is approximately 0.35 m wide, 0.13 m deep, and is unsuitable for the cross-section velocity method and frequently unsuitable for salt dilution gauging. Similar to other stations within the Dome Creek watershed, thick layers of aufeis (commonly referred to as creek 'glaciation') develop through the winter period (typically late during the Q3 period and into Q4) as a surface expression of the groundwater contributions to the channel. Complex, braided channels develop within the ice cover during the spring melt period, making hydrometric gauging impossible. During the ice-free months the channel is confined and deeply incised into the substrate. The channel banks are flanked by willow roots where the fine-grained substrate is eroding around them. The salt tracer measurement reach is a relatively short, steep section of the channel where full mixing can occur. At the downstream end of the measurement reach the water flows over a small waterfall and abruptly reports to a sub-surface channel. Since the establishment of this station in 2012, the location of where the flow reports to sub-surface has migrated upstream.



During the Q4 period, no discharge measurements were obtained due to ice conditions; the station is expected to remain frozen until spring melt in May 2015.

During 2014, measurements became more difficult to obtain using salt tracers at this station due to subtle changes in the channel (increasing pool depth at the input site, channel incision and increased influence of roots in the measurement reach). Using salt tracers at this station is currently the only option for measurement unless a weir or flume structure is installed. Data collection at this station should be re-considered for the 2015 open water season; weighing the value of data for water balance and water quality modelling against the cost of installing a weir or flume structure.

Station discharge measurements collected at H-DC-D1b are presented in APPENDIX D, Figure D-2.

3.2.1.3 H-DC-B

The H-DC-B station is a continuous gauging station during the open-water season established at the downstream end of the Dome Creek diversion channel, downstream of the bridge. The channel is approximately 1.3 m wide and 0.2 m deep with substantial quantities of fine grained sediment transported past the station due to channel disturbance (excavations to maintain conveyance in the diversion channel) through the spring and summer periods, non-cohesive bank material, and the erosion of upstream bank material during rain events.

Benchmark 1 was observed as missing from the station in 2014 and the surveys were conducted using the remaining two benchmarks. Construction activity in the vicinity of the bridge may have damaged Benchmark 1, which was located along the diversion channel berm. Benchmark 1 will need to be re-established in 2015 when the station is reinstalled.

During the winter the station is decommissioned due to substantial ice accumulation and regular excavations in the channel to maintain conveyance under the bridge. While flow is present during the winter, the water typically travels through numerous layers of ice and accurate discharge measurements cannot be obtained. The station is visited during each winter trip in the case that recent excavation activities have produced temporary channel conditions conducive to measuring discharge accurately.

On February 16, 2015 the station was checked for flow because there appeared to be recent overflow ice formed at the site however no flowing water was observed under the 46 cm thick ice. On March 14, 2015, flow was observed, but the conditions were not appropriate for discharge measurement. No discharge measurements were obtained at H-DC-B during the Q4 period due to ice conditions.

The station discharge measurement collected at H-DC-B during Q3 is presented in APPENDIX D, Figure D-3.

3.2.1.4 H-TP

The tailings pond station (H-TP) is a water level monitoring station only. There are three staff gauges installed at the tailings pond, to measure a full depth of 3 m; the lowest of which is not normally visible.



Staff gauge readings are collected when the tailings pond is ice free. No staff gauge readings were obtained during Q4 due to ice on the tailings pond.

3.2.1.5 H-SEEP

The Seepage Pond Outlet (H-SEEP) is an instantaneous hydrometric monitoring station where a volumetric measurement is collected during each site visit. Volumetric measurements are collected at the pipe outlet that discharges to Dome Creek. In addition, readings are obtained from the flow meter operated by AAM/DES in the Seepage Pond pump house. The pump house flow meter units of measurement are litres per minute (L/min). DES manages pumping rates from the seepage pond on a daily basis by maintaining pond levels at 0.200 m on the staff gauge installed at the pump house, and recording pump rates (based on communications with R. Wilkinson, DES). AAM indicated that during the Q4 period there were no events where pumping flow varied more than normal (See Appendix D, Figure D-4) (J. Moore, *pers. comm.*, April 14, 2015).

Volumetric measurements at the pipe outlet and readings observed at the flow meter (shown in *italics*) were collected on January 12, 2015 (0.002 m³/s, *171.227 L/min*), February 16, 2015 (0.002 m³/s, *168.882 L/min*), and March 17, 2015 (0.003 m³/s, *199.915 L/min*). The volumetric measurements at the pipe outlet and the flow meter measurements obtained by EDI at the flow meter were not in agreement in January and February during the Q4 period (APPENDIX D, Figure D-4; Table D-5). The difference is approximately 0.001 m³/s or 60L/min. The difference is relatively small however typically the measurements are in good agreement; the source of the discrepancy is not known; however, the discharge measurements are collected by EDI and DES at different times of the day and operational adjustments to the pumping rates by DES may account for the difference. On March 17, the measurements were back in agreement.

The measurements at the pipe outlet were lower than those observed at the flow meter and that recorded by DES (daily at the flow meter). While the volumetric measurements collected by EDI indicate a constant discharge rate, the daily instantaneous record provided by DES shows that there is some day to day variability; this is shown in the plots of EDI and DES measurements (APPENDIX D, Figure D-4). DES measurements are obtained at the end of each day from the flow meter in the pump house.

3.2.1.6 H-DC-M and H-DC-M WP

A continuous monitoring station operates within the middle reaches of Dome Creek at H-DC-M, downstream of the seepage pond outlet and the diversion channel outlet. This station is intended to measure the cumulative flow from the seepage pond outlet and the diversion channel (H-SEEP and H-DC-B). The channel is moderately well defined within fine grained substrate. Some cobble to boulder sized material persists upstream in the diversion channel where stream gradients are greater. The channel averages 1.08 m in width and 0.16 m in depth. In previous quarters and years of the program, salt dilution gauging was the primary discharge method measurement due to channel conditions being unsuitable for the ADV. In addition, this site is typically maintained as a continuous hydrometric station during the winter; the only continuous winter station on Dome Creek. During the winter months instantaneous discharge



measurements can be difficult due to ice conditions and channel avulsion (due to ice). The conditions also produced poor data quality from the continuous logger.

In April 2014, EDI identified that the hydrometric measurements obtained at this site could be improved (by reducing discharge measurement uncertainty) with the installation of a v-notch weir at a location approximately 15 m upstream of the existing station. A v-notch weir and a new water level logger were installed by EDI in the head pond on May 20, 2014 and completed on June 23, 2014. The weir provides an opportunity for volumetric measurements and discharge measurements based on a rating equation for the weir structure; both methods will reduce uncertainty associated with salt tracers at this station. The weir pond also provides a more stable location for continuous water level data collection.

This new station was named H-DC-M WP; the old logger at H-DC-M remained in place during the Q2, Q3 and Q4 periods, and will be removed in 2015 when the station is ice free. Discharge measurements were obtained using volumetric measurements and water level elevations at the weir were obtained for rating equation calibration during the open water season.

At the end of August 2014 excavations were occurring in the diversion channel upstream to improve conveyance and a relatively intense rainstorm occurred. While there were no field observations at the H-DC-M hydrometric station at the end of August 2014, evidence observed during the September 16, 2014 field visit indicated that a large amount of sediment had been transported down the channel and deposited in the weir head pond. The pond was filled with sediment to within approximately 15 cm of the top edge of the weir and the water level logger was buried in approximately 0.30 m of sediment. This sediment deposition rendered the continuous stage record from the new H-DC-M WP water level logger between August and September suspect and the data was removed from the plots. Further, the weir measurement from September 2014 could not be used because the head pond depths were significantly altered from the original design depths. The weir pond was excavated in October 2014 in a combined effort by AAM and EDI. There is potential for the weir pond to be affected by sedimentation again in the future due to upstream construction/maintenance work and/or heavy rain events, which may require occasional maintenance, thus conditions within the head pond will be monitored monthly.

Continuous water stage elevations and discharge measurements are presented in APPENDIX D, Figure D-5, which covers the Q1, Q2 and Q3 monitoring period. During the Q4 period there was one discharge measurement obtained at H-DC-M using the salt tracer method downstream of the H-DC-M stilling well. Discharge measured on January 13, 2015 was the same as that measured in December 15, 2014 ($0.004 \text{ m}^3/\text{s}$). Measurements could not be obtained in February and March 2015 due to ice conditions.

Table 7 summarizes the rating curve expressions presented for the 2012-2013, 2013-2014 rating periods for H-DC-M; with the installation of H-DC-M WP a new rating relationship will be developed. A relationship between volumetric and weir measurements could not be established during 2014 due to sedimentation in the weir; therefore a relationship will be determined in the open-water season of 2015 and then the H-DC-M logger can be discontinued in 2015. AAM and DES will coordinate a sedimentation control program in the 2015/16 monitoring year and EDI will monitor sediment levels in the weir and stilling well as per the regular hydrometric monitoring maintenance program.

**Table 7. Middle Dome Creek (H-DC-M) open water rating curve equations.**

Stage (m)	Discharge (m ³ /s)	Offset (m)	Slope	Equation
Rating Curve, April, 2012 to March, 2013 (EDI 2013)				
1.556	0.005	1.5	-	-
1.701	0.060	1.5	1.986	$Q = 1.44074 (h - 1.5)^{1.98631}$
2.003	0.356	1.5	1.950	$Q = 1.35912 (h - 1.5)^{1.94996}$
Rating Curve, April, 2013 to March, 2014 (EDI 2014a)				
1.550	0.001	1.52	-	-
1.891	0.771	1.52	2.558	$Q = 10.60 (h - 1.52)^{2.64}$
Rating Curve, April, 2014 to June, 2014 (EDI 2014b)				
Insufficient measurement events to produce a curve for Q1	-	-	-	-
Rating Curve, July 2014 to December, 2014				
1.565	0.001	1.52	-	-
1.891	0.771	1.52	3.106	$Q = 10.60 (h - 1.52)^{2.64}$

3.2.1.7 H-DC-R

The station at H-DC-R was re-established after the 2013-14 winter on June 23, 2014 for the open-water season. The station was re-established at this time because this section of Dome Creek accumulates significant quantities of ice due to the broad, flat nature of the valley bottom and location at the downstream end of the watershed. This station has a continuous water level logger during the open water season. The most recent rating curve equation that was used to convert the Q1 and Q2 stage data to discharge values is presented in Table 8.

During the Q4 period no discharge measurements were obtained due to extensive ice present at the station; the channel conditions were unsuitable for discharge measurements. There was no rating curve developed during the winter due to the presence of ice conditions. Time-series water stage and hydrographs for the Q1, Q2, and Q3 monitoring period are presented in APPENDIX D, Figure D-6.

Table 8. Dome Creek at the Road (H-DC-R) open water rating equations.

Stage (m)	Discharge (m ³ /s)	Offset (m)	Slope	Equation
Rating Curve, April, 2012 to March, 2013 (EDI 2013)				
0.2747	0.002	0.16	-	-
0.6621	0.100	0.16	2.758	$Q = 0.666494 (h - 0.16)^{2.75760}$
1.062	0.477	0.16	2.671	$Q = 0.628053 (h - 0.16)^{2.67137}$



Stage (m)	Discharge (m ³ /s)	Offset (m)	Slope	Equation
Rating Curve, April, 2013 to March, 2014 (EDI 2014a)				
0.274	0.002	0.125	-	-
1.062	0.477	0.125	2.98	$Q = 0.579 (h - 0.125)^{2.98}$
Rating Curve, April 2014 to June, 2014 (EDI 2014b)				
Insufficient measurement events to produce a curve for Q1	-	-	-	-
Rating Curve, April, 2013 to September 2014 (portion of continuous stage data corrupted, equation not applied)				
0.274	0.274	0.274	0.274	0.274
1.062	1.062	1.062	1.062	1.062

3.2.2 Back Creek

3.2.2.1 Back Creek (H-BC)

A continuous station on Back Creek at H-BC was re-installed on May 21, 2014 when the channel was ice-free and removed for the winter period on October 15, 2014. The channel is stable and entrenched into alluvial sediments of both the Back Creek and Victoria Creek floodplains. During the winter the channel is typically frozen to the bed and no flow is observed. Small channel sizes prohibit the use of the ADV as a standard discharge measurement method; therefore, all discharge measurements were made using the salt dilution method.

Typically the channel freezes over and becomes dry to the bed between October and November, remaining that way for the duration of the winter. In November 2014, a layer of ice developed over flowing water that subsequently declined to zero flow without freezing. In December 2014, the formerly dry channel was filled with a small amount of standing water and slush. There was no apparent flow in December that could be measured using any of the hydrometric methods, but the fact that unfrozen conditions were present indicates a change from normal hydrologic conditions. While the reason for the unusual conditions is not known with certainty, the observations are likely related to the relatively warm start to the winter.

A review of a simple surface water balance between H-VC-DBC, H-VC-U and H-BC in 2014 reveals that there is groundwater contributing to the surface flow at H-VC-DBC. A portion of this may be contributed from shallow groundwater flow from the Back Creek watershed, but further analysis is required.

During the Q4 period no discharge measurements were obtained at H-BC. The measurement was obtained on October 15, 2014 using the salt tracer method.

There was no rating curve developed during the winter due to the presence of ice conditions. Time-series water stage and hydrographs for the Q1, Q2, and Q3 monitoring period are presented in APPENDIX D, Figure D-7. Please refer to the Q2 report for detailed information about the continuous stage record for



Back Creek. The most recent rating curve, presented in Table 9, was used to convert the Q1 and Q2 stage data to discharge values.

Table 9. Back Creek (H-BC) open water rating curve equations.

Stage (m)	Discharge (m ³ /s)	Offset (m)	Slope	Equation
Rating Curve, April, 2012 to March, 2013 (EDI 2013)				
1.630	0.001	1.62	-----	-----
1.893	0.063	1.62	1.252	$Q = 0.319 (h - 1.62)^{1.252}$
2.168	0.602	1.62	3.244	$Q = 4.239 (h - 1.62)^{3.244}$
Rating Curve, April, 2013 to March, 2014 (EDI 2014a)				
1.63	0.001	1.49	-	-
2.168	0.602	1.49	4.057	$Q = 2.91 (h - 1.49)^{4.06}$
Rating Curve, April, 2014 to June 2014 (EDI 2014b)				
Insufficient measurement events to produce a curve for Q1	-	-	-	-
Rating Curve, April, 2014 to December 2014				
Insufficient measurement events to produce an updated curve for Q1/Q2/Q3. April 2013-March 2014 rating curve applied to 2014/15 Q2 data.	-	-	-	-

3.2.3 Victoria Creek

3.2.3.1 Upper Victoria Creek (H-VC-U)

The Upper Victoria Creek gauging station (H-VC-U) continuously monitors Victoria Creek stage elevations downstream of the former H-VC-REF station (decommissioned in January 2014), and approximately 65 metres upstream of the Back Creek confluence. Based on continuous measurements collected from the station during the spring, the peak stage occurred on May 9, 2014 and declined to summer low flows during Q2. The response of Victoria Creek to rainfall events during the Q2 period were prominent in the hydrograph for H-VC-U (APPENDIX D). Ice was present on the stream banks in October 2014 and ice cover with open leads was present by November 2014 and continued through the winter. Open leads were present upstream and downstream of the continuous logger station indicating that groundwater flux to the channel is present. Elsewhere the ice cover was 10 to 20 cm thick, including along the stream margins (including the stilling well).

A continuous water level logger was installed at H-VC-U for the winter period to monitor changes in water level. It is recommended that the location of the continuous data logger and stilling well be re-located to a pool immediately upstream of the existing station (right bank) in spring 2015 prior to freshet if possible. Several factors including peak flow sediment deposits and ice conditions in the channel are contributing to



sedimentation in the stilling well during the summer, and freezing to bed in winter. Neither situation is beneficial for the data logger or for the analysis of the data. Near the end of December 2014 the logger malfunctioned and requires replacement. Data loggers located downstream continue to function and this data can be used as a surrogate to the H-VC-U during the winter (assuming Back Creek does not flow during winter). On February 17, 2015, the stilling well and data logger were removed from the site in preparation for replacement in the spring of 2015.

Concurrent ADV velocity-area and salt tracer discharge measurements were collected at H-VC-U during Q4 on January 13, 2015 (0.051 m³/s ADV, 0.057 m³/s salt tracer), February 17, 2015 (0.020 m³/s ADV, 0.018 m³/s salt tracer) and March 16, 2015 (0.010 m³/s ADV, 0.009 m³/s salt tracer). All of the concurrent measurements for each date were in good agreement. The streamflow under ice continued to decline toward baseflow conditions during Q4. It is anticipated that discharge will continue to decrease until April 2015.

Rating curves that convert stage to discharge values were not applied during winter due to ice effects on the channel therefore the rating equations were not updated for Q4. Rating curves for the 2012-2013 and 2013-2014 rating periods are presented in Table 10. Continuous stage records and time-series hydrographs for are presented in APPENDIX D, Figure D-8.

Table 10. Upper Victoria Creek (H-VC-U) open water rating curve equations.

Stage (m)	Discharge (m ³ /s)	Offset (m)	Slope	Equation
Rating Curve, April, 2012 to March, 2013 (EDI 2013)				
1.986	0.038	1.85	-	-
2.385	2.632	1.85	3.098	$Q = 18.2757 (h-1.85)^{3.09810}$
2.641	8.465	1.85	2.987	$Q = 17.0539 (h-1.85)^{2.98748}$
Rating Curve, April, 2013 to March, 2014 (EDI 2014a)				
2.018	0.109	1.86	-	-
2.516	5.770	1.86	2.789	$Q = 18.702 (h - 1.86)^{2.789}$
Rating Curve, April 2013 to June, 2014 (EDI 2014b)				
Insufficient measurement events to produce a curve for Q1	-	-	-	-
Rating Curve, April, 2013 to April, 2014				
1.980	0.04	1.86	-	-
2.300	1.65	1.86	2.863	$Q = 10.874 (h-1.86)^{2.172}$
2.641	7.87	1.86	2.723	$Q = 20.997 (h-1.86)^{2.633}$
Rating Curve, April, 2014 to October, 2014				
2.023	0.09	1.96	-	-
2.343	2.13	1.96	1.777	$Q = 11.702 (h-1.96)^{1.777}$



Stage (m)	Discharge (m ³ /s)	Offset (m)	Slope	Equation
Rating Curve, April, 2014 to April, 2015 (Note: All 2014 data amended)				
1.653	0.02	1.59		
2.111	2.51	1.59	2.240	$Q = 10.802 (h-1.59)^{2.240}$
2.533	9.30	1.59	2.212	$Q = 10.607 (h-1.59)^{2.212}$

3.2.3.2 Victoria Creek, downstream of Back Creek (H-VC-DBC)

The Victoria Creek gauging station downstream of Back Creek (H-VC-DBC) continuously monitors Victoria Creek stage elevations downstream of the Back Creek confluence. Based on continuous measurements collected from the station during the spring, the peak stage occurred on May 9, 2014 and declined to summer low flows during Q2. The channel was predominantly ice free in October 2014; ice cover was present at the station by November 2014 ranging from 10 to 20 cm thick and in some places anchor ice was present obstructing streamflow in the middle of the channel.

The continuous gauging station H-VC-DBC was visited three times during the Q4 period. Concurrent ADV velocity-area and salt tracer discharge measurements were collected at H-VC-DBC during Q4 on January 13, 2015 (0.058 m³/s ADV, 0.052 m³/s salt tracer), February 17, 2015 (0.023 m³/s ADV, 0.034 m³/s salt tracer) and March 16, 2015 (0.013 m³/s ADV, 0.017 m³/s salt tracer). All of the concurrent measurements for each date were in good agreement. The streamflow under ice continued to decline toward baseflow conditions during Q4. It is anticipated that discharge will continue to decrease until April 2015.

A continuous water level logger was installed at H-VC-DBC for the winter period to monitor changes in water level. Rating curves that convert stage to discharge values were not applied during winter due to ice effects on the channel therefore the rating equations were not updated for Q4. The continuous stage record and hydrograph are presented in APPENDIX D, Figure D-9. Rating curve expressions are shown in 0 and include previously reported rating curve expressions for the 2012-2013 and 2013-2014 rating periods.

Table 11. Victoria Creek, downstream of Back Creek (H-VC-DBC) open water rating curve equations.

Stage (m)	Discharge (m ³ /s)	Offset (m)	Slope	Equation
Rating Curve, April, 2012 to March, 2013 (EDI 2013)				
1.681	0.178	1.316	-	-
2.048	2.090	1.316	3.538	$Q = 6.30234 (h-1.316)^{3.53797}$
2.315	9.631	1.316	4.913	$Q = 9.67846 (h-1.316)^{4.91302}$
Rating Curve, April, 2013 to March, 2014 (EDI 2014a)				
1.720	0.109	1.65	-	-
2.147	5.220	1.65	1.568	$Q = 6.189 (h-1.65)^{1.568}$
Rating Curve, April, 2013 to June, 2014 (EDI 2014b)				
Insufficient measurement events to produce a curve for Q1	-	-	-	-



Stage (m)	Discharge (m ³ /s)	Offset (m)	Slope	Equation
Rating Curve, April, 2013 to September, 2014				
1.61	0.04	1.35	-	$Q = 7.958 (h - 1.35)^{3.929}$
2.34	7.65	1.35	3.929	

3.2.3.3 Victoria Creek, upstream of Minnesota Creek (H-VC-UMN)

Victoria Creek upstream of Minnesota Creek (H-VC-UMN) is located in a straight reach upstream of the Minnesota Creek confluence. The channel averages 5.7 m in width and 0.20 m in depth, with channel conditions suitable for standard discharge measurement methods using the ADV. Based on continuous measurements collected from the station during the spring, the peak stage occurred on May 9, 2014 and declined to summer low flows during Q2. Ice began to form on the banks in October 2014 and by November 2014, ice cover was present with an open lead upstream of the station indicating groundwater flux to the channel. Ice thickness varied from 3 to 20 cm on the November 2014 trip, and increased to 30 cm thick in January 2015. Portions of the creek were frozen to the bed in some areas of the channel throughout the Q4 period creating non-ideal measurement conditions; however, three successful measurements were obtained.

Three discharge measurements were collected during the Q4 monitoring period. Discharge was measured on January 1, 2015 (0.036 m³/s ADV, 0.018 m³/s, salt tracer), February 17, 2015 (0.009 m³/s, salt tracer only) and on March 16, 2015 (0.002 m³/s, salt tracer only). Rating curve expressions for H-VC-UMN are presented in Table 12 and include previously reported rating curve expressions for the 2012-2013 and 2013-2014 rating periods.

A continuous water level logger was installed at H-VC-UMN for the winter period to monitor changes in water level. Rating curves that convert stage to discharge values were not applied during winter due to ice effects on the channel therefore the rating equations were not updated for Q3 or Q4. The continuous stage and hydrograph records for H-VC-UMN are found in APPENDIX D, Figure D-10.

Table 12. Victoria Creek, upstream of Minnesota Creek (H-VC-UMN) open water rating curve equations.

Stage (m)	Discharge (m ³ /s)	Offset (m)	Slope	Equation
Rating Curve, April, 2012 to March, 2013 (EDI 2013)				
1.382	0.019	0.979	-----	-----
1.780	1.214	0.979	6.037	$Q = 4.63406 (h - 0.979)^{6.03671}$
1.954	3.684	0.979	5.647	$Q = 4.25022 (h - 0.979)^{5.64705}$
2.140	9.980	0.979	5.708	$Q = 4.25676 (h - 0.979)^{5.70783}$
Rating Curve, April, 2013 to March, 2014 (EDI 2014a)				
1.411	0.049	0.98		$Q = 4.066 (h - 0.979)^{5.250}$
2.066	6.271	0.98	4.250	



Stage (m)	Discharge (m ³ /s)	Offset (m)	Slope	Equation
Rating Curve, May, 2014 to June, 2014 (EDI 2014b)				
Insufficient measurement events to produce a curve for Q1	-	-	-	-
Rating Curve, April, 2013 to April, 2014				
1.50	0.10	0.99	-	Q = 4.15 (h – 0.99) ^{5.532}
2.06	6.03	0.99	5.53	
Rating Curve, April, 2014 to December, 2014 (Note: Q2 2014 data amended)				
1.30	0.003		-	Q = 2.28 (h – 1.28) ^{1.743}
1.644	0.39	1.28	1.74	
2.06	6.03	1.28	3.59	Q = 14.70 (h – 1.28) ^{3.586}

3.2.3.4 Victoria Creek at Road (H-VC-R)

Victoria Creek at Road (H-VC-R) station was established in 2011 as a continuous gauging station. The station is located 90 metres downstream of the Mount Nansen Road culvert in a low gradient, meandering section of the channel. Channel measurements average 6.7 m in width and 0.25 m in depth at the discharge measurement location. The channel geometry and downstream hydraulic control (riffle) shifted after the 2014 freshet due to a large pulse of sediment deposited in the immediate vicinity of the hydrometric station. This change to channel geometry also caused the relationship between stage and discharge to change therefore a new rating period was initiated on May 20, 2014 (Q1).

Ice formation during the Q3 and Q4 periods above and below the Victoria Creek road crossing were thicker and more extensive than in past years. Overflow ice from the main culvert typically extends downstream of the road but does not normally extend past the hydrometric station. A second culvert was installed at the road crossing in spring 2014 and overflow ice is also flowing downstream from this location. In the Q3 and Q4 periods, extremely thick ice extended to the station and has likely confined flow under ice in such a way the logger may no longer be submerged in flowing water. The discharge measurement location was moved downstream to a location where ice was thinner or open leads were visible approximately 100 m downstream of the station. On March 16, the overflow ice was extending over the banks and into the parking area on the right bank; ice conditions observed during the Q4 period have never been observed to the same extent at the station in previous years.

Three discharge measurements were collected during the Q4 monitoring period using the ADV method on January 12, 2015 (0.014 m³/s ADV), February 16, 2015 (0.009 m³/s) and on March 16, 2015 (0.002 m³/s). Notably, the flow measured at this station is lower than that measured at upstream hydrometric locations.

As evidenced by the open water leads observed throughout the Victoria Creek channel, groundwater flux appears to play an important role in maintaining winter flows, however the role of ice accumulations in the channel may also play a role. The substantial ice accumulation (storage) in Victoria Creek upstream of the



Mount Nansen access road also appears to be contributing to the attenuation of flow at H-VC-R. Given that the geometry of the channel changed due to sediment depositions in 2014 (during freshet) and that ice accumulation appears to be hindering measurements since the additional culvert was put in place it is recommended that the station is relocated in spring 2015 prior freshet if possible, to ensure that the continuous logger remains wetted year round. There are potential locations downstream of the existing well that could be investigated.

A continuous water level logger was installed at H-VC-R for the winter period to monitor changes in water level. Rating curves that convert stage to discharge values were not applied during winter due to ice effects on the channel; therefore the rating equations were not updated for Q3 or Q4. Rating curve expressions for the H-VC-R station are presented in Table 13 in addition to the 2012-2013 monitoring period rating curve expressions. Continuous stage measurements are collected at H-VC-R; Stage time-series and hydrographs are presented in APPENDIX D, Figure D-11.

Table 13. Victoria Creek at Road (H-VC-R) open water rating curve equations.

Stage (m)	Discharge (m ³ /s)	Offset (m)	Slope	Equation
Rating Curve, April, 2012 to March, 2013 (EDI 2013)				
1.849	0.057	1.51	-	-
2.196	4.015	1.51	6.041	$Q = 39.1267 (h-1.51)^{6.04113}$
2.307	9.974	1.51	6.067	$Q = 39.5133 (h-1.51)^{6.06722}$
Rating Curve, April, 2013 to September, 2013 (EDI 2014a)				
2.010	0.149	1.90	-	-
2.541	10.340	1.90	2.406	$Q = 30.139 (h - 1.90)^{2.406}$
Rating Curve, May 2014 to June 2014 (EDI 2014b)				
Insufficient measurement events to produce a curve for Q1	-	-	-	-
Rating Curve, April, 2013 to December, 2014				
1.90	0.02	1.58	-	-
2.43	6.59	1.58	5.934	$Q = 17.288 (h - 1.58)^{5.934}$

3.2.4 Pony Creek

3.2.4.1 Pony Creek Downstream of Pit (H-PC-DSP)

Pony Creek Downstream of the Pit (H-PC-DSP) station was originally installed to supplement a hydrogeological investigation. Average widths for the channel at the station range from 0.15 m to 0.50 m while depths range from 0.05 to 0.20 m. Current channel morphology and conditions indicate that the best method of discharge measurement is the volumetric method from the culvert at the Pony Creek road crossing. A small rock weir and a stilling well are located 10 m downstream of the culvert, and the rock weir appears to be functioning as an effective control. As of May 8, 2014, a Solinst data logger has been recording continuous stage data only. The data logger was removed on October 14, 2014 for the winter



period. Due to the large uncertainty associated with the collected rating measurements and stage data, no rating curve is applied to water stage recordings at the H-PC-DSP station.

No discharge measurements were obtained at the station during the Q4 period due to winter ice conditions. Continuous time-series stage elevations and instantaneous discharge measurements from Q1, Q2 and Q3 are presented in APPENDIX D, Figure D-12.

3.3 Water Quality

Water quality results for the Q4 investigation period are discussed for each sampling area in the sections below. The reported results include a summary of samples that exceeded guidelines and/or standards for each site and sampling trip, as well as *in situ* water quality parameters. Detailed lab result data is provided in APPENDIX E, in graphical and table format, and is compared to the CCME-AL guidelines and the Mount Nansen EQS. The graphical format displays data from Q1 through Q4, for quarterly comparisons.

3.3.1 Tailings Pond & Seepage Pond Discharge

The tailings pond and seepage pond discharge sites, WQ-TP and WQ-SEEP, were sampled during every visit of the Q4 period. Both sites exceeded the CCME-AL guidelines for arsenic, cadmium, copper, iron and the Mount Nansen EQS for arsenic, cadmium, copper, iron, manganese, and zinc (Table 14; APPENDIX E). The tailings pond samples also consistently exceeded the CCME-AL for fluoride, lead and silver, and on two occasions ammonia. The seepage pond samples also consistently exceeded the CCME guideline for ammonia. Most of these results are similar to results from the previous quarters (EDI 2014b, 2015a,b) and the 2013/14 program (EDI 2014a).

Of note beginning in January 2015, total and dissolved zinc concentration from the WQ-SEEP sample exceeded the CCME-AL guideline. This is unusual for the WQ-SEEP samples, based on comparing data from April 2013 to present, where the zinc concentrations have never been above the guideline. It is not clear why zinc concentrations have increased at this site, but ongoing surface water and groundwater monitoring will take place. Some additional surface water sampling was conducted by EDI during the March 2015 trip, which was outside of the original 2014/15 investigation scope. This was an additional investigation of areas along Dome Creek and was reported in the March 2015 field memo provided by EDI (Memo Re: *Mount Nansen Hydrology and Water Quality Field Memo: March 16-18, 2015*, dated April 14, 2015).

Toxicity samples from WQ-SEEP were collected on January 12, 2015, and March 17, 2015. The samples passed the test criteria, with the 96 hour LT50 result being greater than 96 hours. However, the rainbow trout survival rate at 96 hours was 70% and 60% for January and March 2015, respectively. Typically for this test of the WQ-SEEP the survival rate is 100%, so the 70% and 60% survival is an unusual result. The remaining surviving fish in the samples did not show any signs of stress.

Regarding fluoride concentrations, some reported lab results may exceed the CCME-AL interim guideline for fluoride on occasion; however, because samples are often diluted and detection limits are adjusted to protect lab instrumentation, there is uncertainty in this result as adjusted detection limits are higher than the CCME-AL guideline. The lab commonly has to dilute several samples (e.g. chloride, fluoride, nitrate and



nitrite) for testing in order to protect lab instrumentation from samples with high conductivity and high sulfate concentrations. Consequently, the detection limits have to be adjusted. This is typically not a concern for our analysis unless the adjusted detection limit is above a CCME-AL guideline or Mount Nansen EQS value, which occurs in the case of fluoride. The interim CCME-AL guideline for fluoride is 0.12 mg/L and when the lab adjusts the fluoride detection limit it is raised from 0.02 to 0.20 mg/L in most cases. This is a common occurrence for Mount Nansen samples and is typically required for samples from the seep, tailings pond, pit lake and Dome Creek where there are high sulfates and high conductivities. To re-analyze fluoride in these cases, a different method would be required. At this time AAM has requested that EDI continue to use consistent methods to previous years.

Total and weak acid dissociable (WAD) cyanide concentrations during the Q4 investigation period did not exceed Mount Nansen EQS criteria (0.3 and 0.1 mg/L, respectively). Cyanide concentrations in samples from the WQ-TP site were below detection limits (detection limits: 0.005 mg/L), similar to previous results for this site. Cyanide concentrations in the WQ-SEEP samples were above detection limits for both total cyanide (0.0978 to 0.108 mg/L; APPENDIX E) and WAD cyanide (0.0162 to 0.0179 mg/L; APPENDIX E).

Table 14. Summary of parameters that exceeded CCME-AL guidelines and/or Mount Nansen EQS for WQ-TP and WQ-SEEP for the Q4 period. Parameters in red bold text exceed both standard and guideline values.

Sampling Trip Date	WQ-TP	WQ-SEEP
January 12-14, 2015	As, F, Cd, Cu, Fe, Pb, Mn, Ag, Zn	NH ₃ , As, Cd, Cu, Fe , Mn, Zn
February 16-17, 2015	NH ₃ , As, F, Cd, Cu, Fe, Pb, Mn, Ag, Zn	NH ₃ , As, Cd, Cu, Fe , Mn, Zn
March 16-18, 2015	NH ₃ , As, F, Cd, Cu, Fe , Pb, Mn, Ag, Zn	NH ₃ , As, Cd, Cu, Fe , Mn, Zn

In situ water quality parameters for the WQ-TP and WQ-SEEP sites for each trip of Q4 are summarized in Table 15. Water temperatures were between 0.2°C and 3.1°C from January to March 2015. Specific conductivity ranged from 1,637 to 2,370 µS/cm and pH from pH 6.90 to 7.86 for the Q4 period. Turbidity was between 4.67 and 18.06 NTU during the period (Table 15).

Table 15. *In situ* water quality data for WQ-TP and WQ-SEEP for the Q4 period.

Site ID	Date	Water Temp. (°C)	Specific Conductivity (µS/cm)	pH	Turbidity (NTU)
WQ-TP	13-Jan-15	3.1	1,826	6.99	4.67
WQ-TP	16-Feb-15	0.6	2,018	7.30	5.32
WQ-TP	17-Mar-15	1.4	2,370	7.67	10.19
WQ-SEEP	12-Jan-15	0.2	1,724	7.15	9.83
WQ-SEEP	16-Feb-15	1.1	1,637	6.90	18.06
WQ-SEEP	17-Mar-15	2.8	1,735	7.86	17.30



3.3.2 Dome Creek

Two of the six sites on Dome Creek were sampled at the start of Q4 period in January 2015, WQ-DC-DX+105 and WQ-DC-U. The other four sites had frozen to substrate for the winter (EDI 2015b). The WQ-DC-DX+105 site usually remains flowing through the winter due to groundwater influences; however, by March 2015 the site had frozen to substrate. The WQ-DC-U site also usually remains flowing through the winter due to contributions from the seepage pond discharge pipe, which pipes water from the seepage pond. However, by February 2015 extensive overflow ice conditions had expanded downstream preventing water sampling.

The WQ-DC-DX+105 site, which lies 105 m downstream from WQ-DC-DX, was sampled on the January and February 2015 trips. The samples consistently exceeded the CCME-AL guidelines for arsenic, cadmium, fluoride, and iron, and the Mount Nansen EQS for manganese, as well as both the guideline and standard for zinc during all sampling events (Table 16; APPENDIX E). These results are similar to the previous quarterly results for the site.

The WQ-DC-U site, which lies downstream of WQ-DC-B and the seepage pond discharge site (WQ-SEEP), was sampled during the January 2015 trip. The sample exceeded the CCME-AL guidelines for ammonia, arsenic, cadmium, fluoride, and zinc, the Mount Nansen EQS for manganese, and both the guideline and standard for iron (Table 17; APPENDIX E).

The WQ-DC-B site within the Dome Creek diversion channel was not sampled in the Q4 period. This site can occasionally be sampled during the winter, if the channel is dredged for maintenance, allowing the stream to flow for a short period of time prior to freezing in multiple layers of overflow ice with water seeping between ice layers. However, during the Q4 period, no water was detected and thus site conditions were not suitable for sampling. Sites WQ-DC-DX, WQ-DC-D1b, and WQ-DC-R remained frozen to bed for the entirety of the Q4 period and no water sampling was conducted at these sites.

As noted with the WQ-SEEP and WQ-TP sites in Section 3.3.1, samples for chloride, fluoride, nitrate and nitrite are commonly diluted and the detection limits adjusted for sites on Dome Creek due to higher conductivities and sulfates which could damage lab instrumentation. Many results for fluoride concentrations are reported as below the adjusted detection limit of 0.20 mg/L (APPENDIX E), and thus may exceed the CCME-AL interim guideline for fluoride of 0.12 mg/L. While detection limits for chloride, nitrate and nitrite were also commonly adjusted, the adjusted detection limits remain below the CCME-AL guidelines for these parameters.

Total and WAD cyanide concentrations for Dome Creek sites during the Q4 investigation period did not exceed Mount Nansen EQS criteria (0.3 and 0.1 mg/L, respectively). Only cyanide concentrations for WQ-DC-U were above detection limits during the January 2015 trip (detection limits: 0.005 mg/L). Total cyanide concentration was 0.0441 mg/L, and WAD cyanide was 0.021 mg/L (APPENDIX E).



Table 16. Summary of parameters that exceeded CCME-AL guidelines and/or Mount Nansen EQS at the upper Dome Creek sites for the Q4 period. Parameters in red bold text exceed both standard and guideline values.

Sampling Trip Date	WQ-DC-DX	WQ-DC-DX+105	WQ-DC-D1b
January 12-14, 2015	Frozen to substrate	As, F, Cd, Fe, Mn, Zn	Frozen to substrate
February 16-17, 2015	Frozen to substrate	As, F, Cd, Fe, Mn, Zn	Frozen to substrate
March 16-18, 2015	Frozen to substrate	Frozen to substrate	Frozen to substrate

Table 17. Summary of parameters that exceeded CCME-AL guidelines and/or Mount Nansen EQS for the lower Dome Creek sites for the Q4 period. Parameters in red bold text exceed both standard and guideline values.

Sampling Trip Date	WQ-DC-B	WQ-DC-U	WQ-DC-R
January 12-14, 2015	Frozen to substrate	NH ₃ , F, As, Cd, Fe , Mn, Zn	Frozen to substrate
February 16-17, 2015	Frozen to substrate	Frozen to substrate	Frozen to substrate
March 16-18, 2015	Frozen to substrate	Frozen to substrate	Frozen to substrate

In situ water quality parameters for the Dome Creek sites for Q4 are summarized in Table 18. Water temperatures in Dome Creek ranged from 0°C to 0.4°C. Specific conductivity in Dome Creek ranged from 1,073 to 1,616 µS/cm. The pH throughout Dome Creek remained neutral during the Q4 period, ranging from pH 6.9 to 7.2. Turbidity was low, ranging from 1.65 to 5.93 NTU during the Q4 period.

Table 18. *In-situ* water quality data for the Dome Creek sites for the Q4 period.

Site ID	Date	Water Temp. (°C)	Specific Conductivity (µS/cm)	pH	Turbidity (NTU)
WQ-DC-DX	14-Jan-15		Frozen to substrate		
WQ-DC-DX	16-Feb-15		Frozen to substrate		
WQ-DC-DX	17-Mar-15		Frozen to substrate		
WQ-DC-DX+105	14-Jan-15	0.4	1,171	6.9	5.93
WQ-DC-DX+105	16-Feb-15	0.2	1,073	7.2	
WQ-DC-DX+105	17-Mar-15		Frozen to substrate		
WQ-DC-D1b	14-Jan-15		Frozen to substrate		
WQ-DC-D1b	16-Feb-15		Frozen to substrate		
WQ-DC-D1b	17-Mar-15		Frozen to substrate		



Site ID	Date	Water Temp. (°C)	Specific Conductivity (µS/cm)	pH	Turbidity (NTU)
WQ-DC-B	14-Jan-15		Frozen to substrate		
WQ-DC-B	16-Feb-15		Frozen to substrate		
WQ-DC-B	17-Mar-15		Frozen to substrate		
WQ-DC-U	12-Jan-15	0.0	1,616	7.02	1.52
WQ-DC-U	16-Feb-15		Frozen to substrate		
WQ-DC-U	17-Mar-15		Frozen to substrate		
WQ-DC-R	12-Jan-15		Frozen to substrate		
WQ-DC-R	16-Feb-15		Frozen to substrate		
WQ-DC-R	17-Mar-15		Frozen to substrate		

3.3.3 Regular Seep Sites

There are a total of six surface water seep sites included in the 2014/15 program: WQ-DESS-01, 02, 03, LW-SEEP-01, WQ-CH-P-13-01 and WQ-MS-S-08. All of these sites were either dry or frozen to substrate during the Q4 period.

The WQ-LW-SEEP-01 site was found dry during all quarters of 2014/15. The Dome East Slope Seeps (WQ-DESS-01, -02, -03) had mostly frozen to substrate by November 2014 and were therefore not suitable for sampling during the Q4 period. The WQ-CH-P-13-01 site was frozen to substrate by the November 2014 trip, and no sampling was scheduled for the Q4 period. The WQ-MS-S-08 site was also dry during the Q4 period, similar to conditions during the Q2 and Q3 periods. This site only appears to have surface flow during the freshet period (May) while during other times of year, the water flows underground and may report to the surface at another location.

3.3.4 Brown-McDade Pit Lake

The Brown-McDade pit lake was sampled during each visit of the Q4 period. Samples from January, February, and March 2015 consistently exceeded the CCME-AL guidelines for arsenic, cadmium, copper, and zinc, at all three sample depths (surface, middle and bottom; Table 19; APPENDIX E). The zinc concentrations from all samples also exceeded the Mount Nansen EQS value (Table 19; APPENDIX E). The Mount Nansen EQS value for manganese was also exceeded for the WQ-PIT-3 samples from January and March 2015 (Table 19; APPENDIX E). These results are consistent with previous quarterly results (EDI 2014b, EDI 2015a,b).

Fluoride concentrations exceeded the CCME-AL guideline in the top and middle samples of the January, February and March 2015 visits, as well as the bottom samples of the January and February 2015 visits. The bottom pit lake sample taken in March 2015 may also exceed the fluoride interim guideline; however the result was reported below the adjusted detection limit of 0.20 mg/L, which is above the guideline value of 0.12 mg/L (Table 19; APPENDIX E). Refer to Section 3.3.1 for additional details on why detection limits



are adjusted by the lab for some analyses - this is a common occurrence at sites where conductivity and sulfate concentrations are high and have the potential to damage lab instrumentation if not diluted.

Table 19. Summary of parameters that exceeded CCME-AL guidelines and/or Mount Nansen EQS for the WQ-PIT for the Q4 period. Parameters in red bold text exceed both standard and guideline values.

Sampling Trip Date	WQ-PIT-1 (surface)	WQ-PIT-2 (mid-depth)	WQ-PIT-3 (bottom)
January 12-14, 2015	As, Cd, Cu, F, Zn	As, Cd, Cu, F, Zn	As, Cd, Cu, F, Mn, Zn
February 16-17, 2015	As, Cd, Cu, F, Zn	As, Cd, Cu, F, Zn	As, Cd, Cu, F, Zn
March 16-18, 2015	As, Cd, Cu, F, Zn	As, Cd, Cu, F, Zn	As, Cd, Cu, Mn, Zn

In situ water quality data was collected along with samples for lab analysis during the Q4 period. Water temperatures in the pit lake ranged from 0.2 to 4.4 °C, with thermal stratification of warmer water towards the bottom of the lake and colder water closer to the ice surface typically (Table 20). Specific conductivities ranged from 1,534 to 2,416 µS/cm, and were generally highest from the bottom sample depth (WQ-PIT-3; Table 20), with the exception of the March 2015 visit where the top sample had the highest specific conductivity. The pH in the pit lake varied from pH 7.06 to 7.44. Turbidity of all samples ranged from 0.37 to 5.47 NTU. Dissolved oxygen ranged from 0.80 to 6.53 mg/L, and was lowest at the bottom of the pit lake and highest towards the middle and/or surface of the lake.

Table 20. *In-situ* water quality data for the Brown McDade Pit Lake for the Q4 period.

Date	Site ID	Sample Depth (m)	Water Temp. (°C)	Specific Conductivity (µS/cm)	pH	Turbidity (NTU)	Dissolved Oxygen ¹ (mg/L)
13-Jan-15	WQ-PIT-1	0.3	0.2	1,790	7.33	1.6	6.53
	WQ-PIT-2	3.0	3.0	1,790	7.37	2.3	5.62
	WQ-PIT-3	6.5	4.4	2,416	7.06	7.75	0.81
17-Feb-15	WQ-PIT-1	0.3	1.3	1,865	7.32	0.88	5.47
	WQ-PIT-2	2.5	2.2	1,869	7.30	0.66	4.50
	WQ-PIT-3	5.0	3.9	1,938	7.19	0.56	0.95
17-Mar-15	WQ-PIT-1	0.3	0.2	1,949	7.35	0.37	4.91
	WQ-PIT-2	2.0	1.4	1,925	7.36	0.42	4.60
	WQ-PIT-3	4.0	1.3	1,534	7.44	0.74	0.80

3.3.5 Pony Creek

All of the Pony Creek sites were frozen to bed during the Q4 period. The WQ-PC-U site was sampled during the October 2014 trip before freezing to substrate for the winter. The WQ-PC-D site, downstream from WQ-PC-U, was sampled during the October and November 2014 trips, as the site continued to have



some flow. The downstream site had frozen to substrate by the December 2014 trip. No samples were collected during the Q4 period.

3.3.6 Back Creek

During the Q4 investigation period, the Back Creek site was not sampled due to unsuitable conditions. The site was last sampled during the October 2014 visit, and was frozen to substrate by November 2014. Unusual conditions were first observed at this site during the January 2015, with the stream at nearly bankfull levels, with water seeping through layers of ice and slush. During the February 2015 visit, the overflow conditions had extended over the surrounding stream banks. By March 2015, the overflow had completely frozen and extended laterally into the surrounding forest. The stilling well at the H-BC station was completely under the ice.

Some of the ice from Back Creek had extended out to Victoria Creek, dropping down to Victoria Creek around the WQ-VC-U site location. If this has any effect at all on water quality at WQ-VC-U, it would have very short term effects during spring melt, and may not even be captured during scheduled sampling events depending on the timing of melt. The magnitude of effect would also depend on the water quality of the actual ice from Back Creek, which would be melting, and the quantity of water this melted ice actually contributes to Victoria Creek at WQ-VC-U. Water quality in Back Creek is typically only a concern when there are high suspended sediments associated with placer activity (and there is no placer activity in the winter). Of note it is common for there to be higher metal concentration during freshet (typically early-May) in both Victoria Creek and Back Creek, related to higher suspended sediments at this time of year.

3.3.7 Victoria Creek

Victoria Creek was sampled at all four sites during the Q4 period (WQ-VC-U, WQ-VC-DBC, WQ-VC-UMN and WQ-VC-R+150). The water samples from WQ-VC-U, the most upstream site on Victoria Creek, did not exceed any guideline or standard criteria during the Q4 investigation period (Table 21; APPENDIX E). This site lies upstream of any impacts from the Mount Nansen Mine or Back Creek placer mine operations. However, of note during the March 2015 trip, ice from Back Creek had extended laterally to the banks of Victoria Creek at WQ-VC-U (Section 3.3.6). Based on the sample results for March 2015, there does not appear to be any consequences to the WQ-VC-U lab result which are similar to previous results for this site.

Results for the remaining downstream sites, WQ-VC-DBC, WQ-VC-UMN and WQ-VC-R+150, did not exceed any guidelines or standard criteria during the January or February 2015 samples. However, during the March 2015 sampling event, the WQ-VC-DBC samples exceeded the cadmium guideline, and the WQ-VC-UMN and WQ-VC-R+150 samples exceeded the copper guideline.

Note the Victoria Creek at Road site was sampled from the winter sampling location (WQ-VC-R+150) during the Q4 period, as aufeis conditions had developed up and downstream of the road crossing making sampling impossible at the typical WQ-VC-R location. The winter sampling location is 150 m downstream of the regular sampling site.



Table 21. Summary of parameters that exceeded CCME-AL guidelines and/or Mount Nansen EQS for sites within the Victoria Creek watershed for the Q4 period. Parameters in red bold text exceed both standard and guideline values.

Sampling Trip Dates	WQ-VC-U	WQ-VC-DBC	WQ-VC-UMN	WQ-VC-R+150
January 12-14, 2015	None	None	None	None
February 16-17, 2015	None	None	None	None
March 16-18, 2015	None	Cd	Cu	Cu

In situ water quality parameters for the Victoria Creek sites during each trip in Q4 are summarized in Table 22. Water temperatures during the Q4 period ranged from 0.1 to 0.5°C (Table 22). Specific conductivity remained relatively consistent through Victoria Creek, ranging from 219.1 to 300.3 µS/cm. The pH across the Victoria Creek sites ranged from pH 6.66 to 7.23. Turbidity during the period ranged from 0.0 to 3.9 NTU.

Table 22. *In situ* water quality data for sites within Victoria Creek for the Q4 period.

Site ID	Date	Water Temp. (°C)	Specific Conductivity (µS/cm)	pH	Turbidity (NTU)
WQ-VC-U	13-Jan-15	0.1	219.1	7.33	0.82
WQ-VC-U	17-Feb-15	0.1	246.7	6.99	0.00
WQ-VC-U	16-Mar-15	0.2	245.0	6.66	0.00
WQ-VC-DBC	13-Jan-15	0.1	228.9	7.22	0.54
WQ-VC-DBC	17-Feb-15	0.1	249.1	6.98	0.80
WQ-VC-DBC	16-Mar-15	0.1	251.6	6.70	0.00
WQ-VC-UMN	13-Jan-15	0.2	272.0	7.09	0.21
WQ-VC-UMN	17-Feb-15	0.5	298.5	6.85	0.00
WQ-VC-UMN	16-Mar-15	0.2	300.3	6.72	0.35
WQ-VC-R+150	12-Jan-15	0.2	241.8	6.61	0.11
WQ-VC-R+150	16-Feb-15	0.1	237.8	6.87	0.11
WQ-VC-R+150	16-Mar-15	0.1	264.8	7.23	3.90

3.3.8 Pump House Well

The pump house well (WQ-PW) was sampled during all visits of the Q4 period. Drinking water package samples were collected in addition to bacteriological samples. None of the Q4 samples exceeded the Health Canada Guidelines for Canadian Drinking Water, the CCME-AL guidelines or the Mount Nansen EQS. The January, February and March 2015 bacteriological samples collected by EDI were free of *E. coli* and total coliforms.

Water quality parameters collected *in situ* are presented in Table 23. Water temperatures ranged from 0.1°C to 0.5°C, specific conductivity ranged from 391 to 408.9 µS/cm, pH ranged from pH 7.48 to pH 7.72, and



turbidity ranged from 0.00 to 0.25 NTU (Table 23). All results are within range of the Q1, Q2 and Q3 results (EDI 2014b, EDI 2015a,b).

Table 23. In situ water quality data for WQ-PW for the Q4 period.

Site ID	Date	Water Temp. (°C)	Specific Conductivity (µS/cm)	pH	Turbidity (NTU)
WQ-PW	14-Jan-15	0.1	397.6	7.61	0.00
WQ-PW	17-Feb-15	0.3	408.9	7.48	0.10
WQ-PW	17-Mar-15	0.5	391	7.72	0.25

3.3.9 QA/QC Program

Field blank and travel blank samples were included on every trip during the Q4 period. In general, field and travel blank samples showed no contamination from field sampling methodologies or transportation and storage (*i.e.*, all anion and metal concentrations were below detection limits). The two exceptions were that the February 2015 travel blank had an ammonia concentration above the detection limit, while the February 2015 field blank sample had a dissolved zinc concentration above the detection limit. Both values were below standard and guidelines criteria. Regarding the ammonia in the travel blank, it is common for the ammonia concentration to be above the detection limit for some travel blank samples, when the samples provided by the lab are dated. No contamination from actual travel or storage is suspected. The dissolved zinc value above the detection limit in the field blank sample may be a result of field contamination from air/dust/water during sample handling or an improperly tightened lid. The data collected at the same time as the field blank was reviewed and results were found to be within expected ranges (WQ-VC-R+150).

Replicate samples were collected from one site during each sampling event in Q4 (Table 24). The results from the January 2015 replicate sample was on average 4% different than the regular sample for that site, while the March 2015 replicate sample was on average 9% different than the regular sample for that site. This is less than the 10% threshold for QA/QC and results are therefore within an acceptable range. However, there were some individual parameters that were greater than 10% different between replicate and regular samples. See APPENDIX E - Tables E-1–E-3 for parameters that were flagged as greater than +/- 10% (highlighted in yellow). These could be an indication of variable site conditions and/or a measure of lab precision.

The results from the February 2015 replicate sample, taken from the tailings pond, were on average 27% different than the regular sample for that site, which is greater than the 10% QA/QC threshold (APPENDIX E – Table E-2). Of note, a difference of 1303% was detected in the total chromium concentration. Large differences can sometimes be attributed to high suspended sediments as metals bind readily to particulate matter; however, the sample total suspended sediment value was <3.0 mg/L, while field measured turbidity was 5.32 NTU which could contribute to some of the variability. Of note, some of the WQ-TP sample bottles were frozen in the field accidentally (including the routine, total and dissolved



metals, and cyanide). While the lab did not expect this to cause any concerns for these analyses, it could be the reason for the extremely large differences as the WQ-TP-r sample bottles did not freeze.

Table 24. Summary of sites randomly selected as replicate samples for each sampling trip over the Q4 period, with average percent differences in brackets.

Sampling Trip Date	Replicate #1	Replicate #2
January 12-14, 2015	WQ-VC-UMN-r (4%)	n/a
February 16-17, 2015	WQ-TP-r (27%)	n/a
March 16-18, 2015	WQ-VC-UMN-r (9%)	n/a



4 CONCLUSIONS & RECOMMENDATIONS

Based on results of the Q4 period of the Mount Nansen Water Resources Investigations Program from January 1, 2015 to March 31, 2015, EDI recommends that monitoring should continue as scheduled for 2015/16 investigations with added consideration of several recommendations outlined below. These recommendations attempt to improve the overall program data quality and efficiency.

- Once snow has melted in Spring 2015, the area directly below the snow sensor should be prepared with a flat surface and any surrounding vegetation should be removed. The snow sensor will then need to be re-calibrated by Northern Avcom and the data monitored during the snow-free summer months, to ensure the sensor is reading around zero metres snow depth (+/- sensor resolution).
- The volumetric measurements at the seepage pond pipe outlet (H-SEEP) and the flow meter at the pump house flow meter were not in agreement in January and February during the Q4 period (APPENDIX D, Figure D-4; Table D-5). The measurements at the pipe outlet were lower than those observed at the flow meter and that recorded by DES (daily at the flow meter). The difference is approximately 0.001 m³/s or 60L/min. The difference is relatively small however typically the measurements are in good agreement; the source of the discrepancy is not known.
- It is recommended that location of the H-VC-U continuous data logger and stilling well be re-located to a pool immediately upstream (approximately 10 m) of the existing station (right bank) in spring 2015. Several factors including peak flow sediment deposits and ice conditions in the channel are contributing to sedimentation in the stilling well during summer and causing the stilling well to freeze to bed in winter. The data logger at this station is malfunctioning and requires replacement, however this is likely not feasible until break-up occurs. It may be prudent to replace some or all other loggers on Site as many loggers are likely nearing the end of their lifespan.
- The geometry of the channel at H-VC-R changed due to sediment depositions in 2014 (during freshet). Substantial ice accumulation (storage) in Victoria Creek upstream of the Mount Nansen access road appears to be contributing to the attenuation of flow at H-VC-R. The ice accumulation and sediment deposits are hindering measurements at the station therefore it is recommended that the H-VC-R station be relocated downstream of the existing well in spring 2015 prior freshet if possible. A potential location has been located approximately 90 m downstream. This will ensure that the measurement location is stable and the continuous logger remains wetted year round.
- Construction activity in the vicinity of the bridge and the H-DC-B station during Q3 may have damaged Benchmark 1, which was located along the diversion channel berm. Benchmark 1 will need to be re-established in 2015 when the station is reinstalled.



- The H-DC-M weir pond will likely require repairs due to substantial ice accumulations and continued maintenance due to sedimentation, particularly following rain storms and excavation work upstream which mobilizes sediment into the stream.
- It is recommended that if future hydrologic monitoring is required at the H-DC-DX+105 station during summer and/or year round, that a small, temporary weir or flume structure is installed to confine flow so that a volumetric measurement can be obtained. In the 2014/2015 monitoring period, very few useable discharge measurements were obtained.
- During 2014/2015, measurements became more difficult to obtain using salt tracers at the H-DC-D1b station due to subtle changes in the channel (increasing pool depth at the input site, channel incision and increased influence of roots in the measurement reach). Currently, using salt tracers during the open water season is the only option for measurement unless a weir or flume structure is installed. Data collection at this station should be re-considered for the 2015 open water season; weighing the value of data for water balance and water quality modelling against the cost of installing a weir or flume structure.
- The existing data loggers on site require replacement as they are nearing the end of their life span; all water level loggers will be replaced in 2015 with Solinst Edge water level loggers.
- Planning for freshet investigations should take place in late April 2015, with anticipation of freshet occurring in early-May 2015.
- The WQ-SEEP samples from Q4 had some unusual results including total and dissolved zinc concentrations above the CCME-AL guideline and LT50 results from January 2015 and March 2015 with less than 100% fish survival after 96 hours in 100% sample concentration. Groundwater and surface water quality should continue to be monitored in the seepage and tailings pond facility during the 2015/16 program to detect any changes over time.



5 REFERENCES

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APPENDIX A. SUPPORTING METHODOLOGY

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HYDROLOGY METHODOLOGY

Velocity-Area Mid-Section

The velocity-area mid-section method was used to determine discharge at hydrometric stations where channel criteria met those outlined in standard guidance documents (RISC 2009; WSC 1999). Cross-section locations were established for each hydrometric station where this method was applied; these cross-sections were located in close proximity to continuous data logger installations.

Using the continuity relationship for discharge (Q),

$$Q = v \cdot A = b d v \quad [1]$$

Depth (d), velocity (v) and width (b) measurements were obtained for at least 20 panels across the metering cross-section. The cross-section panel width and depth were multiplied by the velocity and averaged over 40 seconds (RISC 2009) to obtain an instantaneous discharge measurement (q) for each panel. Panel discharges were subsequently summed to obtain total discharge. The discharge for the first and last panels was calculated using half the distance from the edge to the first and last mid-panel verticals.

The velocity-area discharge calculation is described by the following equations:

$$q_n = v_n d_n \frac{(b_{n+1} - b_{n-1})}{2} \quad [2]$$

$$Q = q_1 + q_2 + q_3 + q_4 + q_5 + \cdots q_n \quad [3]$$

Where SI units of m^3/s , m/s , and m are used for discharge, velocity and depth respectively.

The current meter used to obtain the velocity measurements is a 2-dimension, side looking, FlowTracker Handheld Acoustic Doppler Velocimeter (ADV) (Sontek/YSI Inc. 2009). The FlowTracker is used by both the Water Survey of Canada and the U.S. Geological Survey. The FlowTracker computer calculates discharge using the mid-section method and calculates the statistical discharge uncertainty based on methods developed by the U.S. Geological Survey (Cohn *et al.* 2006). This method of calculating uncertainty accounts for the uncertainty associated with width, depth and accuracy of the FlowTracker calibration and the effects of channel variability on depth and velocity across the cross-section (Sontek/YSI 1999). The statistical discharge uncertainty calculated by the FlowTracker at Mount Nansen was typically less than $\pm 5\%$. An uncertainty of $\pm 10\%$ is considered by industry as acceptable for the velocity-area mid-section method. The statistical uncertainty was applied for all velocity-area discharge measurements obtained with the ADV.

Salt Dilution Gauging

Salt dilution gauging was used at hydrometric stations where the channel conditions were not suitable for using a current meter. Typically this occurred when water depths were less than 0.05 m, channel widths were



less than 3.0 m or during winter months when ice was prohibitively thick for conducting velocity-area measurements beneath the ice.

There are three different methods of salt dilution gauging: constant rate injection (brine); slug injection (brine) and dry salt injection. Method selection depends on the magnitude of discharge to be measured, channel conditions and feasibility for remote sites as the required equipment varies for each method. All methods require the selection of an input (injection) site and a downstream electrical conductivity measurement site. The distance between these sites (mixing length) is optimized for the minimum distance required for complete mixing of the fully dissolved salt tracer.

Specific channel conditions during open water and winter periods are required for successful salt dilution gauging. These criteria ensure that complete lateral and vertical mixing occurs in as short a distance as possible: minimal pools; no backwater areas; no braiding; little to no in-stream vegetation; and no losses or gains of water (Moore 2004a; Moore 2004b; Laberge Environmental Services 1999).

Channel geomorphology and winter temperatures required some adaptations to the methodology presented in Moore (2004; 2005), therefore field protocols and subsequent calculations were modified to incorporate methods presented in Kite (1994) and Laberge Environmental Services (1999). Laberge Environmental Services (1999) describes practical, field tested and validated protocols for winter low flow measurements in the Yukon with a focus on streams with high background conductivities similar to the Mount Nansen region. However, the methods and calculations provided by Moore (2004a; 2004b; 2005) were used as they were thought to be significantly more robust and adaptable to site-specific stream conditions.

The gram conductivity of salt, the conductivity of 1 g NaCl in 1 m³ of solution at 25 °C, is non-linear at higher background conductivities (Laberge Environmental Services 1999). Background specific conductance at the hydrometric stations range widely, from ~29 µS/cm to upwards of 1,500 µS/cm. The field protocol presented in Moore (2004a; 2004b; 2005) accounts for the non-linearity of the gram conductivity but requires additional field calibration tests for each visit and each gauging location. This method was not practical during extremely cold temperatures but was employed whenever possible in the Q1 period.

The slug injection (brine) method was selected for use at the Mount Nansen Site hydrometric stations because this method was most feasible for the remote sites, channel conditions, discharges and the most efficient method for the field monitoring program. In addition, the use of brine slugs allows for shorter mixing lengths to be used; ideal for channels at Mount Nansen. Measurement reaches were carefully selected to meet the measurement criteria and overlap with the physical location of continuous water level loggers. Salt injection sites were located upstream of constrictions (e.g., culverts) where possible to facilitate full mixing. A conductivity meter records specific conductance approximately 60 m downstream for the smaller creeks and approximately 90 m for Victoria Creek, depending on channel conditions.

The same measurement reach was used for each field visit unless changes to the channel conditions warranted minor adjustments to the measurement locations. The slug injection method requires an electrical conductivity meter (YSI ProPlus Multi-Meters with logging capabilities) to be set up at the downstream end of the measurement reach. Background electrical conductivity was logged for several minutes before the



slug injection to allow for the instrument to equilibrate and to measure background variability. Specific electrical conductance¹ (SPC) is measured (logged) because the values are compensated for water temperature. A known mass of salt (NaCl) is dissolved into a graduated bucket of stream water at the injection site. Once fully dissolved, the salt slug is injected at the upstream site and the electrical conductivity of the salt wave is measured at the downstream location at two to five second intervals depending on the stream velocity. Two trials were conducted at each station. When possible, a secondary method of discharge measurement was used to validate the salt dilution measurement (*i.e.*, volumetric discharge measurement, ADV measurement).

The formula used to calculate discharge for the Mount Nansen salt slug injections is:

$$Q = \frac{V_{ss}}{1000 \cdot CF \cdot T \cdot \tau \cdot \sum (SPC_t - SPC_o)} \quad [4]$$

Where Q is discharge (m^3/s), V_{ss} is the volume of salt slug injection (L), τ is the time interval in seconds and SPC_t and SPC_o are the measured and background conductivity at time interval t , respectively. The $CF \cdot T$ value is the calibration factor that accounts for the non-linearity of electrical conductance and salt concentration in stream water. The $CF \cdot T$ value is taken as the slope of the line of SPC and relative concentration of the salt slug in an aliquot of sample stream water. The target peak specific conductance for the salt wave was an increase of at least ten-times the resolution of the conductivity meter used. Typically, an increase between 10% and 50% of SPC_o was achieved, above the required increase of 2 to 5 $\mu S/cm$.

Stream discharge was calculated for each salt slug trial using Equation [4] and averaged to provide a discharge estimate. The average estimated measurement accuracy for the salt dilution gauging method is $\pm 20\%$. However, salt dilution gauging accuracy will vary between each station due to differences in individual channel conditions and stream water velocities.

In some instances where ambient air temperatures were prohibitively cold (*i.e.*, $< -30^\circ C$), the dry salt slug injection method using a mass-balance approach was used. This was due to limitations that rapidly freezing water placed on equipment, field procedures and safety of field personnel. The formula for calculating discharge using the dry salt slug injection differs slightly from equation [4], and follows the calculations provided by Moore (2004). The discharge calculation formula for the dry salt slug injection is:

$$Q = \frac{m}{\sum (EC - EC_o) \cdot CF \cdot t_{int}} \quad [5]$$

Where m is the mass of salt used for the dry slug injection, EC is the electrical conductivity measured at a defined time interval (t_{int}), EC_o is the background electrical conductivity. CF is a site-specific constant that is determined by measuring changes in specific conductivity with known masses of salt. Stream discharge was calculated using equation 5 for each salt slug trial during the monitoring period. The estimated measurement

¹ Specific electrical conductivity measured by the YSI ProPlus and the YSI 556 multi-meters are linearly compensated for temperature. The multi-meters are calibrated daily during each field visit before use.



accuracy for dry salt slug injection is $\pm 30\%$. However, the discharge uncertainty varies considerably between each station due to differences in channel conditions and stream water velocities.

Volumetric

Volumetric discharge measurement is ideal for low flows because all the stream flow is captured in a bucket of a known volume at a confined outlet or constriction in the channel. Channel constrictions created by culverts, pipes and weirs provided an opportunity to measure stream flow by measuring the time to fill a bucket of known volume. The volumetric method for measuring discharge is used periodically at two stations at Mount Nansen where a culvert or pipe is available (H-PC-U; H-SEEP). During extreme low flows it is also possible to obtain volumetric estimates at H-DC-DX+105.

The volumetric measurement is completed using a graduated 20 L bucket and a timing device. The time required to fill the volume is recorded over five separate volumetric trials. All five volumetric trials are averaged to provide a discharge estimate. The estimated measurement accuracy is $\pm 30\%$.

The volumetric measurement method employed at H-SEEP (Tailings Dam Seepage Pond pump pipe outlet) is used to validate daily instantaneous measurements read at the flow meter attached to the pump that is used to manage water levels in the Seepage Pond. Daily flow meter readings were collected by the site maintenance crews and data is maintained by AAM. EDI staff collects concurrent flow meter readings when volumetric measurements are made at the pipe outlet.

Ice-Cover Hydrometrics

Hydrologic measurements completed during periods when the channel is covered with ice have lower accuracy than open channel measurements because the standard hydrometric methods are based on open channel hydraulic relationships between the impelling and resisting forces of flow. Ice increases the resistance to flow, slowing velocities and increasing the water surface elevation (backwater effect). Frazil ice, anchor ice, slush and ice jams influence the water surface profile and effective depth of flow in the channel. As a result, the relationship between stage and discharge changes during the winter. Cold temperatures frequently cause problems with measurement equipment, including continuous water level loggers. In the Yukon, winter measurement instruments are usually working at or beyond the cold temperature operating limits and resultant data is carefully analyzed and often excluded from analysis. All measurements collected when ice was observed in the channel were flagged in the data record with 'B'; the standard data flag used by the WSC indicating backwater or ice effects. Measurements influenced by ice are not included in the open water stage-discharge rating curve development.

In Victoria Creek, the velocity-area and salt dilution methods were feasible during ice-cover periods when ice thicknesses and ambient air temperatures were not prohibitive. Salt dilution was used on the smaller channels if they were not frozen to the bed. Regardless of the technique used, careful attention was paid to ice and flow conditions. In many of the streams at the Mount Nansen Site, multiple layers of ice are present with flow travelling through complex networks within and on the surface of the ice. In such conditions, discharge measurements become increasingly uncertain and are not performed.



Hydrometric Leveling Surveys

Hydrometric leveling surveys are performed during each visit at stations where continuous data loggers are installed. The purpose of the survey is to tie the data logger water levels to the local station datum. Each station has a local, relative datum defined by benchmarks in close proximity to the data logger and stilling well. Three benchmarks are installed at each continuous station as per RISC (2009) Data Grade A guidelines. Each survey includes a survey with a level and rod for Benchmark 1 (BM1), Benchmark 2 (BM2), Benchmark 3 (BM3), the top of the staff gauge (TOS), the water surface elevation (WATER) and the elevation of the fixed-length logger apparatus (named LOGGERROD). The elevation of Benchmark 1 at every station defines a local elevation of 3.000 m above datum. The local datum is always located below the elevation of zero flow. The benchmarks and the top of the staff gauge are regularly checked for shifting as a result of periglacial processes and survey error. While there is some apparent movement in the benchmark elevations and occasionally anomalous survey data, the water surface elevation data was carefully reviewed using staff gauge readings and the field records of stilling well maintenance (logger or staff gauge shifts) before applying local datum offsets to the raw data logger record. All suspect data is excluded from the corrected data. All stage data is presented in metres referenced to the local datum (L.D.) unless otherwise noted.

Hydrometric Validation & QA/QC Program

The velocity-area, weir and volumetric hydrometric measurement methods used for the Mount Nansen hydrometric program are standardized by the WSC and the USGS. Several stations do not meet standardized criteria. At these stations, alternative methods (e.g., salt dilution) are used. In some cases, concurrent standardized methods (e.g., velocity-area measurements) allow for the validation and calibration of alternate methods. Concurrent measurements also facilitate uncertainty estimates for stream discharge measurements.

Quality control and quality assurance (QA/QC) checks begin during field visits. The Flow Tracker ADV provides numerous QA/QC checks in real-time during velocity measurements that allow the field crew to increase the precision of the measurements. Upon return from the field, data entry staff performs preliminary checks and reviews of the raw data and discharge calculations prior to the production of trip and quarterly reports. A third round of QA/QC is completed during data entry into the hydrometric database. A final QA/QC is completed during the development of rating curves and hydrographs for each hydrometric station.

Rating Curve Development

Rating curves are based on open channel hydraulic relationships between stage (water level) and discharge. They are based on open-water conditions only and are not representative of ice-cover channel conditions. The y-axis represents the recorded stage level at the gauge and the x-axis the discharge. The rating curve equation represents the hydraulic reaction of flow a smoothly varying channel with increasing stage (or a constant control point at all stages) (Maidment 1993). The rating curve equation [6] has the form:

$$Q = C(h + a)^N \quad [6]$$



Where Q is discharge in m^3/s , C is typically proportional to the channel width, $(b+a)$ represents the depth of water above the stage of zero flow (water level where flow becomes zero) and the value of N is a function of the channel geometry (Maidment, 1993). If the pressure transducer is below the point of zero flow, the value of 'a' is negative; conversely a positive 'a' value indicates that it is above. Typically as the stage increases, the hydraulic control shifts from low flow hydraulic control to channel friction control or to ice related controls. As a result multiple rating curve expressions for a single channel and various stages are often required to accurately represent the full range of flows.

By taking the log of both sides of the rating curve in equation [7], we obtain:

$$\log Q = \log C + N \log(h + a) \quad [7]$$

the rating curve equation [8] takes the linear form $y=mx+b$ and can be fit to the discharge rating points as a straight line. Rating curves may be developed using several different methods including fitting the calibration points by eye and the maximum likelihood solution. Given the small size of the channels at the Mount Nansen Site, the narrow range of stage changes, and channel instabilities, each rating curves is developed by fitting by eye within the Aquarius Time-Series Software environment (Aquarius Informatics Inc. 2014).

Rating curves are developed for stations with continuous water level loggers using surveyed water levels (stage) and instantaneous discharge measurements. A rating curve is considered preliminary if the following conditions are met: there are less than 10 reliable rating measurements (RISC 2009), if rating measurements do not capture an acceptable range of flows (*i.e.*, 10 %-200 % of mean discharge (MD)), or, if there is a high rating curve error.

Rating curves are developed with rating measurements obtained when the channel is ice free. Any rating measurement obtained during ice conditions are reported simply as instantaneous measurements. Rating curves are valid only for a defined rating period. A rating period represents a section of time where both the channel and hydrometric installation are stable.

Timely monitoring events during the spring freshet period allow the capture of higher spring flows. A conservative approach was adopted for presenting the continuous hydrometric record in this report. Predicting flood or low flows can introduce error into hydrologic analysis and should be carefully considered in the context of channel hydraulic geometry.

Continuous Stage and Discharge

A combination of HOBO (Model: U20-001-04, Onset Corporation) and Levellogger (Model Gold 3001, Solinst) pressure transducers are used on site. Two barometric and temperature data loggers (ATM-DC2 (HOBO) and ATM-DC4 (Solinst)) were maintained in the middle of the watershed near hydrometric station H-DC-B. All of the data loggers are non-vented pressure transducers that record water or air temperature and pressure.



The hydrostatic pressure data was compensated for atmospheric pressure using data from the barometric pressure logger located at ATM-DC4. Data from the redundant barometric loggers was not required.

Sensor depth below the surface of the water was calculated manually for the HOBO loggers submerged in the streams using the following relationship from the Euler equation [8] where:

$$H = \frac{P}{\gamma} + z \quad [8]$$

Hydraulic head (H) or water depth above the sensor, hydrostatic pressure (P) in Pa, the specific weight of water $\gamma = \rho g$ where ρ is the density of water at a given temperature ($\text{kg}\cdot\text{m}^{-3}$), g is acceleration due to gravity ($\text{m}\cdot\text{s}^{-2}$) and z is elevation above a datum. Density of water varies with temperature and given the wide range in stream temperatures throughout the year, the density was computed using the Thiesen-Scheel-Diesselhorst equation [9] (Maidment 1993):

$$\rho = 1000 \left[1 - \frac{t+288.94}{508929.2(t+68.12963)} (t - 3.9863)^2 \right] \quad [9]$$

Where t = temperature ($^{\circ}\text{C}$). The Solinst logger records at stream sites did not require water depth conversions because water depth is automatically calculated as an output from the record.

Continuous stage records are collected at 15 minute intervals and re-sampled to 30 minute intervals. Continuous discharge is calculated using the stage-discharge rating curve developed for the rating period at each respective station. The continuous stage record (rather than discharge record) is presented for stations where developing reliable rating curves is considered unsuitable due to channel conditions and available measurement techniques.

Hydrometric Data Management

Hydrometric data is compiled into a MS Access database after each visit to the Mount Nansen Site (*EDI 14-Y-0455 Hydrology Database.accd*). The hydrometric database is designed to hold raw field data including hydrometric station metadata, station history, field measurements, survey data and data logger files. The hydrometric database is also used for QA/QC.

WATER QUALITY METHODOLOGY

Field Sampling Methods

An Oakton T100 turbidity meter was used to collect *in situ* turbidity (NTU). This meter is calibrated on a monthly basis according to instrument specifications. A YSI ProPlus multi-meter was used to collect *in situ* water temperature (degrees Celsius), pH (pH units), specific conductivity ($\mu\text{S}/\text{cm}$). Field crews calibrated the YSI meter prior to each trip and as required in the field. A YSI ProODO meter was used to measure dissolved oxygen (mg/L) from the pit lake (this probe does not require any calibration). Field data is recorded on standard field datasheets including site name, sample identifier, sample date and time, water temperature, specific conductivity, pH, photo numbers and a record of qualitative site conditions including flow stage (low, moderate, high), turbidity (clear, low, moderate, high), and ice observations (if present).



Laboratory-cleaned bottles are filled using clean techniques (*i.e.*, nitrile gloves, appropriate bottle handling) and samples are filtered and preserved on site, as directed by the lab (ALS Laboratories). Samples from the pit lake are taken from the same general location on the lake at three different depths, from the surface, at mid depth and just off the bottom. In the event that ice covers the water surface, an ice auger is used to access the water column. A Kemmerer sampler is used to collect all pit samples and is also used to measure the depth. When the pit lake is ice free, a row boat is used to access the sampling location, and samples are collected again with the Kemmerer.

Samples are kept in coolers immediately following collection, and later transferred to the Mount Nansen Site sample refrigerator until they could be transferred to Whitehorse on the final day of each sampling event. For chemical analysis, Chain of Custody forms, supplied by the lab, are included in each sample cooler, and samples are delivered to ALS Laboratories upon arrival back in Whitehorse, YT to ensure lab holding times were met.

Laboratory Analysis

All surface water quality laboratory analysis is conducted by ALS. Several lab analysis packages have been organized for the Mount Nansen Site, including a pit lake package (WQ-PIT), a drinking water package (WQ-PW), an LT50 package (WQ-SEEP), and a standard site package (all other sites). The parameters included in each package are outlined in Table A-1.

Table A-1. Laboratory analysis parameters included in various ‘packages’ created for surface water quality sampling at Mount Nansen (continues on next page).

Analysis Package	Parameters Included
Standard Site Package	Cyanides: Cyanate, Total Cyanide (as Strong Acid Dissociable), Weak Acid Dissociable, Thiocyanate Physical Tests: Conductivity, Hardness, pH, Total Dissolved Solids, Total Suspended Solids Anions and Nutrients: Bicarbonate, Carbonate, Hydroxide, Total Alkalinity, Total Ammonia, Chloride, Fluoride, Nitrate, Nitrite, Sulphate Total Metals: Aluminum, Antimony, Arsenic, Barium, Beryllium, Bismuth, Boron, Cadmium, Calcium, Chromium, Cobalt, Copper, Iron, Lead, Lithium, Magnesium, Manganese, Mercury, Molybdenum, Nickel, Phosphorus, Potassium, Selenium, Silicon, Silver, Sodium, Strontium, Sulfur, Thallium, Tin, Titanium, Uranium, Vanadium, Zinc. Dissolved Metals: Aluminum, Antimony, Arsenic, Barium, Beryllium, Bismuth, Boron, Cadmium, Calcium, Chromium, Cobalt, Copper, Iron, Lead, Lithium, Magnesium, Manganese, Mercury, Molybdenum, Nickel, Phosphorus, Potassium, Selenium, Silicon, Silver, Sodium, Strontium, Sulfur, Thallium, Tin, Titanium, Uranium, Vanadium, Zinc.
Pit Lake Package	Physical Tests: Conductivity, Hardness, pH, Total Dissolved Solids, Total Suspended Solids Anions and Nutrients: Bicarbonate, Carbonate, Hydroxide, Total Alkalinity, Total Ammonia, Chloride, Fluoride, Nitrate, Nitrite, Sulphate Total Metals: Aluminum, Antimony, Arsenic, Barium, Beryllium, Bismuth, Boron, Cadmium, Calcium, Chromium, Cobalt, Copper, Iron, Lead, Lithium, Magnesium,



Analysis Package	Parameters Included
	Manganese, Mercury, Molybdenum, Nickel, Phosphorus, Potassium, Selenium, Silicon, Silver, Sodium, Strontium, Sulfur, Thallium, Tin, Titanium, Uranium, Vanadium, Zinc. Dissolved Metals: Aluminum, Antimony, Arsenic, Barium, Beryllium, Bismuth, Boron, Cadmium, Calcium, Chromium, Cobalt, Copper, Iron, Lead, Lithium, Magnesium, Manganese, Mercury, Molybdenum, Nickel, Phosphorus, Potassium, Selenium, Silicon, Silver, Sodium, Strontium, Sulfur, Thallium, Tin, Titanium, Uranium, Vanadium, Zinc.
Drinking Water Package	Physical Tests: True Colour, Conductivity, Hardness, pH, Total Dissolved Solids, Turbidity Anions and Nutrients: Alkalinity, Total, Chloride, Fluoride, Nitrate, Nitrite, Sulphate Total Metals: Aluminum, Antimony, Arsenic, Barium, Boron, Cadmium, Calcium, Chromium, Copper, Iron, Lead, Magnesium, Manganese, Mercury, Potassium, Selenium, Sodium, Uranium, Zinc.
LT50	LT50 test, 96-hr test to be conducted with Rainbow trout.

QA/QC Program

A QA/QC sampling program is conducted as part of the monitoring program, including replicate samples, a field blank sample and a trip blank sample. These are described in detail below:

- Replicate samples are essentially sample replicates collected at the same date, time and location as the regular sample. All sampling methodology is the same, as if it is a separate site. Replicates are collected from one to three sites, randomly selected, during each trip, depending on the total number of sites per trip, to cover approximately 10% of the total sites sampled. The replicate samples are collected to check the accuracy and precision of the laboratory analysis, as well as a measure of the variability in water quality at a site for a given time.
- The field blank samples are collected on site, where a set of sample bottles is filled with deionized water at some point during the sampling trip. Sampling methodology is the same as if sampling from a stream, with filtering and preserving as required. The purpose of a field blank is to identify any contamination introduced to the sample during the act of field sampling (*i.e.*, sample filling/handling, exposure to questionable air quality) or via the supplies (filter, syringe, bottle, or preservative).
- The travel blank is a sample set provided by the laboratory to be carried by the staff to and from site during the field work. The travel blank is not opened at any time during the trip. The purpose of including a travel blank is to identify any contamination of the sample caused during transportation or storage.

Following receipt of the laboratory analysis results, a review of the QA/QC sample results is completed. This involved comparing the replicate samples and the regular samples collected at the randomly selected replicate sites to ensure they are within acceptable limits of each other (within +/-10%). Field and travel



blank sample data is also reviewed to ensure that concentrations of all potential contaminants are low to below detection limits.

Data Analysis

Data are reviewed and parameters of concern are graphed and compared with the Canadian Council of Ministers of the Environment (CCME) guidelines for the protection of freshwater aquatic life (CCME-AL; CCME 2014; Table A-2), and with the Effluent Quality Standards (EQS) outlined in Yukon Water Board Water license No. QZ94-004, issued to BYG Natural Resources Inc. on February 13, 1996 (Table A-3). Drinking water quality from the WQ-PW site is compared to the applicable Guidelines for Canadian Drinking Water Quality (Health Canada 2012; Table A-4).

Table A-2. CCME-AL guidelines applicable to Mount Nansen surface water quality sampling program (CCME 2014).

Water Quality Parameter	CCME-AL Guideline	Units	Comments
Aluminum (Al)	0.1	mg/L	CCME is 0.1 at pH > 6.5, if pH is lower than 6.5, guideline is set at 0.005 mg/L
Ammonia (Total N)	0.75	mg/L	Guideline is temperature and pH dependent. This represents a highly conservative guideline calculated for a pH of 8.5 and a water temperature of 0°C. Guideline decreases with increasing pH and temperature.
Arsenic (As)	0.005	mg/L	-
Cadmium (Cd)	0.00009	mg/L	Guideline is hardness dependent. This value represents the conservative guideline when hardness is unknown.
Chloride (Cl)	120	mg/L	-
Chromium (Cr)	0.0089	mg/L	-
Copper (Cu)	0.002	mg/L	Guideline is hardness dependent. This value represents the conservative guideline when hardness is unknown.
Total Cyanide	0.005	mg/L	SAD Cyanide is used as a measure of total cyanide
Fluoride (F)	0.120	mg/L	-
Iron (Fe)	0.3	mg/L	-
Lead (Pb)	0.001	mg/L	Guideline is hardness dependent. This value represents the conservative guideline when hardness is unknown.
Mercury (Hg)	0.000026	mg/L	-
Molybdenum (Mo)	0.0073	mg/L	-
Nickel (Ni)	0.025	mg/L	Guideline is hardness dependent. This value represents the conservative guideline when hardness is unknown.
Nitrate (N)	13	mg/L	-
Nitrite (N)	0.06	mg/L	-
pH	6.5 - 9.0	pH	-
Selenium (Se)	0.001	mg/L	-



Water Quality Parameter	CCME-AL Guideline	Units	Comments
Silver (Ag)	0.0001	mg/L	-
Thallium (Tl)	0.0008	mg/L	-
Uranium (U)	0.015	mg/L	-
Zinc (Zn)	0.03	mg/L	-

Table A-3. Mount Nansen Effluent Quality Standards outlined in Yukon Water License #QZ94-004.

Water Quality Parameter	Effluent Discharge Standard
pH	6.0 to 8.5 pH
Total Suspended Solids (TSS)	50 mg/L
Toxicity (LT50 – 96 hr. for rainbow trout, pH non-adjusted)	100%
WAD Cyanide	0.1 mg/L
Total (SAD) Cyanide	0.3 mg/L
Antimony (Total)	0.15 mg/L
Arsenic (Dissolved)	0.15 mg/L
Barium (Total)	1.0 mg/L
Cadmium (Total)	0.02 mg/L
Chromium (Total)	0.04 mg/L
Copper (Total)	0.2 mg/L
Iron (Total)	1.0 mg/L
Lead (Total)	0.1 mg/L
Manganese (Total)	0.5 mg/L
Mercury (Total)	0.005 mg/L
Nickel (Total)	0.3 mg/L
Silver (Total)	0.10 mg/L
Zinc (Total)	0.3 mg/L

Table A-4. Applicable Guidelines for Canadian Drinking Water Quality for WQ-PW (Health Canada 2012).

Water Quality Parameter	Health Canada Guideline
Antimony	0.006 mg/L
Arsenic	0.010 mg/L
Barium	1.0 mg/L
Boron	5.0 mg/L
Cadmium	0.005 mg/L
Chromium	0.05 mg/L
Fluoride	1.5 mg/L



Water Quality Parameter	Health Canada Guideline
Lead	0.010 mg/L
Mercury	0.001 mg/L
Nitrate	45 mg/L
Selenium	0.01 mg/L
Uranium	0.02 mg/L



APPENDIX B. Q4 PHOTOGRAPHS

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Dome Creek Sites/Stations



Photo 1. WQ-DC-DX+105, looking upstream (January 14, 2015).



Photo 2. WQ-DC-R, looking downstream (February 16, 2015).



Photo 3. Recently dredged diversion channel downstream of H-DC-B (January 1, 2015).



Photo 4. WQ-DC-B, looking downstream (March 17, 2015).



Photo 5. H/WQ-DC-U, looking downstream (February 16, 2015).



Photo 6. H/WQ-DC-U, looking upstream (February 16, 2015).



Photo 7. Extensive overflow at H/WQ-DC-U, looking upstream (March 17, 2015).



Photo 8. Overview of H-DC-U weir and staff gage (March 17, 2015).



Victoria Creek Sites/Stations



**Photo 9. H-VC-U, looking upstream
(February 17, 2015).**



**Photo 10. WQ-VC-U, looking downstream
towards Back Creek confluence
(February 17, 2015).**



**Photo 11. H-VC-DBC, looking upstream
(March 16, 2015).**



**Photo 12. WQ-VC-DBC, looking upstream
(March 16, 2015).**



Photo 13. ATM-VC5, new MET station established at WQ-VC-U (February 17, 2015).



Photo 14. WQ-VC-UMN, looking upstream (February 17, 2015).



Photo 15. H-VC-UMN, looking downstream (January 13, 2015).



Photo 16. WQ-VC-R, looking upstream from road crossing, showing overflow conditions (January 14, 2015).



Photo 17. H/WQ-VC-R+150, looking downstream (January 12, 2015).



Photo 18. H-VC-R, looking upstream towards road crossing, staff gauge on right downstream bank (March 16, 2015).

Back Creek Sites/Stations



Photo 19. H/WQ-BC, looking downstream, showing overflow conditions and staff gauge on the right downstream bank (January 13, 2015).



Photo 20. H/WQ-BC, looking upstream, showing overflow conditions (March 16, 2015).



Pit Lake/Tailings Pond/Seepage Pond Discharge



Photo 21. H/WQ-SEEP (February 16, 2015).



Photo 22. H/WQ-TP (March 17, 2015).



**Photo 23. WQ-PIT sampling location
(February 17, 2015)**



**Photo 24. WQ-PIT sampling location,
showing collapsed overflow ice
(March 17, 2015).**



Pump House Well



**Photo 25. WQ-PW
(March 17, 2015).**

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APPENDIX C. Q4 VISIT RECORD

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**Table C-1. Record of sites sampled and stations monitored during each site visit during the Q4 period, January 1 to March 31, 2015.**

Station / Site Name	January 12-14, 2015	February 16-17, 2015	March 16-18, 2015
WQ-PC-U	N	N	N
H-PC-DSP/WQ-PC-D	N	N	N
WQ-PIT-1,2,3	Y	Y	Y
WQ-DC-DX	N	N	N
H/WQ-DC-DX+105	Y	Y _w	N
H/WQ-DC-D1b	N	N	N
H/WQ-DC-B	N	N	N
H-DC-M/WQ-DC-U	Y	N	N
H/WQ-DC-R	N	N	N
H/WQ-TP	Y _w	Y _w	Y _w
H/WQ-SEEP	Y	Y	Y
WQ-MS-S-08	N	N	N
H/WQ-BC	N	N	N
H/WQ-VC-U	Y	Y	Y
H/WQ-VC-DBC	Y	Y	Y
H/WQ-VC-UMN	Y	Y	Y
H/WQ-VC-R	n/a	n/a	n/a
WQ-VC-R+150	Y	Y	Y
WQ-PW	Y	Y	Y
WQ-DESS-01	n/a	n/a	n/a
WQ-DESS-02	n/a	n/a	n/a
WQ-DESS-03	n/a	n/a	n/a
WQ-CH-P-13-01	N	N	N
WQ-LW-Seep-01	n/a	n/a	n/a

Codes

N – site or station not sampled due to no observations of flow or lack of suitable conditions for sampling

Y – water sampling conducted and/or discharge measurement collected

Y_w – water quality only (if a combined hydrology station and water quality site)Y_h – hydrology only (if a combined hydrology station and water quality site)

n/a – not applicable as sampling/monitoring not scheduled for respective sampling event

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APPENDIX D. HYDROLOGY DATA

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Table D-1. Hydrometric Instrument Accuracy.

Instrument	Parameter	Instrument Accuracy
Acoustic Doppler Velocimeter (ADV)	Velocity	± 1%
Swoffer Current Meter	Velocity	± 1%
Staff Gauge	Water depth	± 1 mm
Survey Rod	Elevation	± 1 mm
Measuring Tape	Distance	± 1 mm
YSI ProPlus Multi-Meter	Temperature	± 0.2 °C
YSI ProPlus Multi-Meter	Specific Conductivity	0.5% of reading or 0.001 µs/cm, whichever is greater
Stop Watch	Time	± 0.01 s
HOBO Pressure Transducer	Pressure	± .03 kPa ; ± 0.003 m
HOBO Pressure Transducer	Temperature	± 0.37 (at 20C) (-20 to -50C Op. Range)
Solinst Barologger	Pressure	± 0.001 m
Solinst Pressure Transducer - Pressure	Pressure	± 0.003 m
Solinst Pressure Transducer	Temperature	± 0.05 °C (-10 to +40 C Comp. Range)
Graduated Bucket	Volume	± .5 L
Graduated Cylinders	Volume	± 2 mL
Lab Scale	Mass	± 0.00005 kg



Table D-2. Hydrometric station monitoring record to the end of Q4 (April 1, 2014 through March 17, 2015).

HID	Monitoring Start	Q1 Measurements		Q2 Measurements		Q3 Measurements		Q4 Measurements		Logger Type	Rating Curve Status ¹	Method
		#	# Q Ratings	#	# Q Ratings	#	# Q Ratings	#	# Q Rating			
ATM-DC-2	Continuous Year-Round	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	HOBO	N/A	N/A
ATM-DC-4	Continuous Year-Round	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Solinst Gold	N/A	N/A
ATM-VC-5	14-Apr-14Continuous Year-Round	N/A	N/A	Discontinued/Destroyed July, 2014N/A		N/A	N/A	N/A	N/A	Solinst Edge	N/A	SS,VN/A
H-PC-U		4	N/A							Solinst Gold	N/A	
H-PC-DSP	14-Apr-14	5	3	3	2	1	1	N/A	N/A	Solinst Gold	P	SS, V
H-DX+105	14-Apr-14	3	N/A	0	N/A	2	N/A	N/A	N/A	N/A	N/A	SS, V
H-DC-D1b	14-Apr-14	1	N/A	3	N/A	1	N/A	N/A	N/A	N/A	N/A	SS
H-TP	14-Apr-14	2	N/A	3	N/A	0	N/A	N/A	N/A	N/A	N/A	SG
H-SEEP	14-Apr-14	4	N/A	3	N/A	3	N/A	N/A	N/A	N/A	N/A	V, Flow Meter
H-DC-B	14-Apr-14	3	1	3	3	1	1	N/A	N/A	HOBO	P	SS
H-DC-M	14-Apr-14	5	4	3	3	2	N/A	N/A	N/A	Solinst Gold	P	SS, V
H-DC-M WP	23-Jun-14	1	N/A	3	3	2	1	N/A	N/A	Solinst Gold	P	V, Weir
H-DC-R	14-Apr-14	3	3	3	3	1	1	N/A	N/A	HOBO	P	ADV, SS, V
H-BC	15-Apr-14	3	2	3	1	1	1	N/A	N/A	Solinst Gold	P	ADV, SS
H-VC-U	15-Apr-14	6	4	3	3	2	1	N/A	N/A	Solinst Gold	P	ADV, SS
H-VC-DBC	15-Apr-14	5	3	3	3	3	1	N/A	N/A	Solinst Gold	P	ADV, SS
H-VC-UMN	15-Apr-14	6	2	3	3	3	1	N/A	N/A	Solinst Gold	P	ADV, SS
H-VC-R	15-Apr-14	4	1	3	3	3	1	N/A	N/A	Solinst Gold	P	ADV, SS

Note: Q4 period corresponds with winter ice cover and no additional rating points were obtained. ATM-VC5 was established in Q4 and ATM-DC2/ATM-DC4 were discontinued.

Q - Discharge

P – preliminary

SS – Salt Slug, V – volumetric, ADV – acoustic Doppler velocimeter, Flow Meter – Flow master totalizer.



Table D-3 Hydrometric data summary for station visits between April 1 and March 17, 2015.

HID	Date	Time	Measurement	Staff Gauge	Discharge	Data Flag	Water Surface Elevation
	(MM/DD/YYYY)	(HH:MM)	Type	(m, $\pm$ 2 mm)	(m ³ /s)	Flag	(m L.D., $\pm$ 5 mm)
ATM-DC2	4/14/2014	16:49	N	-	-	-	-
ATM-DC2	5/8/2014	-	N	-	-	-	-
ATM-DC2	5/20/2014	15:00	N	-	-	-	-
ATM-DC2	6/23/2014	9:00	N	-	-	-	-
ATM-DC2	7/15/2014	12:48	N	-	-	-	-
ATM-DC2	8/12/2014	10:22	N	-	-	-	-
ATM-DC2	9/16/2014	16:00	N	-	-	-	-
ATM-DC2	10/15/2014	9:07	N	-	-	-	-
ATM-DC2	11/13/2014	15:17	N	-	-	-	-
ATM-DC2	12/15/2014	16:55	N	-	-	-	-
ATM-DC2	1/13/2015	10:26	N	-	-	-	-
ATM-DC2	2/16/2015	19:52	N	-	-	Discontinued	-
ATM-DC4	4/14/2014	16:38	N	-	-	-	-
ATM-DC4	5/8/2014	-	N	-	-	-	-
ATM-DC4	5/20/2014	15:24	N	-	-	-	-
ATM-DC4	6/24/2014	8:56	N	-	-	-	-
ATM-DC4	7/15/2014	12:49	N	-	-	-	-
ATM-DC4	8/12/2014	10:18	N	-	-	-	-
ATM-DC4	9/16/2014	16:00	N	-	-	-	-
ATM-DC4	10/15/2014	9:05	N	-	-	-	-
ATM-DC4	11/13/2014	15:17	N	-	-	-	-
ATM-DC4	12/15/2014	16:55	N	-	-	-	-
ATM-DC4	1/13/2015	10:26	N	-	-	-	-
ATM-DC4	2/16/2015	19:52	N	-	-	Discontinued	-
ATM-VC5	2/17/2015	13:59	N	-	-	-	-
ATM-VC5	3/16/2015	19:00	N	-	-	-	-
H-BC	4/15/2014	11:50	N	0.000	0.000	X	-
H-BC	5/9/2014	11:25	SS	0.420	0.373	-	2.060
H-BC	5/21/2014	12:10	SS	0.201	0.047	-	1.847
H-BC	6/24/2014	20:38	N	0.000	0.000	X	-
H-BC	7/14/2014	15:33	N	0.000	0.000	X	-



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HID	Date	Time	Measurement	Staff Gauge	Discharge	Data Flag	Water Surface Elevation
	(MM/DD/YYYY)	(HH:MM)	Type	(m, $\pm$ 2 mm)	(m ³ /s)	Flag	(m L.D., $\pm$ 5 mm)
H-BC	8/11/2014	19:28	N	0.055	0.000	X	-
H-BC	9/16/2014	12:44	SS	0.173	0.070	-	1.858
H-BC	10/15/2014	12:50	SS	0.163	0.045	B	1.859
H-BC	11/13/2014	10:00	N	-	-	X	-
H-BC	12/16/2014	10:30	N	-	-	X	-
H-BC	1/13/2015	-	N	-	-	-	-
H-BC	2/16/2015	-	N	-	-	-	-
H-BC	3/16/2015	-	N	-	-	-	-
H-DC-B	4/14/2014	16:15	N	-	0.000	X	-
H-DC-B	5/8/2014	14:37	SS		0.119	-	1.810
H-DC-B	5/8/2014	14:37	SS		0.119	-	1.808
H-DC-B	5/20/2014	15:17	SS		0.04	-	-
H-DC-B	6/24/2014	10:40	SS		0.01	-	1.430
H-DC-B	7/15/2014	13:19	SS	0.165	0.004	-	-
H-DC-B	8/12/2014	10:51	SS	0.19	0.01	-	-
H-DC-B	9/16/2014	15:59	SS	0.201	0.014	-	1.458
H-DC-B	10/15/2014	8:22	SS	0.219	0.027	B	-
H-DC-B	11/13/2014	13:00	N	-	-	-	-
H-DC-B	12/15/2014	16:00	N	-	-	-	-
H-DC-B	1/13/2015	-	N	-	-	-	-
H-DC-B	2/16/2015	-	N	-	-	-	-
H-DC-B	3/16/2015	-	N	-	-	-	-
H-DC-D1b	4/14/2014	-	N	-	0	X	-
H-DC-D1b	5/8/2014	15:00	N		-	X	-
H-DC-D1b	5/21/2014	18:07	N	-	-	X	-
H-DC-D1b	6/24/2014	13:35	SS	-	0.005	E	-
H-DC-D1b	7/15/2014	17:45	SS	-	0.002	-	-
H-DC-D1b	8/12/2014	14:08	SS	-	0.005	-	-
H-DC-D1b	9/17/2014	11:11	SS	-	0.004	-	-
H-DC-D1b	10/15/2014	15:39	SS	-	0.010	UR	-
H-DC-D1b	11/13/2014	17:15	N	-	-	X	-
H-DC-D1b	12/15/2014	-	N	-	-	X	-
H-DC-D1b	1/13/2015	-	N	-	-	-	-



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HID	Date	Time	Measurement	Staff Gauge	Discharge	Data Flag	Water Surface Elevation
	(MM/DD/YYYY)	(HH:MM)	Type	(m, $\pm$ 2 mm)	(m ³ /s)	Flag	(m L.D., $\pm$ 5 mm)
H-DC-D1b	2/16/2015	-	N	-	-	-	-
H-DC-D1b	3/16/2015	-	N	-	-	-	-
H-DC-DX+105	4/14/2014	17:18	N	-	0.000	X	-
H-DC-DX+105	5/8/2014	17:11	SS	-	0.019	-	-
H-DC-DX+105	5/21/2014	15:08	SS	-	0.011	E	-
H-DC-DX+105	6/24/2014	15:15	SS	-	0.001	E	-
H-DC-DX+105	7/15/2014	18:43	N	-	-	X	-
H-DC-DX+105	8/12/2014	15:15	N	-	-	X	-
H-DC-DX+105	9/16/2014	18:00	N	-	-	X	-
H-DC-DX+105	10/15/2014	-	N	-	-	X	-
H-DC-DX+105	11/12/2014	17:54	SS	-	0.000	O	-
H-DC-DX+105	12/16/2014	14:39	SS	-	0.001	B	-
H-DC-DX+105	1/14/2015	8:50	SS	-	0.000	O	-
H-DC-DX+105	2/16/2015	-	-	-	-	-	-
H-DC-DX+105	3/16/2015	-	-	-	-	-	-
H-DC-M	4/14/2014	14:40	SS	-	0.002	B	1.617
H-DC-M	5/8/2014	13:59	SS	0.322	0.154	-	1.798
H-DC-M	5/20/2014	14:30	SS	0.194	0.045	-	1.667
H-DC-M	6/23/2014	18:49	V	0.150	0.009	-	1.621
H-DC-M	6/23/2014	18:49	SS	0.150	0.012	-	1.621
H-DC-M	6/23/2014	18:49	V	0.150	0.009	-	1.619
H-DC-M	6/23/2014	18:49	SS	0.150	0.012	-	1.619
H-DC-M	7/15/2014	12:30	V	0.148	0.005	-	-
H-DC-M	9/16/2014	14:15	V	0.158	-	X	-
H-DC-M	10/15/2014	10:41	V	0.159	0.014	B	-
H-DC-M	11/13/2014	13:12	V	0.123	0.004	B	2.294
H-DC-M	12/15/2014	16:05	V	-	0.004	B	-
H-DC-M	1/13/2015	9:25	SS	-	0.004	B	-
H-DC-M	2/16/2015	-	-	-	-	X	-
H-DC-M	3/16/2015	-	-	-	-	X	-
H-DC-M WP	6/23/2014	18:49	V	-	0.009	-	-
H-DC-M WP	7/15/2014	14:30	V	-	0.005	-	2.242
H-DC-M WP	8/12/2014	9:15	V	0.382	0.010	-	-



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HID	Date	Time	Measurement	Staff Gauge	Discharge	Data Flag	Water Surface Elevation
	(MM/DD/YYYY)	(HH:MM)	Type	(m, $\pm$ 2 mm)	(m ³ /s)	Flag	(m L.D., $\pm$ 5 mm)
H-DC-M WP	9/16/2014	14:15	V	-	0.014	-	2.296
H-DC-M WP	10/15/2014	10:41	V	-	0.014	B	-
H-DC-M WP	11/13/2014	13:14	V	-	0.004	B	2.294
H-DC-M WP	12/15/2014	16:05	V	-	0.004	B	2.156
H-DC-M WP	1/13/2015	-	-	-	-	X	-
H-DC-M WP	2/16/2015	-	-	-	-	X	-
H-DC-M WP	3/16/2015	-	-	-	-	X	-
H-DC-R	4/14/2014	13:58	N	-	-	X	-
H-DC-R	5/8/2014	13:24	SS	-	0.152	B	-
H-DC-R	5/20/2014	13:48	SS	-	0.056	-	-
H-DC-R	6/23/2014	17:17	SS	0.301	0.014	-	0.428
H-DC-R	7/15/2014	11:18	SS	0.262	0.009	-	-
H-DC-R	8/11/2014	16:26	SS	0.295	0.023	-	-
H-DC-R	9/16/2014	8:58	SS	0.355	0.024	-	0.501
H-DC-R	10/14/2014	16:02	SS	0.377	0.022	B	0.516
H-DC-R	11/12/2014	15:30	N	-	-	X	-
H-DC-R	12/15/2014	-	N	-	-	X	-
H-DC-R	1/13/2015	-	N	-	-	X	-
H-DC-R	2/16/2015	-	N	-	-	X	-
H-DC-R	3/16/2015	-	N	-	-	X	-
H-PC-DSP	4/14/2014	19:10	N	0.000	0.000	X	-
H-PC-DSP	5/8/2014	15:29	SS	0.318	0.027	-	2.493
H-PC-DSP	5/8/2014	15:29	SS	0.318	0.027	-	2.491
H-PC-DSP	5/20/2014	15:56	SS	0.296	0.006	-	2.456
H-PC-DSP	5/20/2014	15:56	V	0.296	0.005	-	2.456
H-PC-DSP	6/24/2014	16:54	V	0.171	0.001	-	2.323
H-PC-DSP	6/24/2014	16:54	V	0.171	0.001	-	2.325
H-PC-DSP	7/14/2014	17:45	V	0.000	0.002	-	-
H-PC-DSP	8/12/2014	12:34	V	0.162	0.494	-	-
H-PC-DSP	9/15/2014	17:50	V	0.276	0.003	-	2.425
H-PC-DSP	10/14/2014	17:24	V	0.312	0.003	B	2.460
H-PC-DSP	11/12/2014	16:50	N	-	-	X	-
H-PC-DSP	12/15/2014	-	N	-	-	X	-



Mount Nansen Water Resources Investigations Quarterly Report (Q4): January- March 2015

HID	Date	Time	Measurement	Staff Gauge	Discharge	Data Flag	Water Surface Elevation
	(MM/DD/YYYY)	(HH:MM)	Type	(m, $\pm$ 2 mm)	(m ³ /s)	Flag	(m L.D., $\pm$ 5 mm)
H-PC-DSP	1/13/2015	-	N	-	-	X	-
H-PC-DSP	2/16/2015	-	N	-	-	X	-
H-PC-DSP	3/16/2015	-	N	-	-	X	-
H-PC-U	4/14/2014	-	N	-	0.000	X	-
H-PC-U	5/8/2014	16:12	SS	-	0.024	-	-
H-PC-U	5/20/2014	16:46	SS	-	0.006	-	-
H-PC-U	6/23/2014	13:25	SS	-	0.001	-	-
H-SEEP	4/14/2014	15:40	V	-	0.003	-	-
H-SEEP	5/9/2014	13:03	N	-	-	-	-
H-SEEP	5/21/2014	13:15	V	-	0.001	-	-
H-SEEP	6/24/2014	9:28	V	0.208	0.003	-	-
H-SEEP	7/16/2014	10:25	V	0.205	0.003	-	-
H-SEEP	8/12/2014	10:00	V	0.230	0.003	-	-
H-SEEP	9/16/2014	15:21	V	0.200	0.003	-	-
H-SEEP	10/14/2014	18:07	V	-	0.003	-	-
H-SEEP	11/13/2014	14:00	V	-	0.003	-	-
H-SEEP	12/15/2014	16:40	V	-	0.003	-	-
H-SEEP	1/12/2015	17:20	V	-	0.002	-	-
H-SEEP	2/16/2015	15:55	V	-	0.002	-	-
H-SEEP	3/17/2015	8:25	V	-	0.003	-	-
H-TP	4/14/2014	15:16	N	-	-	X	-
H-TP	5/9/2014	13:25	N	1.855	-	-	-
H-TP	5/21/2014	13:35	N	1.877	-	-	-
H-TP	6/24/2014	9:45	N	1.629	-	-	-
H-TP	7/15/2014	16:30	N	1.475	-	-	-
H-TP	8/12/2014	11:20	N	1.388	-	-	-
H-TP	9/16/2014	16:42	N	1.376	-	-	-
H-TP	10/14/2014	-	N	-	-	-	-
H-TP	11/13/2014	-	N	-	-	-	-
H-TP	12/15/2014	-	N	-	-	-	-
H-TP	1/13/2015	-	N	-	-	-	-
H-TP	2/16/2015	-	N	-	-	-	-
H-TP	3/16/2015	-	N	-	-	-	-



Mount Nansen Water Resources Investigations Quarterly Report (Q4): January- March 2015

HID	Date	Time	Measurement	Staff Gauge	Discharge	Data Flag	Water Surface Elevation
	(MM/DD/YYYY)	(HH:MM)	Type	(m, $\pm$ 2 mm)	(m ³ /s)	Flag	(m L.D., $\pm$ 5 mm)
H-VC-DBC	4/15/2014	9:50	CM-MID	0.368	0.047	B	1.724
H-VC-DBC	4/15/2014	9:50	SS	0.368	0.044	B	1.724
H-VC-DBC	5/9/2014	11:40	ADV-MID	0.732	2.388	-	2.086
H-VC-DBC	5/9/2014	11:40	ADV-MID	0.732	2.388	-	2.083
H-VC-DBC	5/21/2014	10:25	ADV-MID	0.526	0.627	-	1.878
H-VC-DBC	6/24/2014	19:28	ADV-MID	0.406	0.177	-	1.748
H-VC-DBC	6/24/2014	19:28	ADV-MID	0.406	0.177	-	1.751
H-VC-DBC	7/14/2014	14:40	ADV-MID	0.378	0.104	-	1.729
H-VC-DBC	8/11/2014	17:45	ADV-MID	0.433	0.288	-	-
H-VC-DBC	9/16/2014	10:07	ADV-MID	0.526	0.670	-	1.874
H-VC-DBC	10/15/2014	11:20	ADV-MID	0.495	0.478	B	1.845
H-VC-DBC	11/13/2014	9:30	ADV-MID	-	0.227	B	-
H-VC-DBC	12/16/2014	9:25	ADV-MID	-	0.178	B	-
H-VC-DBC	1/13/2015	16:14	SS	-	0.052	B	-
H-VC-DBC	1/13/2015	16:14	ADV-MID	-	0.058	B	-
H-VC-DBC	2/17/2015	12:46	SS	-	0.034	B	-
H-VC-DBC	2/17/2015	12:46	ADV-MID	-	0.023	B	-
H-VC-DBC	3/16/2015	17:57	SS	-	0.017	B	-
H-VC-DBC	3/16/2015	17:57	ADV-MID	-	0.013	B	-
H-VC-R	5/8/2014	11:54	ADV-MID	0.765	3.204	-	2.338
H-VC-R	5/8/2014	11:54	ADV-MID	0.765	3.204	-	2.345
H-VC-R	5/8/2014	11:54	ADV-MID	0.765	3.204	-	2.337
H-VC-R	5/20/2014	13:03	ADV-MID	0.594	0.758	-	2.167
H-VC-R	6/23/2014	16:03	ADV-MID	0.487	0.179	SH-L	2.061
H-VC-R	7/14/2014	16:46	ADV-MID	0.471	0.121	-	2.050
H-VC-R	8/11/2014	12:40	ADV-MID	0.522	0.329	-	-
H-VC-R	9/15/2014	14:39	ADV-MID	0.579	0.770	-	2.173
H-VC-R	10/14/2014	13:20	ADV-MID	-	0.577	-	-
H-VC-R	11/12/2014	13:00	ADV-MID	-	0.252	-	-
H-VC-R	12/15/2014	13:33	N	-	-	F	-
H-VC-R	1/13/2015	14:45	ADV-MID	-	0.014	B	-
H-VC-R	2/16/2015	13:00	ADV-MID	-	0.009	B	-
H-VC-R	3/16/2015	13:00	ADV-MID	-	0.002	B	-



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HID	Date	Time	Measurement	Staff Gauge	Discharge	Data Flag	Water Surface Elevation
	(MM/DD/YYYY)	(HH:MM)	Type	(m, $\pm$ 2 mm)	(m ³ /s)	Flag	(m L.D., $\pm$ 5 mm)
H-VC-U	5/9/2014	11:37	ADV-MID	0.415	1.929	-	2.313
H-VC-U	5/9/2014	11:37	ADV-MID	0.415	1.929	-	2.315
H-VC-U	5/21/2014	11:21	SS	0.227	0.392	-	2.133
H-VC-U	5/21/2014	11:21	ADV-MID	0.227	0.556	-	2.133
H-VC-U	6/24/2014	20:05	ADV-MID	0.138	0.172	-	2.048
H-VC-U	7/14/2014	13:09	ADV-MID	0.113	0.144	-	2.021
H-VC-U	8/11/2014	18:52	ADV-MID	0.160	0.261	-	-
H-VC-U	9/16/2014	11:20	ADV-MID	0.238	0.571	-	2.147
H-VC-U	10/15/2014	12:18	ADV-MID	0.201	0.422	-	2.113
H-VC-U	11/13/2014	10:40	ADV-MID	-	0.185	-	-
H-VC-U	12/16/2014	10:15	ADV-MID	-	-	S	-
H-VC-U	1/13/2015	18:00	SS	-	0.057	B	-
H-VC-U	1/13/2015	18:00	ADV-MID	-	0.051	B	-
H-VC-U	2/17/2015	13:58	SS	-	0.018	B	-
H-VC-U	2/17/2015	13:58	ADV-MID	-	0.020	B	-
H-VC-U	3/16/2015	20:18	SS	-	0.009	B	-
H-VC-U	3/16/2015	20:18	ADV-MID	-	0.010	B	-
H-VC-UMN	4/15/2014	8:40	SS	0.528	0.019	B	-
H-VC-UMN	4/15/2014	8:40	CM-MID	0.528	0.022	B	-
H-VC-UMN	5/9/2014	8:30	ADV-MID	0.900	2.605	-	1.918
H-VC-UMN	5/9/2014	8:30	ADV-MID	0.900	2.605	-	1.919
H-VC-UMN	5/21/2014	8:51	SS	0.709	0.741	-	1.695
H-VC-UMN	5/21/2014	8:51	ADV-MID	0.709	0.702	SH-SG	1.695
H-VC-UMN	6/24/2014	18:29	ADV-MID	0.592	0.188	-	1.587
H-VC-UMN	7/15/2014	9:00	ADV-MID	0.571	0.120	-	1.569
H-VC-UMN	8/11/2014	15:00	ADV-MID	0.622	0.283	-	-
H-VC-UMN	9/15/2014	16:10	ADV-MID	0.700	0.660	-	1.681
H-VC-UMN	10/14/2014	14:30	ADV-MID	0.677	0.511	B	1.665
H-VC-UMN	11/12/2014	14:35	ADV-MID	0.677	0.199	B	-
H-VC-UMN	12/15/2014	14:38	ADV-MID	0.677	0.134	B	-
H-VC-UMN	1/13/2015	13:17	ADV-MID	-	0.036	B	-
H-VC-UMN	1/13/2015	13:17	SS	-	0.018	B	-
H-VC-UMN	2/17/2015	9:12	SS	-	0.009	B	-



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HID	Date	Time	Measurement	Staff Gauge	Discharge	Data Flag	Water Surface Elevation
	(MM/DD/YYYY)	(HH:MM)	Type	(m, $\pm$ 2 mm)	(m ³ /s)	Flag	(m L.D., $\pm$ 5 mm)
H-VC-UMN	3/16/2015	15:15	SS	-	0.002	B	-

Notes:

HID = Hydrometric ID, unique hydrometric station identifier in hydrometric database.

L.D. = Local datum.

Measurement types: ADV – acoustic Doppler velocimeter; SS – salt dilution, slug injection; V – volumetric; CM – current meter; W – weir; N – no measurement obtained.

Data Flag = B – Ice Present, X – Poor channel conditions not appropriate for discharge measurement, E – Estimated Value

Table D-4. Hydrometric survey data summary from April 1 through March 17, 2015 (Note: no surveys conducted during Q4 due to ice).

Station	Date	Time	BM 1	BM 2	BM 3	Logger Rod	TOS	Water Surface
			(m L.D.)	(m L.D.)	(m L.D.)	(m L.D.)	(m L.D.)	(m L.D.)
H-BC	5/9/2014	11:40	3	2.991	3.018	2.876	2.640	2.060
H-BC	5/21/2014	12:21	3	3.009	3.028	2.881	2.645	1.847
H-BC	9/16/2014	13:03	3	3.016	3.065	2.919	2.686	1.858
H-BC	9/16/2014	13:03	3	3.016	3.065	2.919	2.686	1.858
H-BC	10/15/2014	13:11	3	3.015	3.066	2.919	2.686	1.859
H-DC-B	5/8/2014	-	3	3.355	2.997	-	-	1.809
H-DC-B	6/24/2014	10:50	3	3.351	2.993	2.775	-	1.431
H-DC-B	9/16/2014	16:27	3	3.351	2.993	2.796	2.252	1.458
H-DC-B	9/16/2014	16:27	3	3.351	2.993	2.796	2.252	1.458
H-DC-M	4/14/2014	14:32	3	2.713	2.319	2.711	2.480	1.617
H-DC-M	5/8/2014	14:10	3	2.313	2.713	2.727	2.479	1.798
H-DC-M	5/20/2014	14:34	3	2.315	2.712	2.709	2.478	1.667
H-DC-M	6/23/2014	19:23	3	2.519	2.718	2.702	2.470	1.620
H-DC-M	7/14/2014	14:45	3	2.338	2.725	2.716	2.483	1.617
H-DC-M	7/14/2014	14:45	3	2.338	2.725	2.716	2.483	1.617
H-DC-M	9/16/2014	15:00	2.035*	1.756	1.376	-	-	-
H-DC-M	9/16/2014	15:00	2.035*	1.756	1.376	-	-	-
H-DC-M WP	7/15/2014	15:45	3	2.284	2.875	3.523	2.973	2.242



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Station	Date	Time	BM 1	BM 2	BM 3	Logger Rod	TOS	Water Surface
			(m L.D.)	(m L.D.)	(m L.D.)	(m L.D.)	(m L.D.)	(m L.D.)
H-DC-M WP	7/15/2014	15:45	3	2.284	2.875	3.523	2.973	2.242
H-DC-M WP	9/16/2014	15:00	3	2.287	2.876	-	-	2.296
H-DC-M WP	9/16/2014	15:00	3	2.287	2.876	-	-	2.296
H-DC-M WP	10/15/2014	10:32	3	2.285	2.874	3.561	2.967	2.291
H-DC-M WP	11/13/2014	13:20	3	2.292	2.872	3.558	2.964	2.220
H-DC-R	6/23/2014		3	2.973	2.3125	1.968	1.132	0.425
H-DC-R	9/16/2014	9:01	3	2.986	2.314	1.984	1.15	0.502
H-DC-R	10/14/2014	16:25	3	2.988	2.313	1.989	1.152	0.516
H-PC-DSP	5/8/2014	15:56	3	3.658	3.248	3.424	3.1725	2.492
H-PC-DSP	5/20/2014	16:09	3	3.250	3.635	3.418	3.169	2.456
H-PC-DSP	6/24/2014	17:00	3	3.2425	3.6225	3.3965	3.148	2.324
H-PC-DSP	9/15/2014	17:40	3	3.242	3.625	3.398	3.148	2.425
H-PC-DSP	10/14/2014	17:14	3	3.241	3.625	3.396	3.148	2.460
H-VC-DBC	4/15/2014	10:40	3	3.029	2.919	2.571	2.354	1.724
H-VC-DBC	5/9/2014	9:50	3	3.024	2.917	2.565	2.341	2.084
H-VC-DBC	5/21/2014	10:37	3	3.028	2.918	2.568	2.355	1.878
H-VC-DBC	6/24/2014	19:33	3	3.026	2.910	2.567	2.348	1.749
H-VC-DBC	7/14/2014	14:55	3	3.026	2.911	2.569	2.35	1.729
H-VC-DBC	9/16/2014	10:28	3	3.027	1.911	2.567	2.349	1.877
H-VC-DBC	10/15/2014	11:34	3	3.027	2.909	2.567	2.349	1.845
H-VC-DBC	11/13/2014	10:22	3	3.028	2.910	2.570	2.351	-
H-VC-R	4/14/2014	13:20	3	3.431	3.170	2.812	2.573	-
H-VC-R	4/14/2014	13:20	3	3.431	3.170	2.812	2.573	-
H-VC-R	5/8/2014	12:20	3	3.4315	3.171	2.811	-	2.34
H-VC-R	5/8/2014	12:20	3	3.432	3.171	2.811	-	2.34
H-VC-R	5/20/2014	13:16	3	3.426	3.172	2.870	2.575	2.167
H-VC-R	5/20/2014	13:16	3	3.426	3.172	2.87	2.575	2.167



Mount Nansen Water Resources Investigations Quarterly Report (Q4): January- March 2015

Station	Date	Time	BM 1	BM 2	BM 3	Logger Rod	TOS	Water Surface
			(m L.D.)	(m L.D.)	(m L.D.)	(m L.D.)	(m L.D.)	(m L.D.)
H-VC-R	6/23/2014	16:22	3	3.417	3.167	2.891	2.575	2.059
H-VC-R	6/23/2014	16:22	3	3.417	3.167	2.891	2.575	2.059
H-VC-R	7/14/2014	16:50	3	3.423	3.167	2.893	3.579	2.05
H-VC-R	9/15/2014	14:50	3	3.433	3.178	2.902	2.588	2.173
H-VC-R	10/14/2014	13:44	3	3.426	3.175	2.898	2.585	2.139
H-VC-R	11/12/2014	13:44	3	3.427	3.172	2.896	2.581	-
H-VC-U	4/15/2014		3	3.359	3.243	3.15	2.904	-
H-VC-U	5/9/2014	10:40	3	3.361	3.244	3.149	2.902	2.314
H-VC-U	5/21/2014	11:45	3	3.359	3.242	3.148	2.904	2.133
H-VC-U	6/24/2014	20:31	3	3.356	3.244	3.1555	2.910	2.048
H-VC-U	7/14/2014	13:55	3	3.356	3.243	3.156	2.91	2.026
H-VC-U	9/16/2014	11:34	3	3.357	3.241	3.156	2.91	2.147
H-VC-U	10/15/2014	12:22	3	3.352	3.242	3.156	2.912	2.113
H-VC-U	11/13/2014	11:00	3	3.355	3.238	3.158	2.913	-
H-VC-UMN	5/9/2014	9:00	3	3.008	2.678	2.191	1.984	1.918
H-VC-UMN	5/21/2014	9:18	3	3.007	2.678	2.207	1.993	1.695
H-VC-UMN	6/24/2014	18:27	3	3.009	2.677	2.21	1.996	1.588
H-VC-UMN	7/15/2014	9:00	3	3.007	2.678	2.212	1.997	1.57
H-VC-UMN	9/15/2014	16:52	3	3.004	2.673	2.214	1.999	1.681
H-VC-UMN	10/14/2014	14:31	3	3.005	2.674	2.213	1.999	-
H-VC-UMN	11/12/2014	15:15	3	3.006	2.671	2.210	2.004	-

Notes:

L.D. = Local datum TOS = Top of Staff Gauge LoggerRod = Top of fixed-length data logger installation rod *Survey measurements obtained using H-DC-M WP local datum



Table D-5. Seepage Pond discharge volumetric measurements, April 1 to March 17, 2014.

HID	Measurement Date		Method	Discharge	
	Date (MM/DD/YYYY)	Time		m ³ /s	L/s
H-SEEP	4/14/2014	15:40	V	0.003	3
H-SEEP	5/9/2014	13:03	-	-	-
H-SEEP	5/21/2014	13:15	V	0.001	1
H-SEEP	6/24/2014	9:28	V	0.003	3
H-SEEP	7/16/2014	10:25	V	0.003	3
H-SEEP	8/12/2014	10:00	V	0.003	3
H-SEEP	9/16/2014	15:21	V	0.003	3
H-SEEP	10/14/2014	18:07	V	0.003	3
H-SEEP	11/13/2014	14:00	V	0.003	3
H-SEEP	12/15/2014	16:40	V	0.003	3
H-SEEP	1/12/2015	17:20	V	0.002	2
H-SEEP	2/16/2015	15:55	V	0.002	2
H-SEEP	3/17/2015	8:25	V	0.003	3

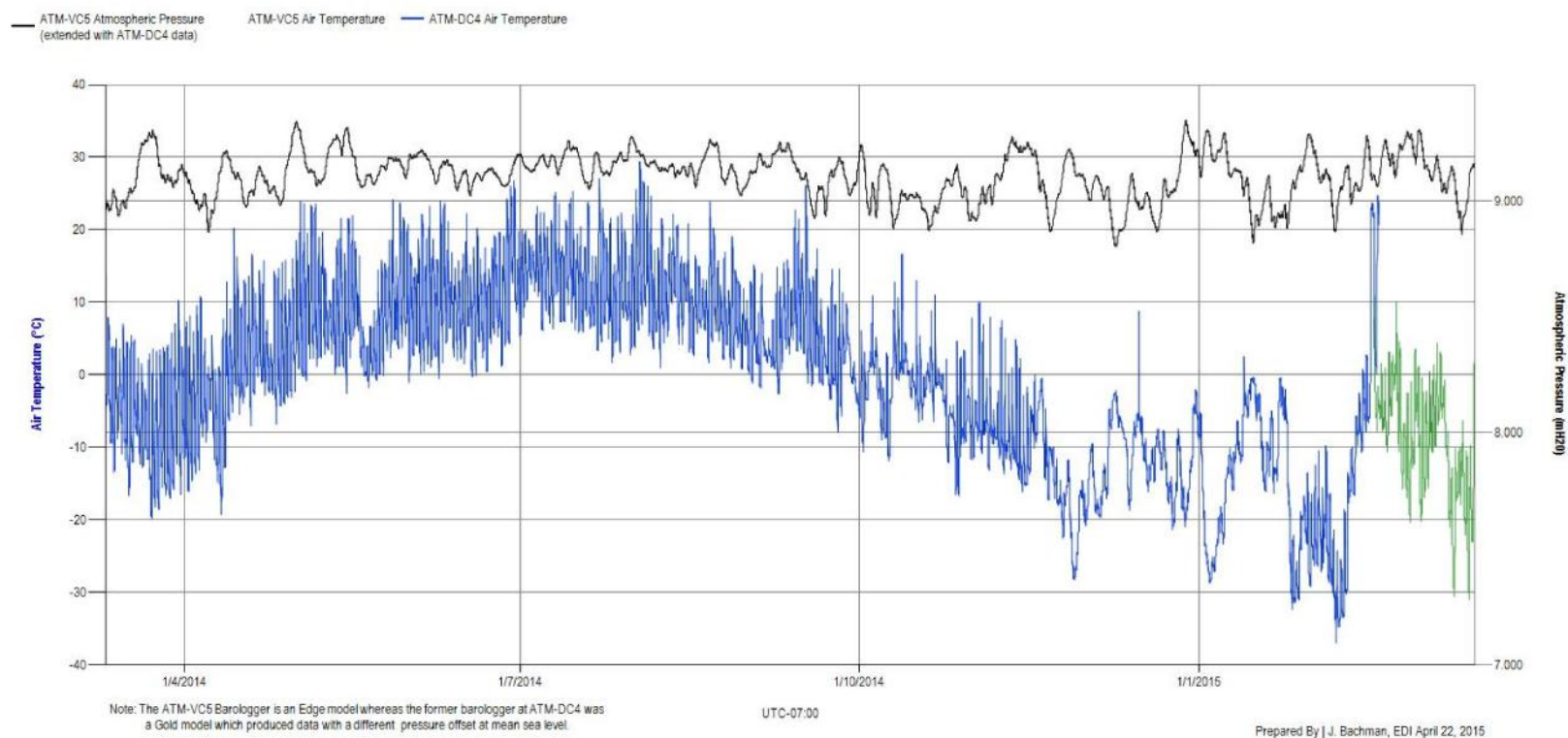


Figure D-1. ATM-DC4 and ATM-VC5 atmospheric pressure and air temperature.

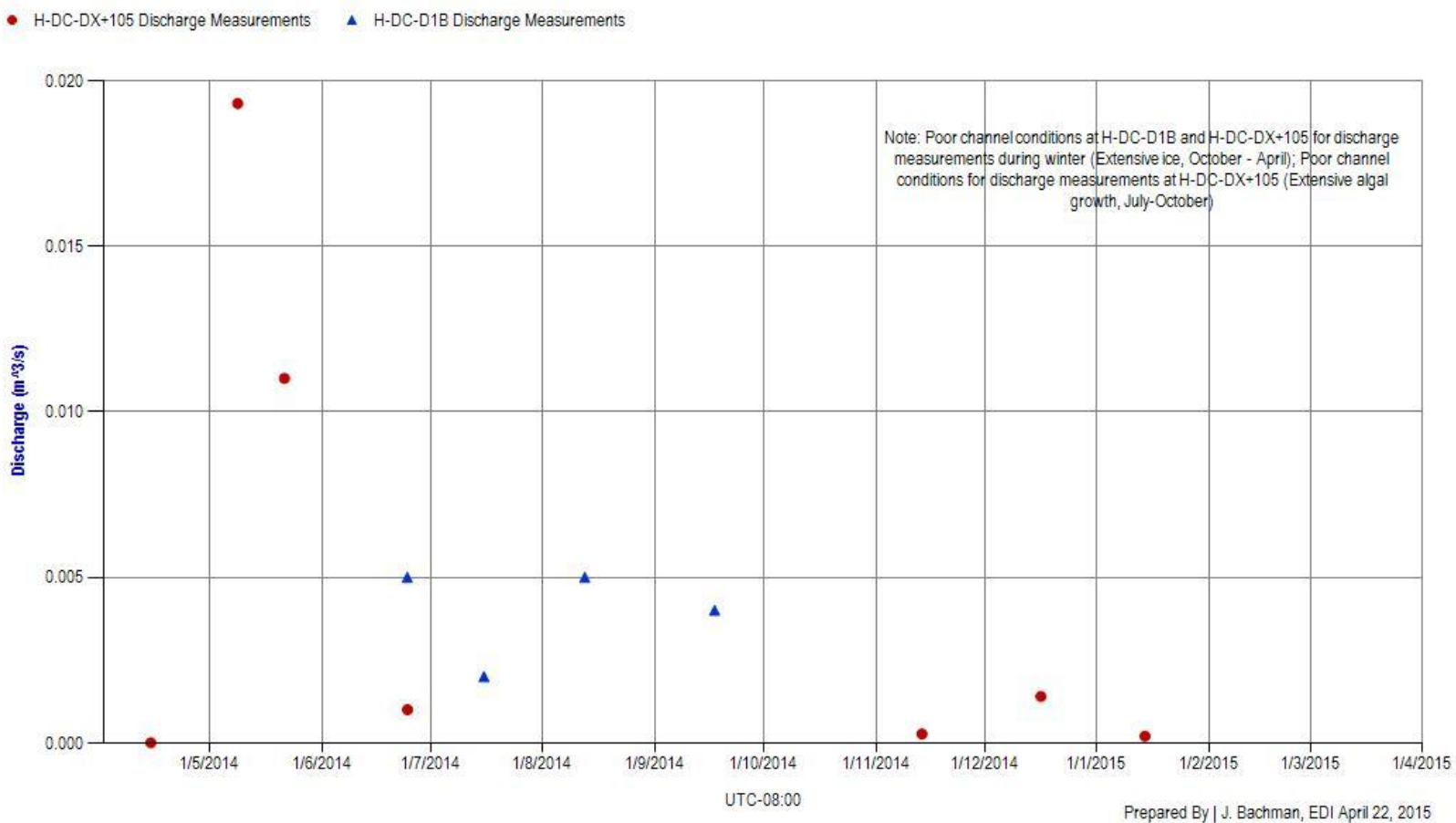


Figure D-2. Instantaneous discharge measurements from the upper Dome Stations: H-DC-DX+105 and H-DC-D1B.

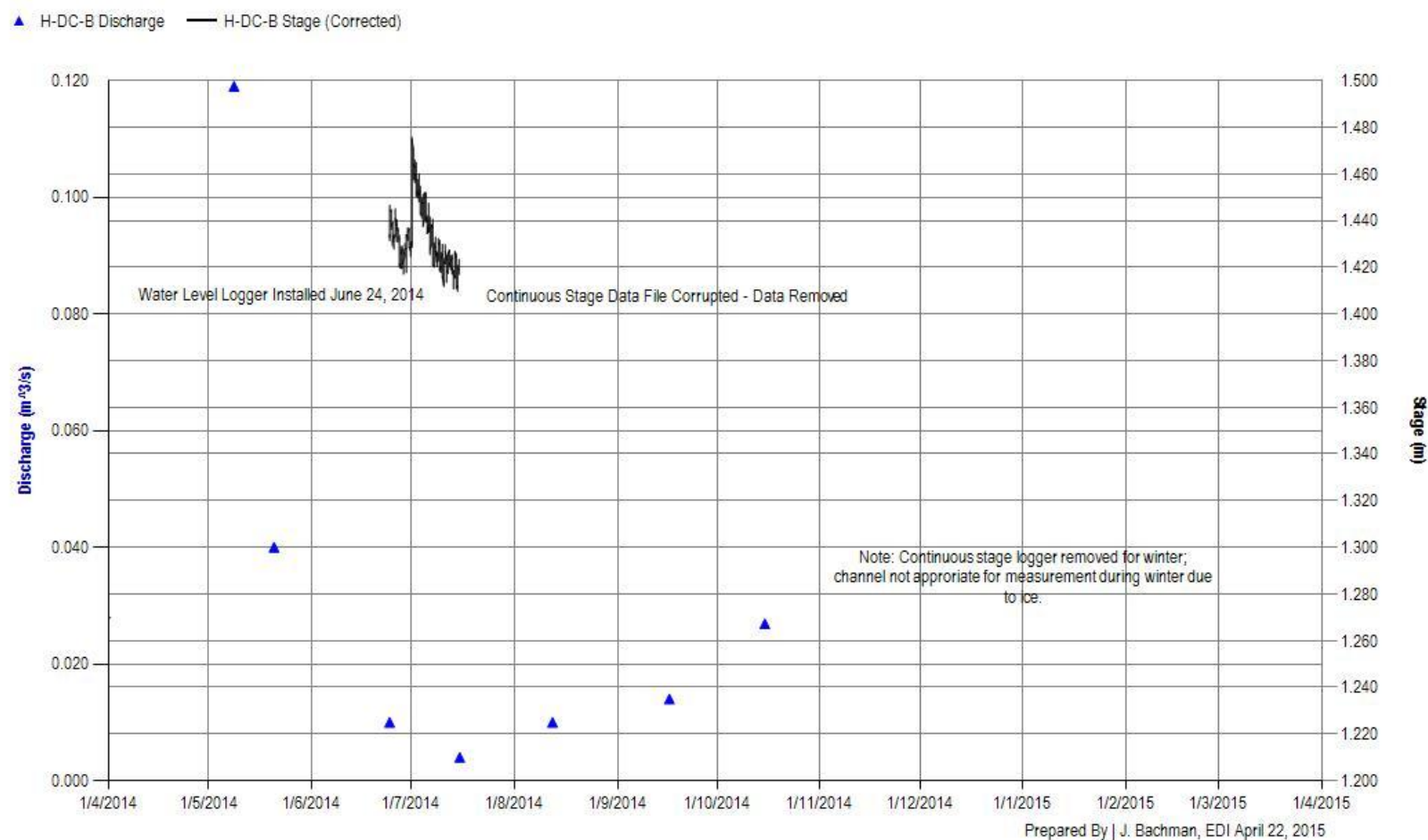


Figure D-3. Instantaneous discharge and continuous stage measurements at H-DC-B.

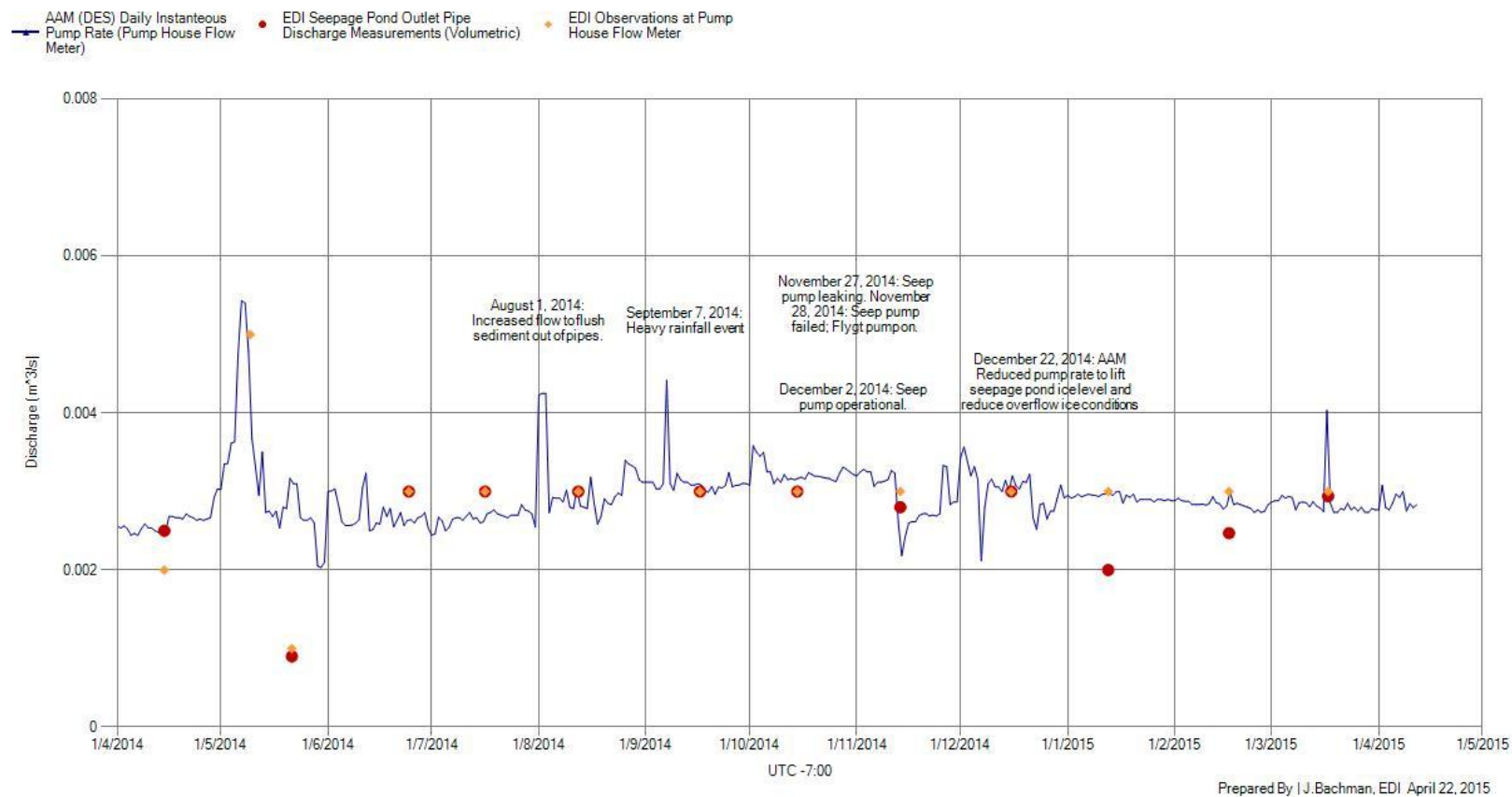


Figure D-4. Instantaneous discharge measurements at H-SEEP, and Pump House Flow Meter.

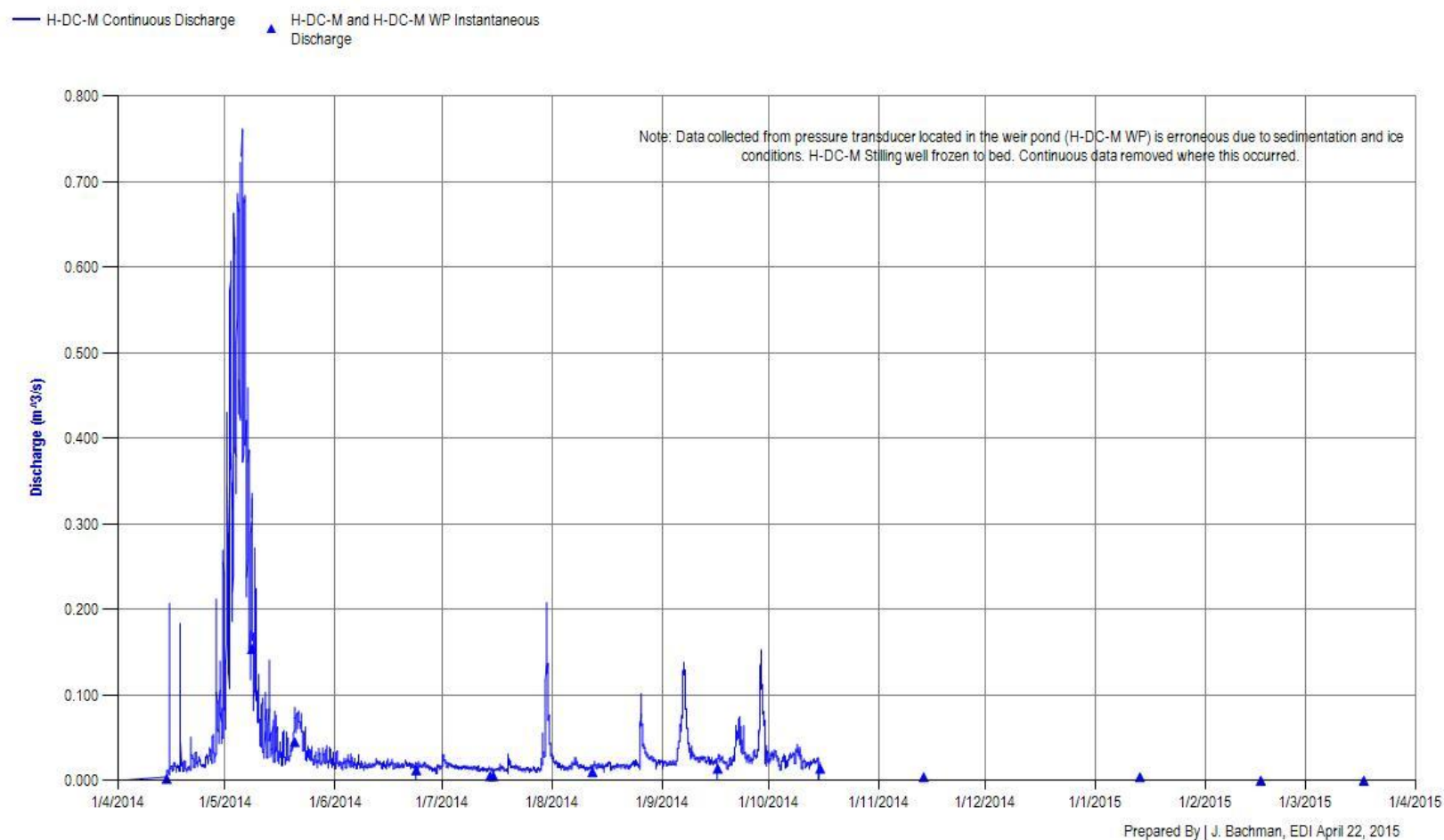


Figure D-5. Instantaneous and continuous stage and discharge measurements at H-DC-M and H-DC-M WP.

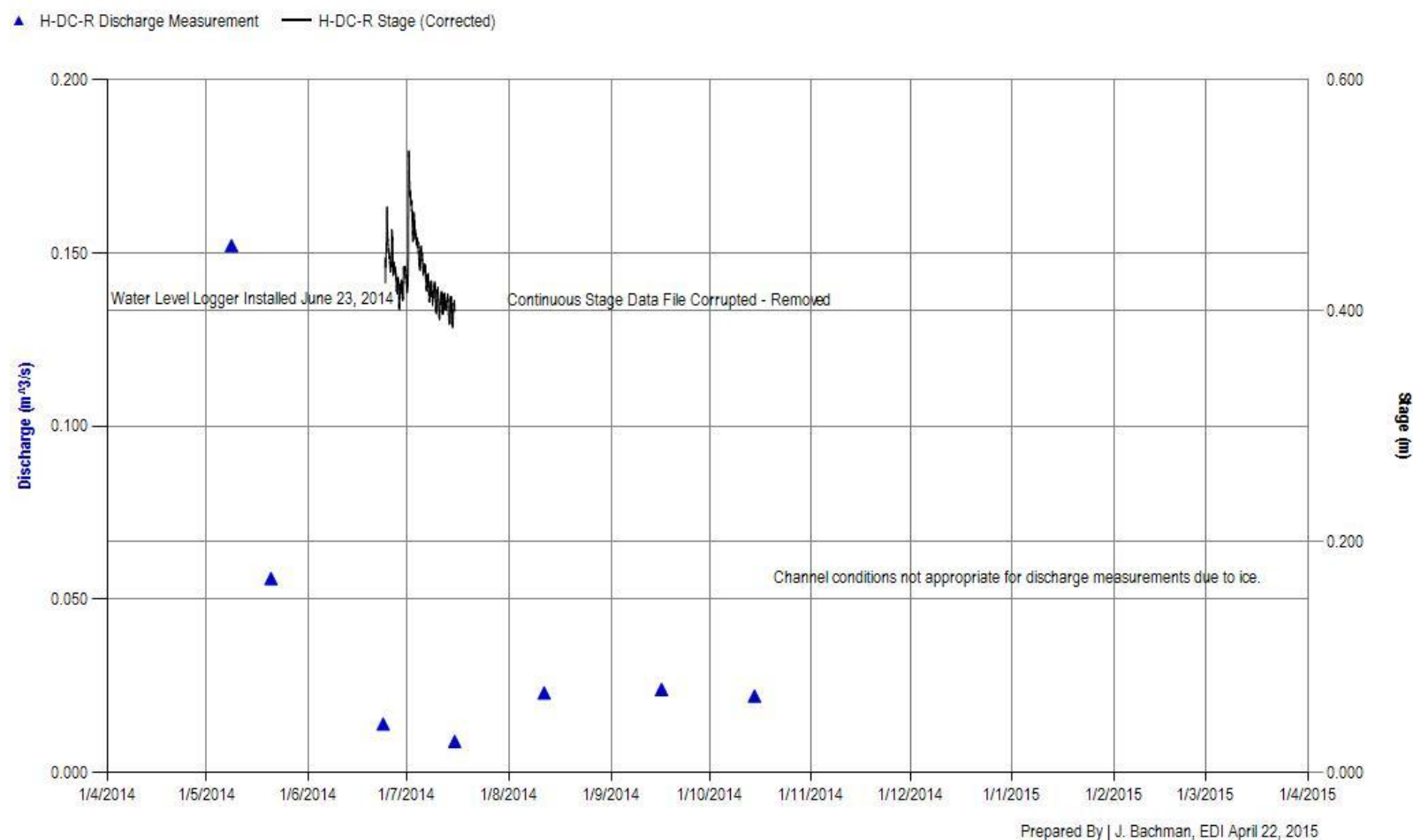


Figure D-6. Instantaneous discharge and stage measurements with continuous stage record at H-DC-R.

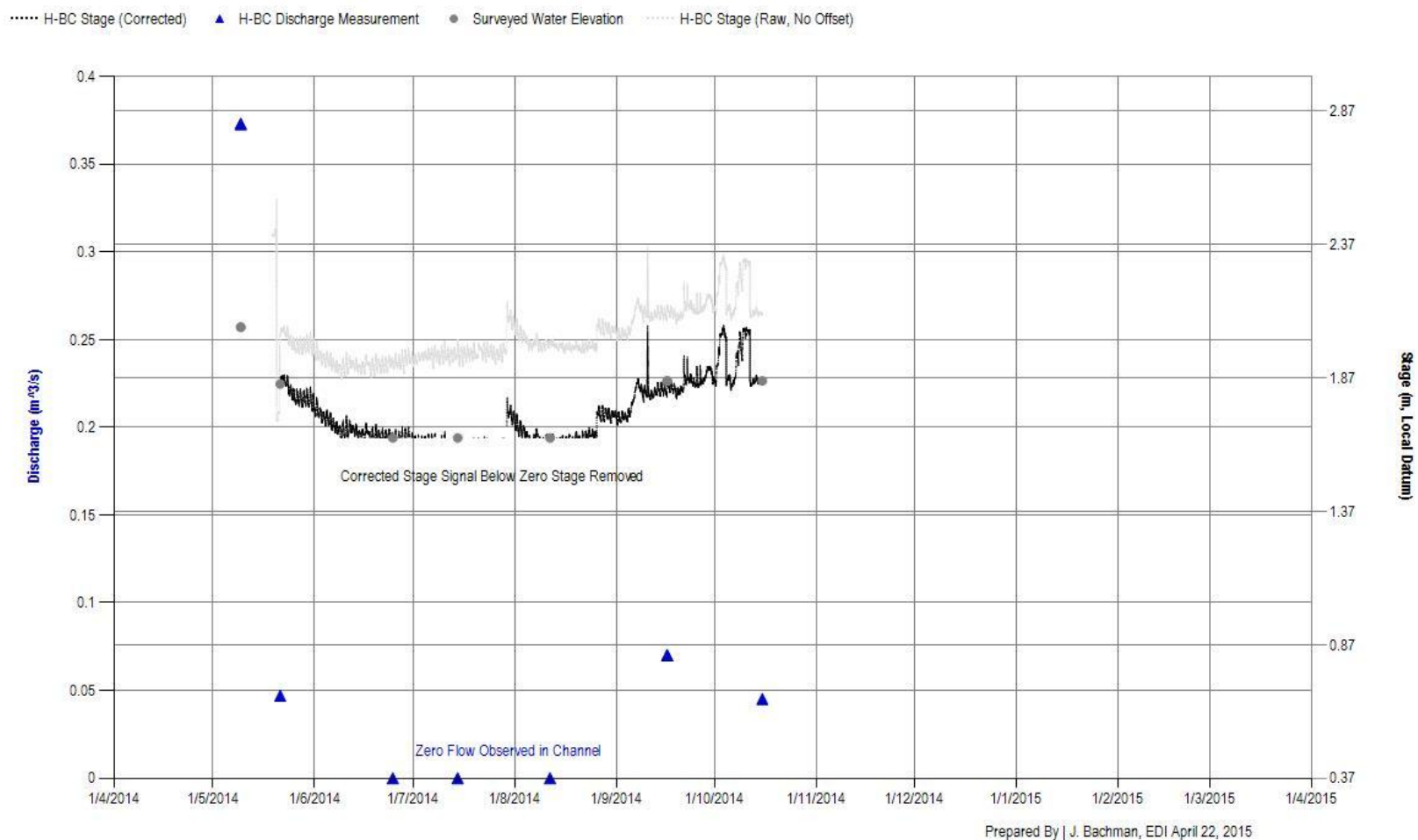


Figure D-7. Instantaneous and continuous discharge and stage measurements at H-BC.

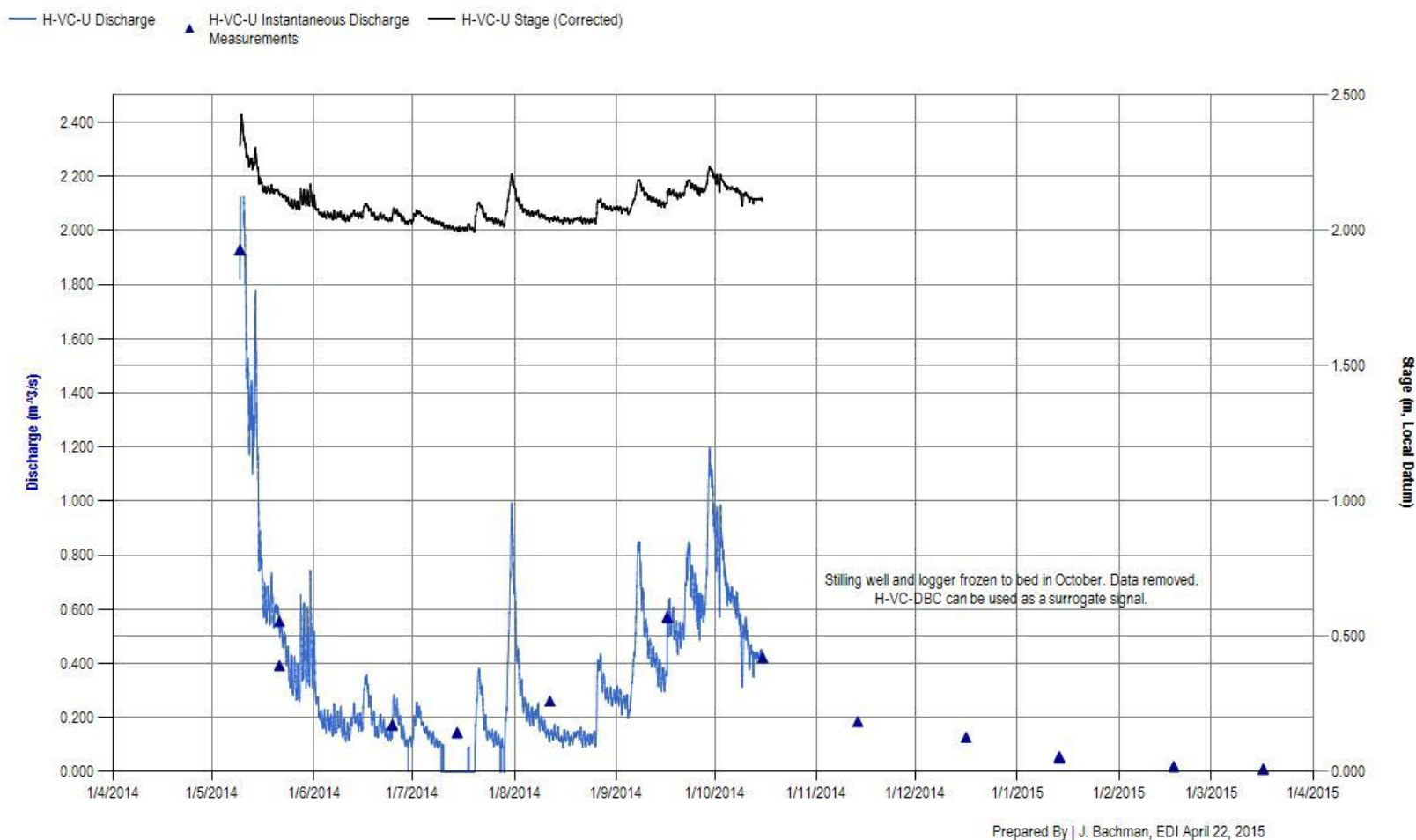


Figure D-8. Instantaneous and continuous discharge and stage measurements at H-VC-U. Note: the continuous record was corrected using the Q3 rating curve equation that differs than that used in Q2.

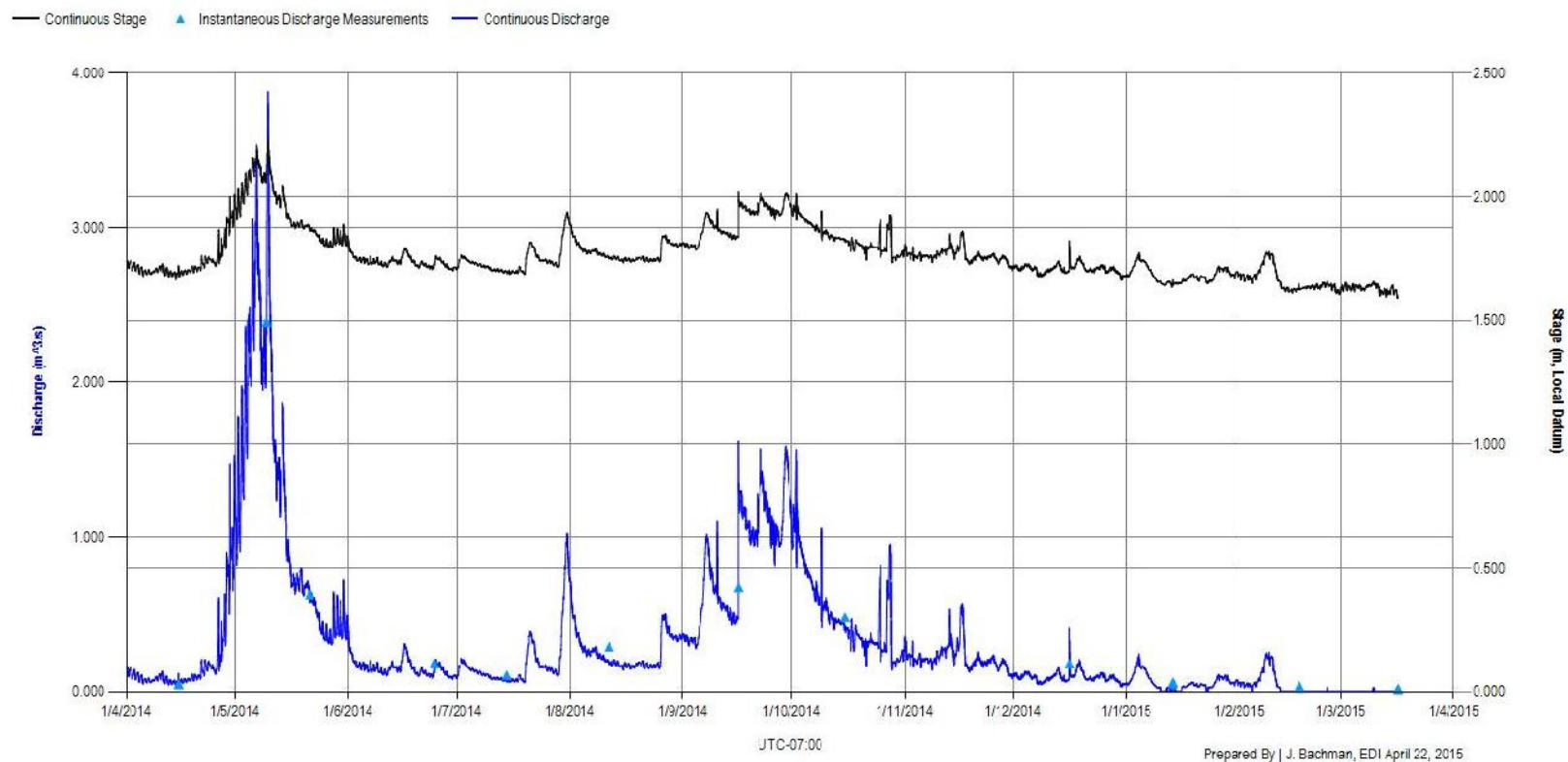


Figure D-9. Instantaneous and continuous stage and discharge measurements at H-VC-DBC. Note that the rating curve equation was amended in Q4.

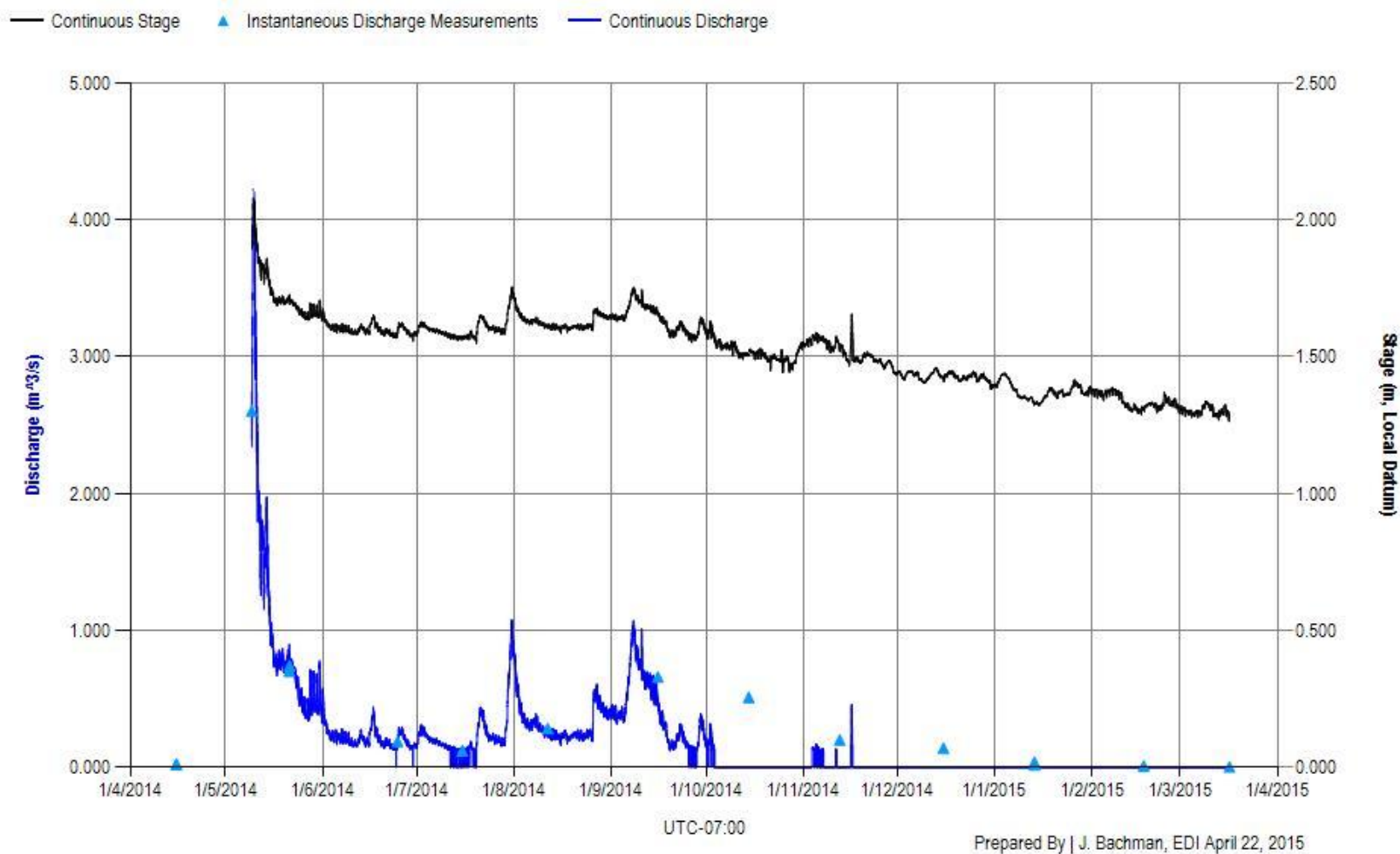


Figure D-10. Instantaneous and continuous stage and discharge measurements at H-VC-UMN. Note that the rating curve equation was amended in Q4.

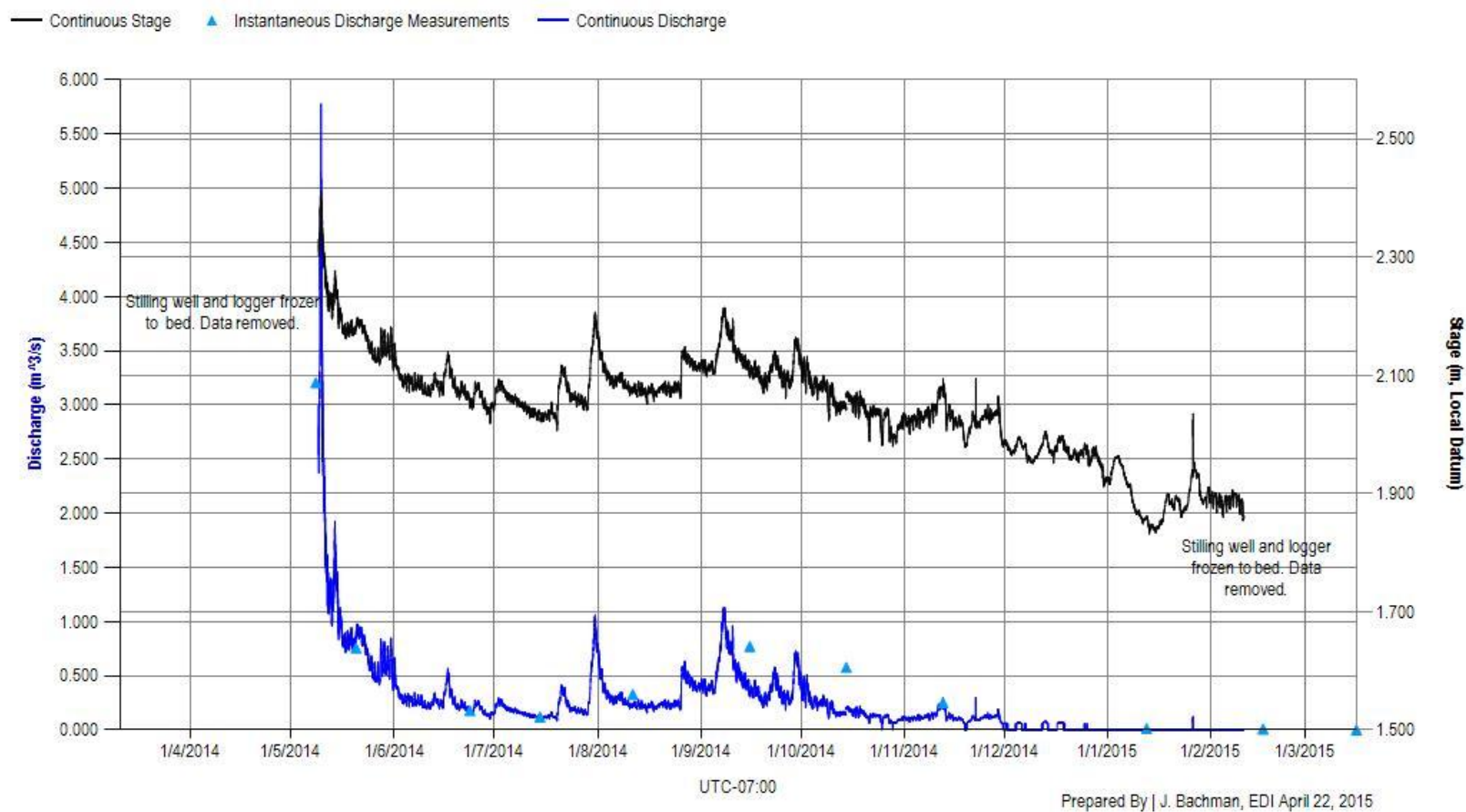


Figure D-11. Instantaneous and continuous stage and discharge measurements at H-VC-R.

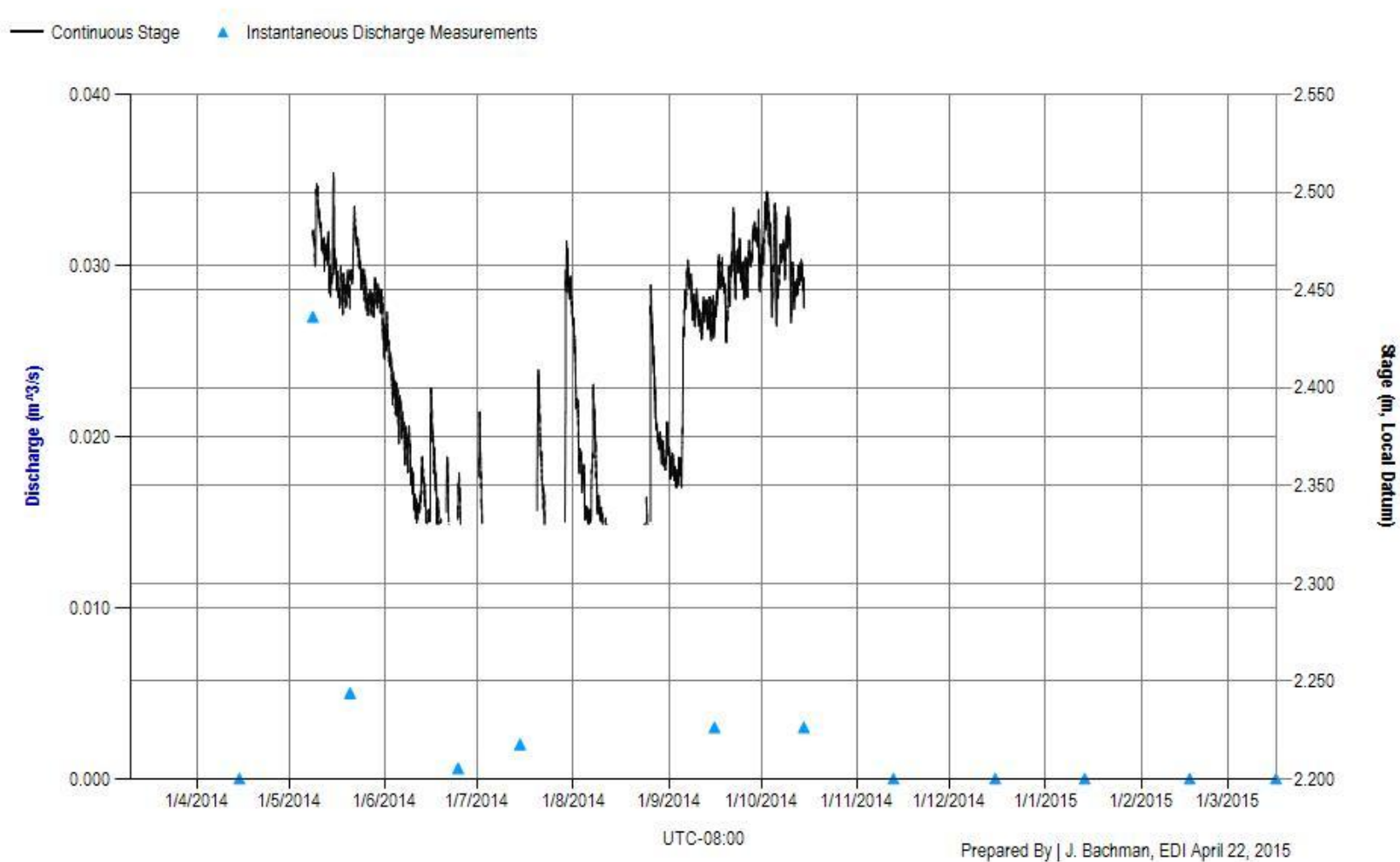


Figure D-12. Instantaneous discharge and discharge measurements with continuous stage H-PC-DSP.

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APPENDIX E. WATER QUALITY DATA

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Figure E-1. Concentrations of aluminum, arsenic and ammonia for sites on Upper Dome Creek (left column) and Lower Dome Creek (right column) - y-axis in log concentration (mg/L).

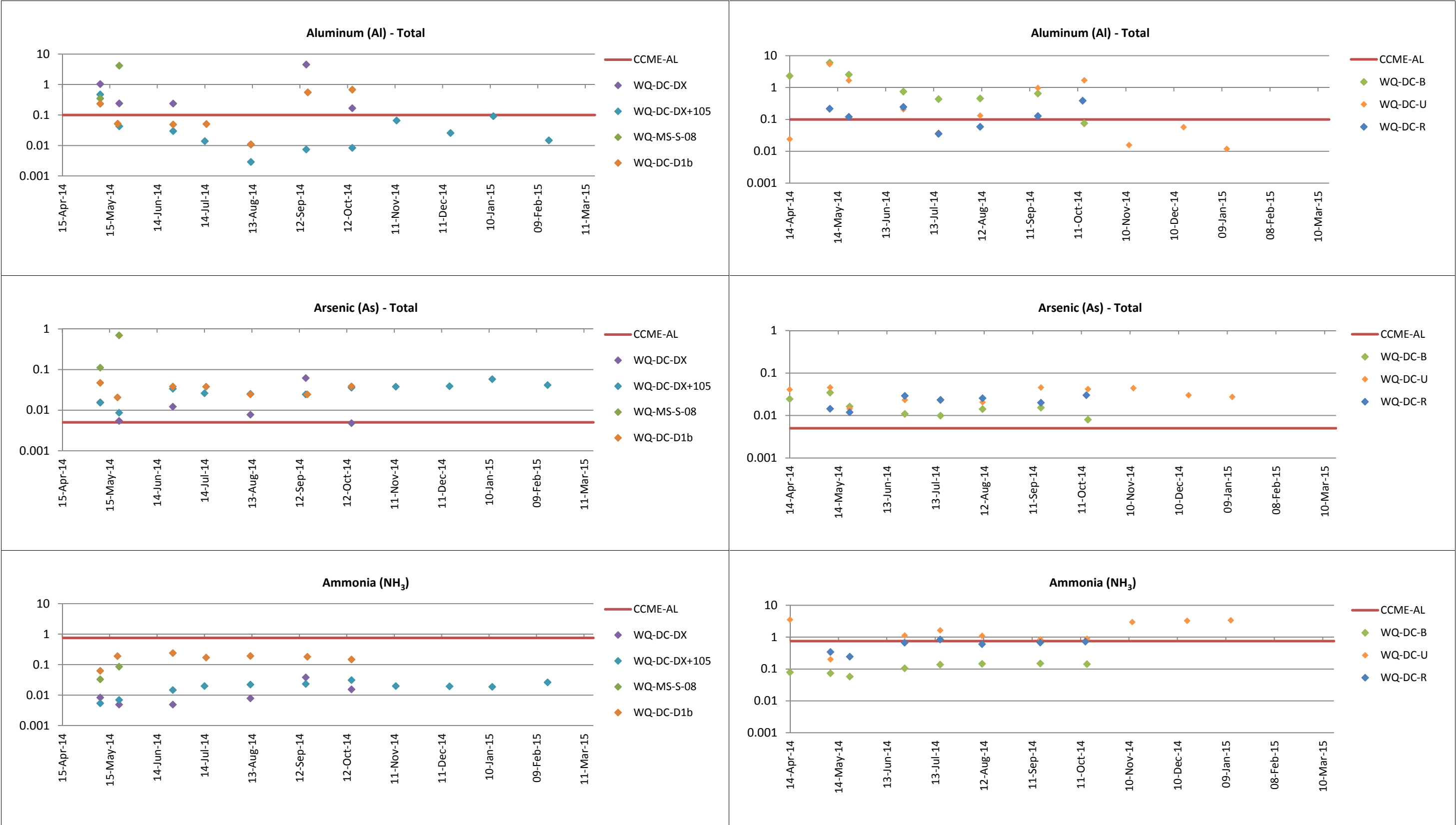




Figure E-2. Concentrations of cadmium, chromium and copper for sites on Dome Creek (Left column: Upper Dome Creek sites, Right Column: Lower Dome Creek sites) - y-axis in log concentration (mg/L).

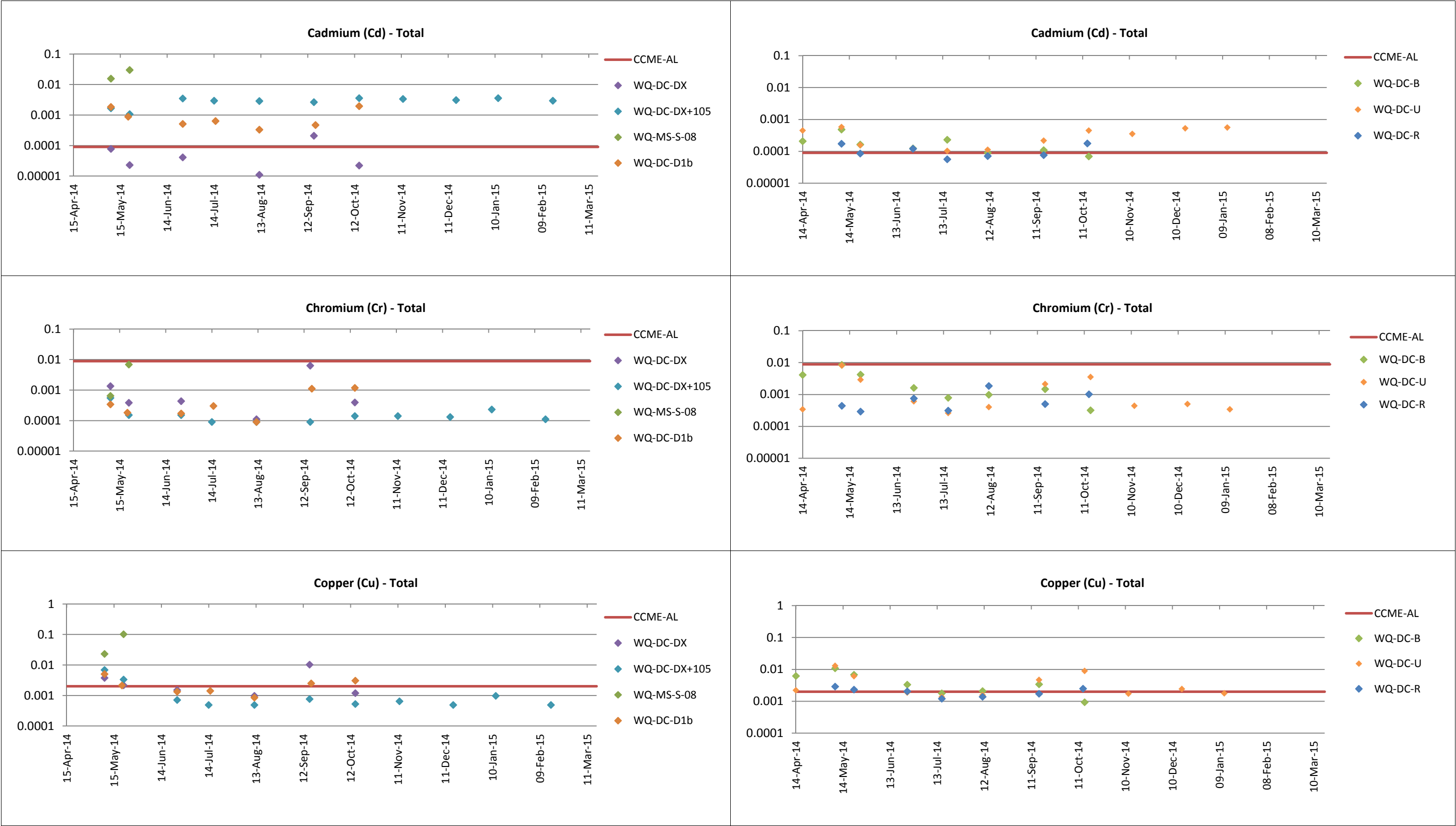




Figure E-3. Concentrations of iron, lead, and manganese for sites on Dome Creek (Left column: Upper Dome Creek sites, Right Column: Lower Dome Creek sites) - y-axis in log concentration (mg/L).

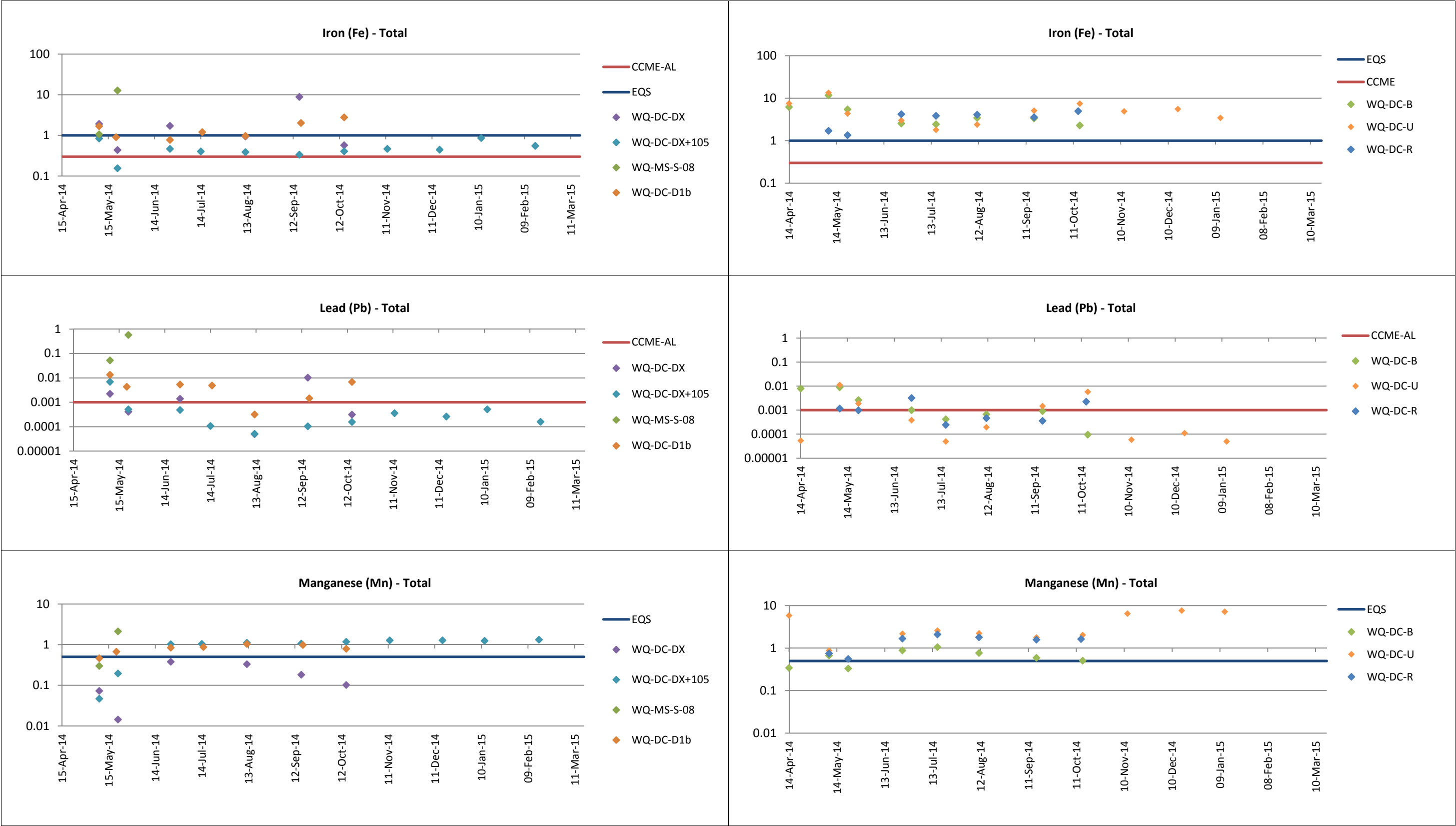




Figure E-4. Concentrations of mercury, silver and zinc for sites on Dome Creek (Left column: Upper Dome Creek sites, Right Column: Lower Dome Creek sites) - y-axis in log concentration (mg/L).

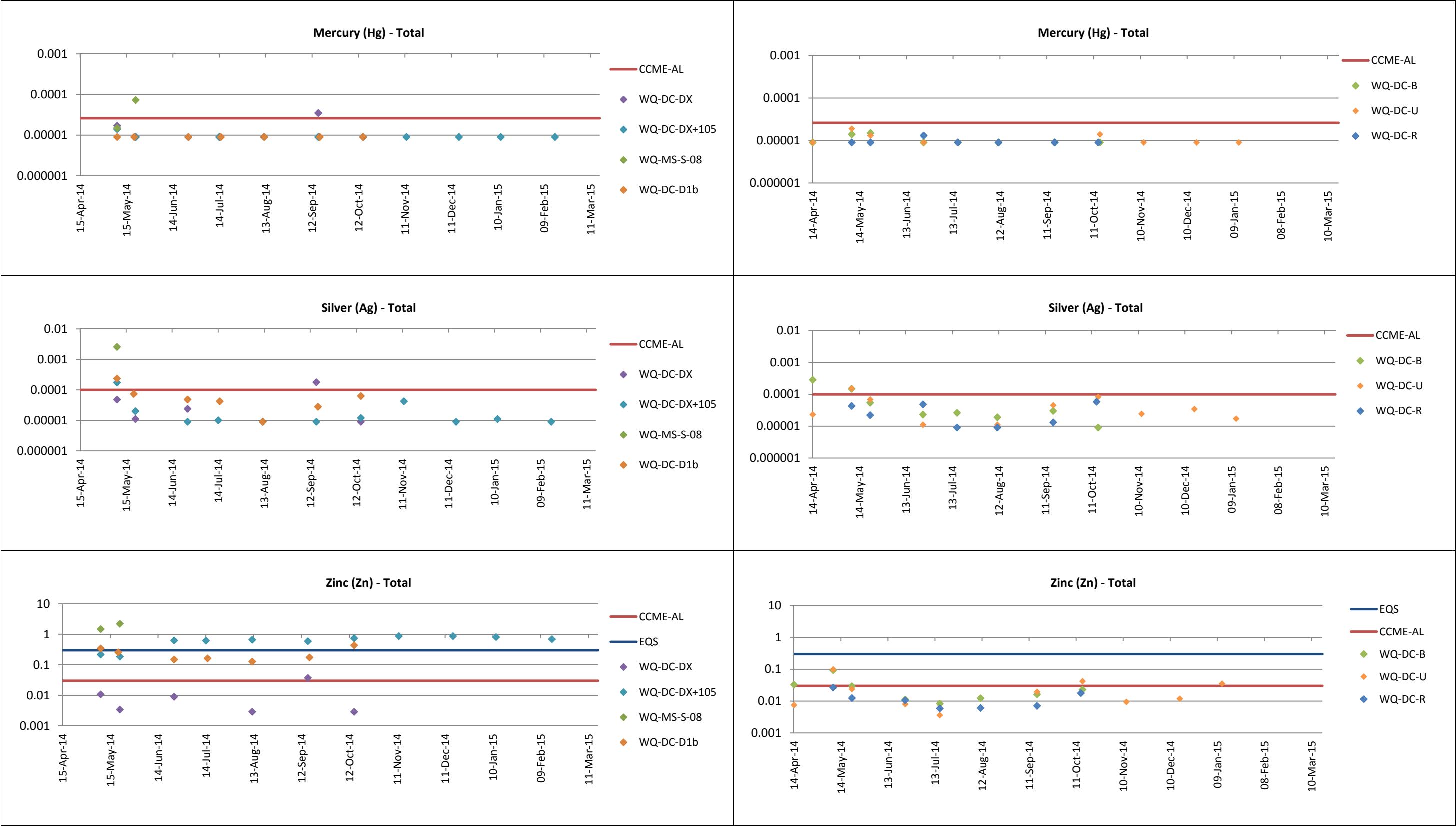




Figure E-5. Concentrations of total suspended solids for sites on Dome Creek (Left column: Upper Dome Creek sites, Right Column: Lower Dome Creek sites) - y-axis in log concentration (mg/L).

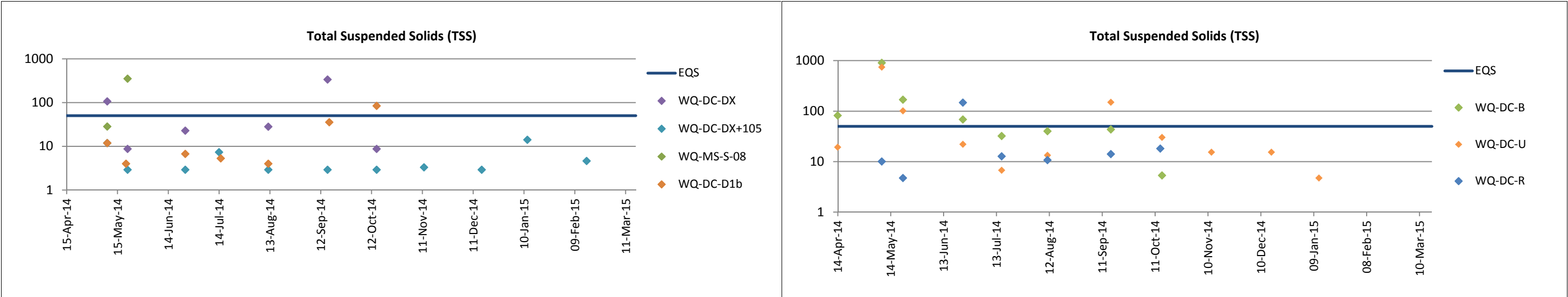


Figure E-6. Concentrations of total and WAD cyanide for the tailings pond and seepage site (left column) and Lower Dome Creek sites (right column) - y-axis in log concentration (mg/L).

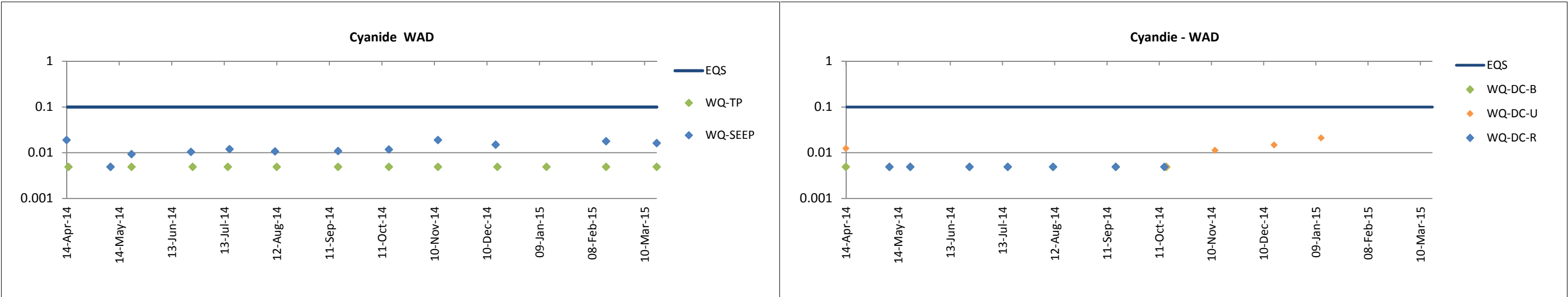




Figure E-7. Concentrations of aluminum, arsenic and ammonia for the tailings pond and seepage site (left column) and the Brown-McDade pit lake site (right column) - y-axis in log concentration (mg/L).

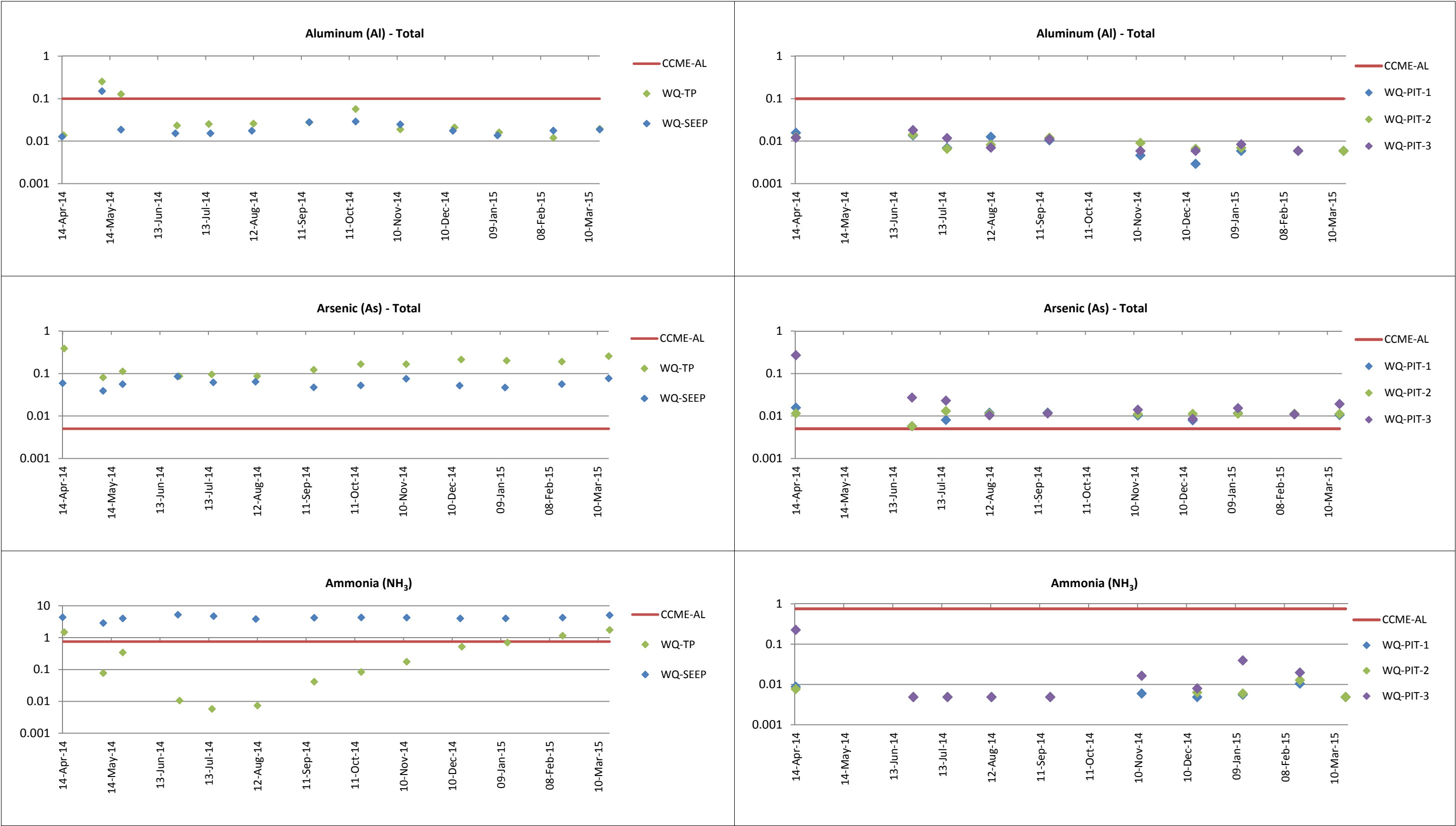




Figure E-8. Concentrations of cadmium, chromium and copper for the tailings pond and seepage site (left column) and the Brown-McDade pit lake site (right column) - y-axis in log concentration (mg/L).

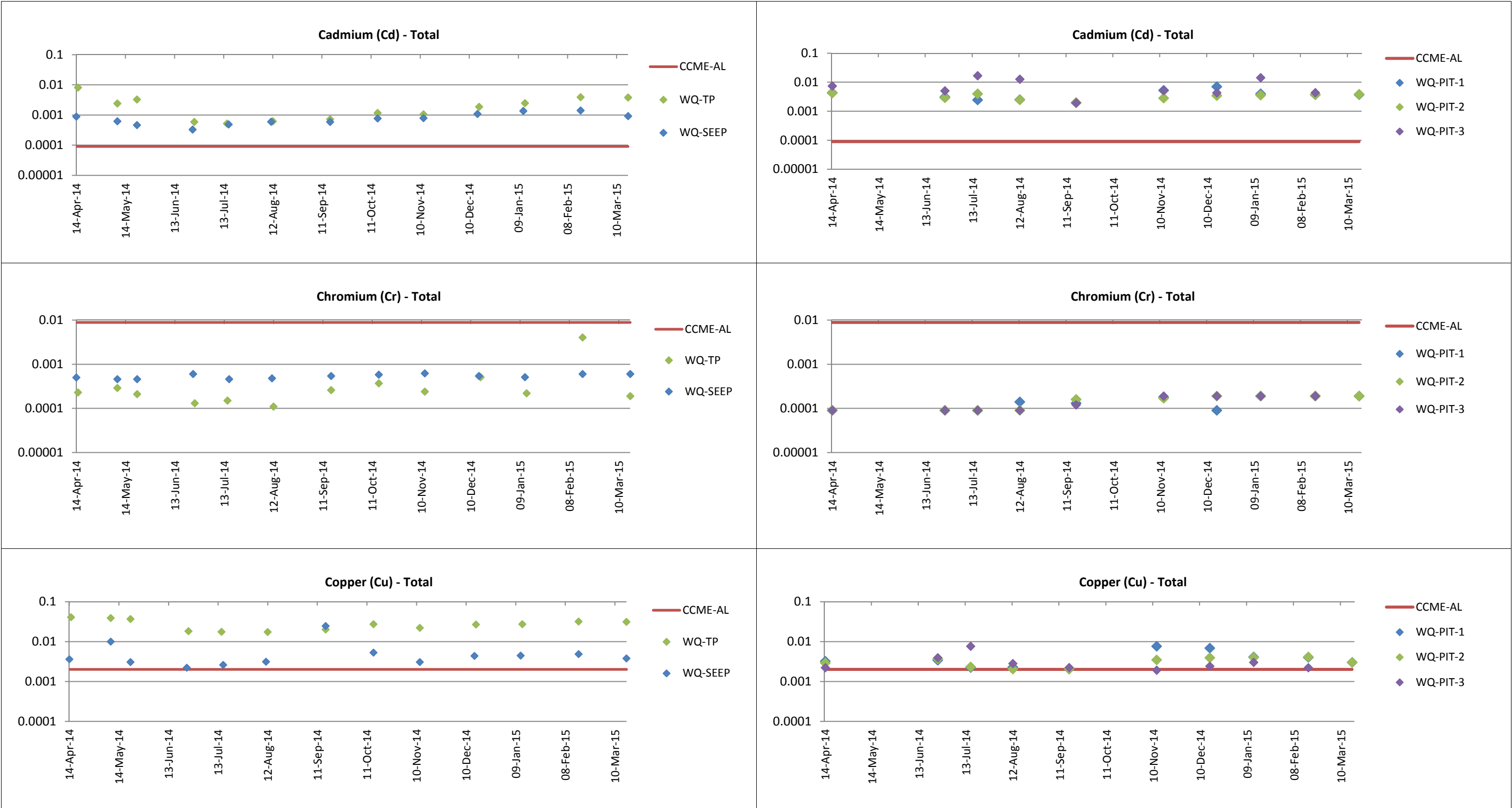




Figure E-9. Concentrations of iron, lead and manganese for the tailings pond and seepage site (left column) and the Brown-McDade pit lake site (right column) - y-axis in log concentration (mg/L).

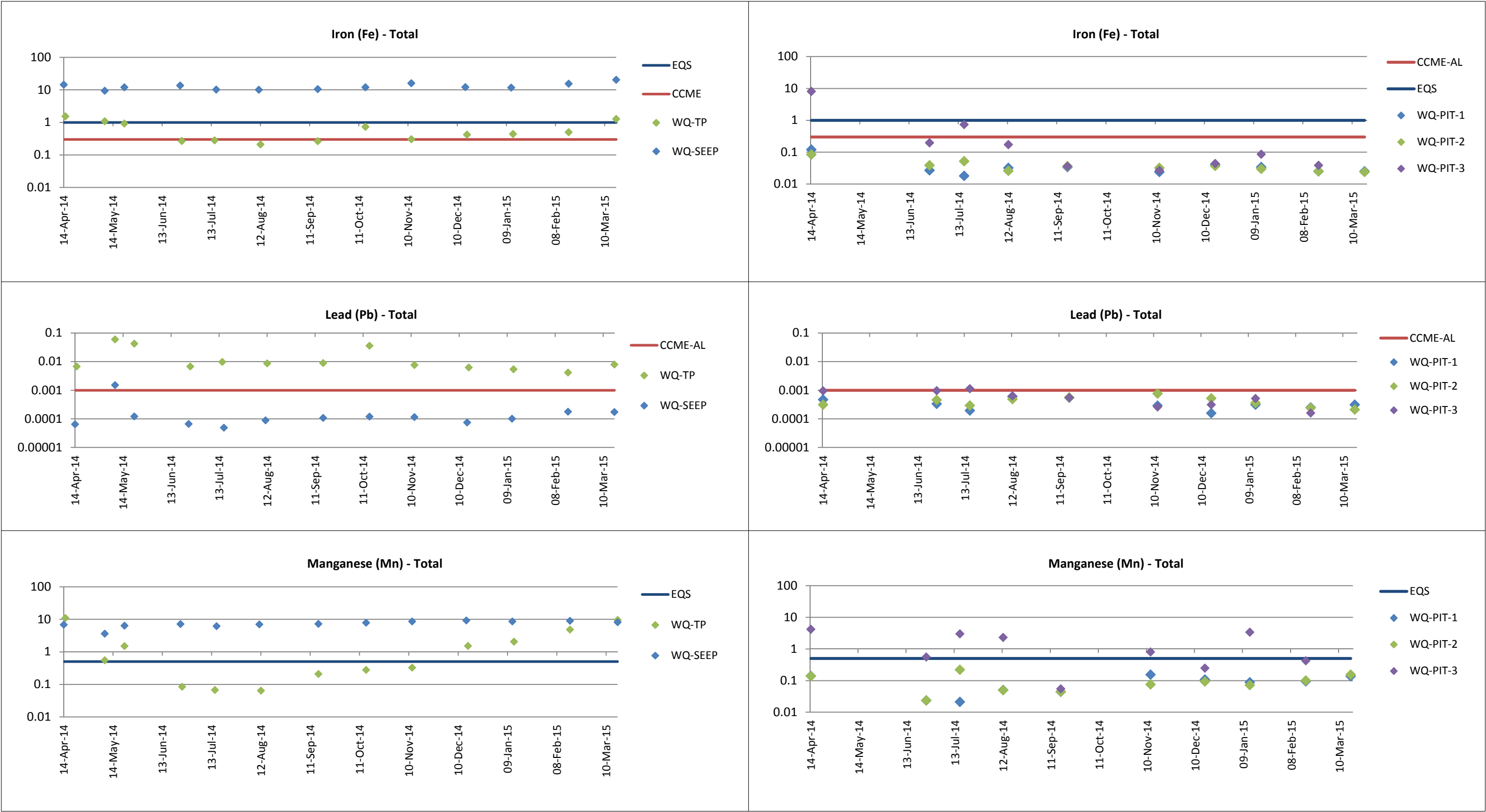




Figure E-10. Concentrations of mercury, silver and zinc for the tailings pond and seepage site (left column) and the Brown-McDade pit lake site (right column) – y-axis in log concentration (mg/L).





Figure E-11. Concentrations of total suspended solids for the tailings pond and seepage site (left column) and the Brown-McDade pit lake site (right column) - y-axis in log concentration (mg/L).

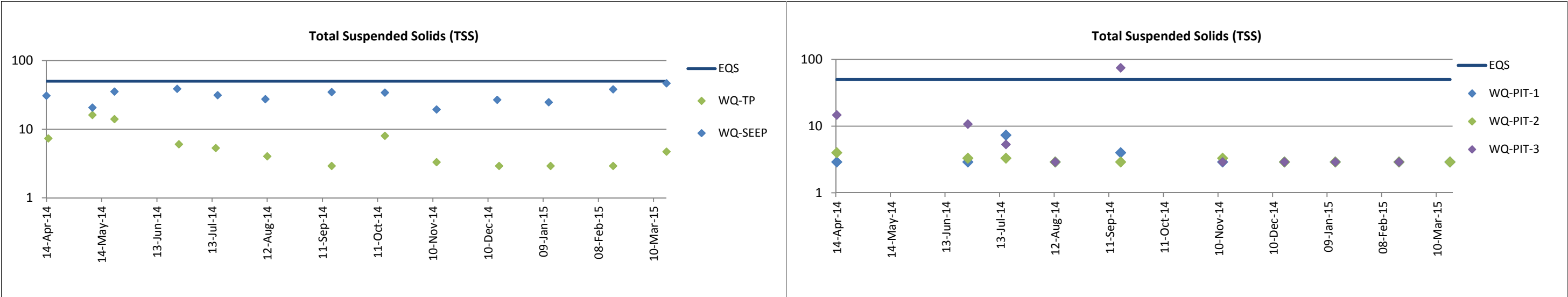


Figure E-12. Concentrations of total suspended solids for the Victoria Creek sites (left column) and the Back and Pony creek sites (right column) - y-axis in log concentration (mg/L).

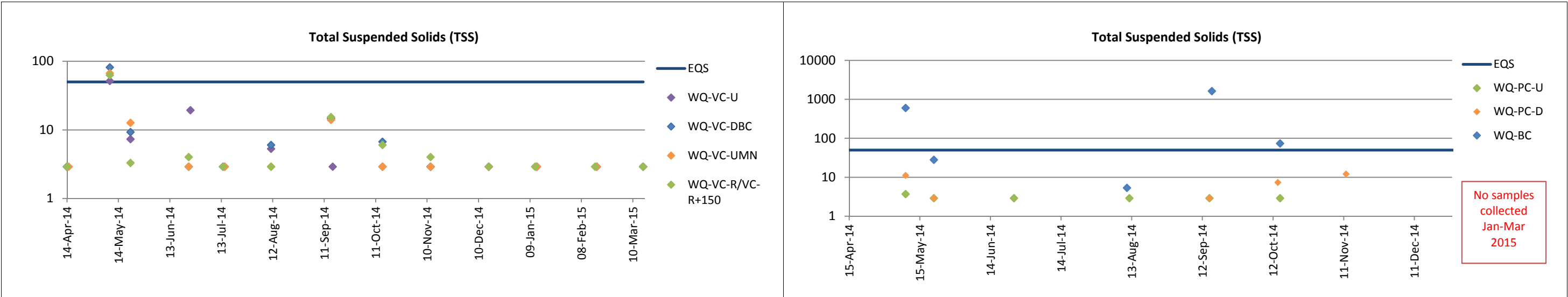




Figure E-13. Concentrations of aluminum, arsenic and ammonia for sites on Victoria Creek (left column) and sites on Back and Pony creeks (right column) – y-axis in log concentration (mg/L).

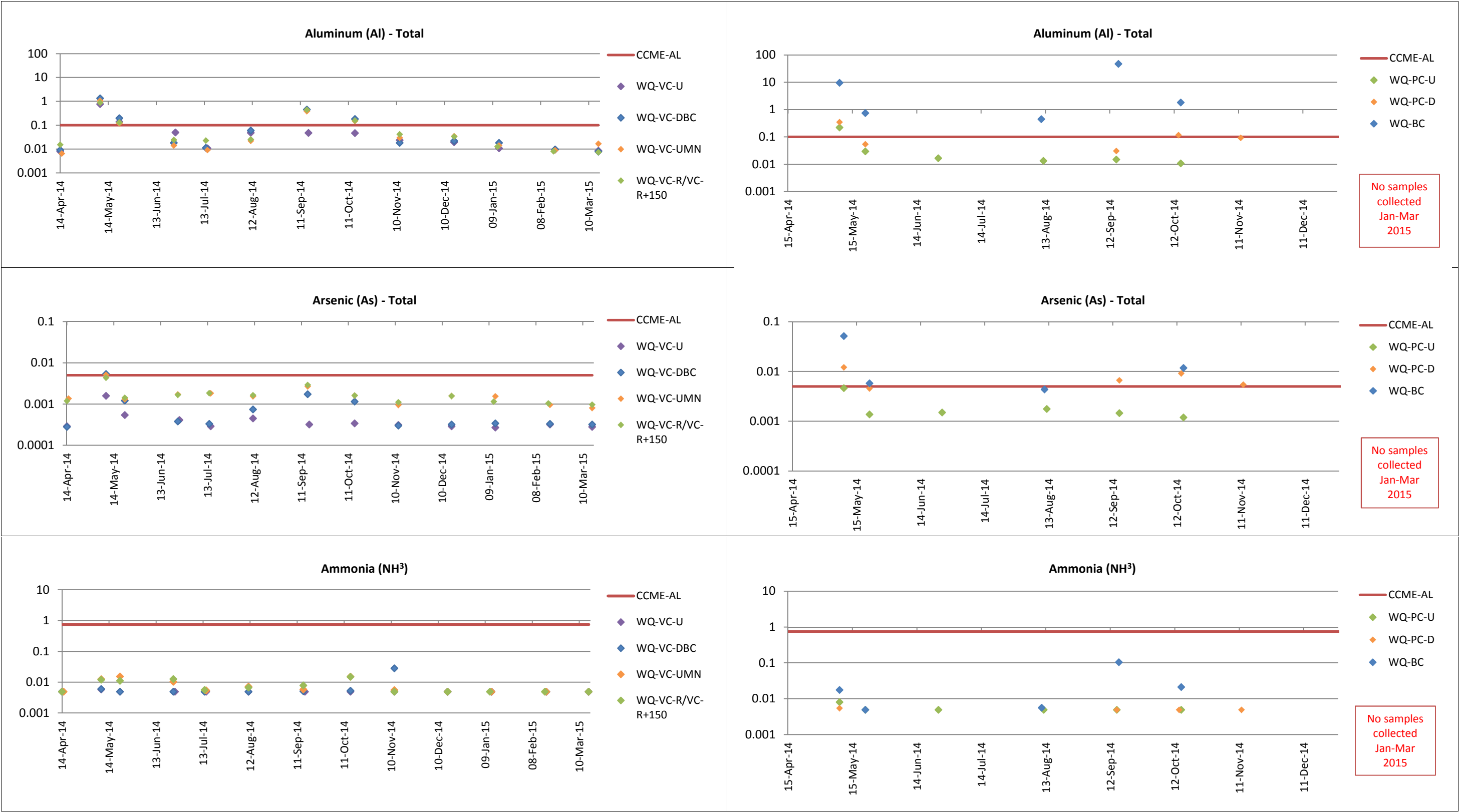




Figure E-14. Concentrations of cadmium, chromium and copper for sites on Victoria Creek (left column) and sites on Back and Pony creeks (right column) - y-axis in log concentration (mg/L).

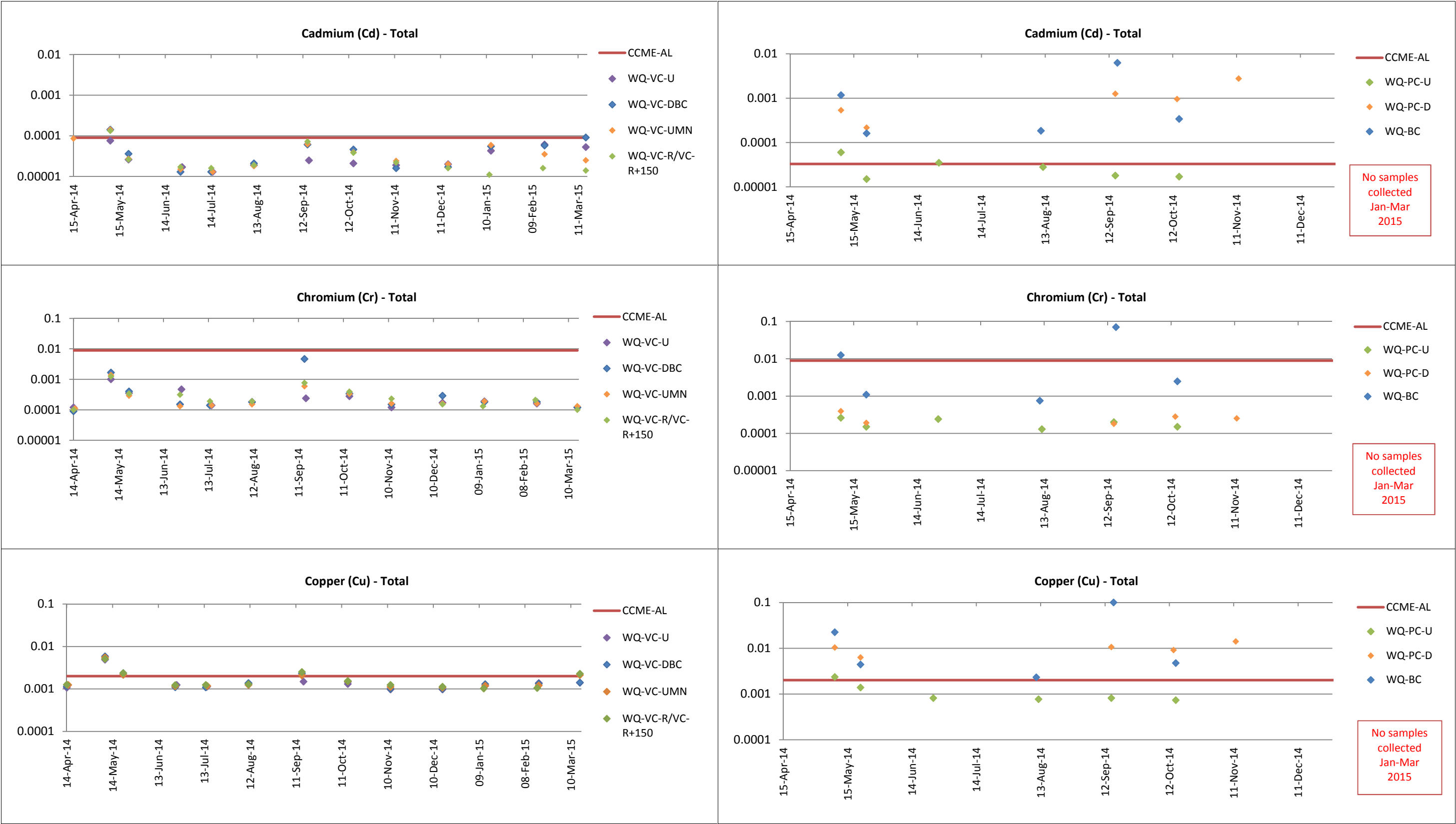




Figure E-15. Concentrations of iron, lead and manganese for sites on Victoria Creek (left column) and sites on Back and Pony creeks (right column) - y-axis in log concentration (mg/L).

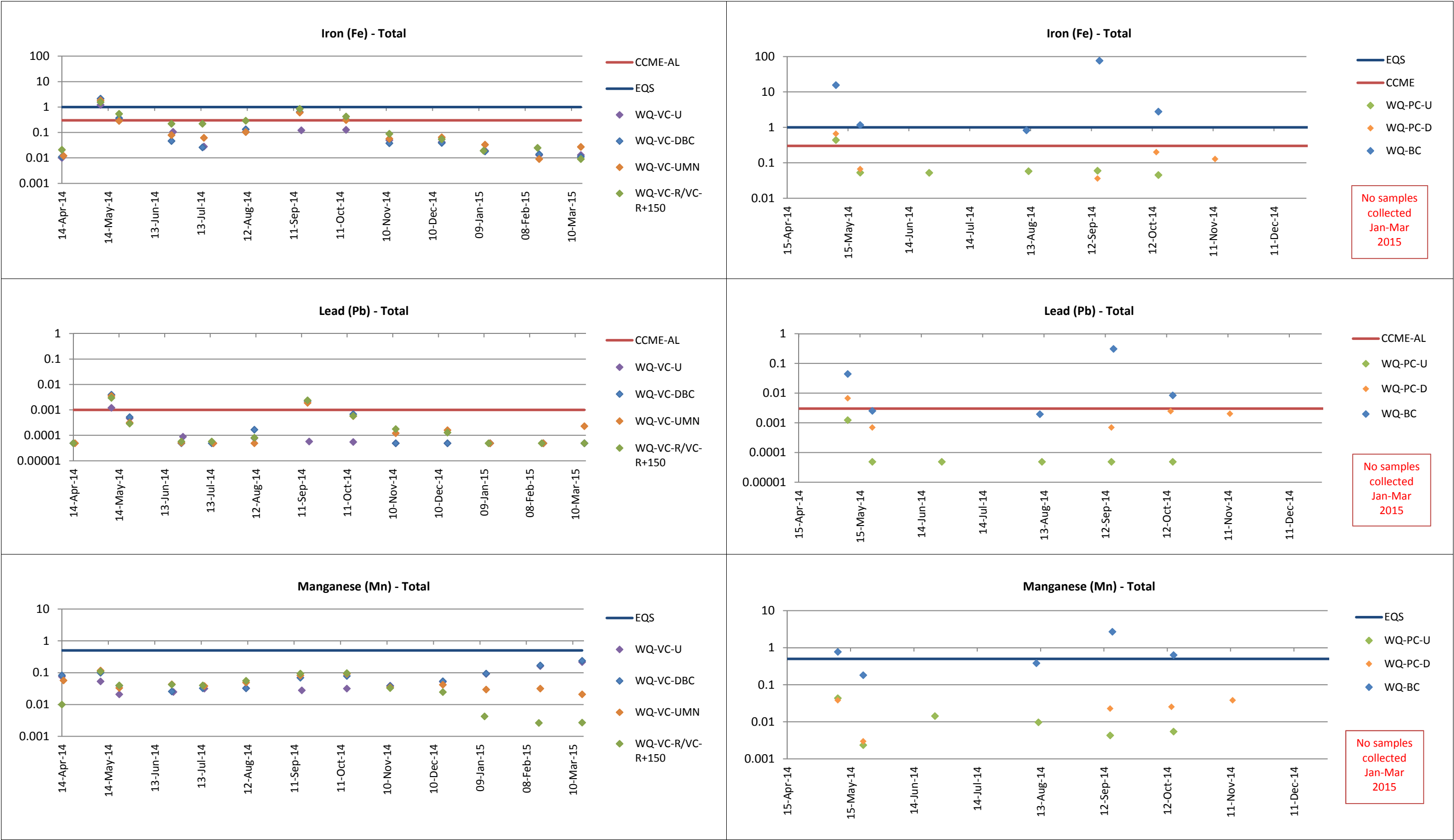




Figure E-16. Concentrations of mercury, silver and zinc for sites on Victoria Creek (left column) and sites on Back and Pony creeks (right column) - y-axis in log concentration (mg/L).

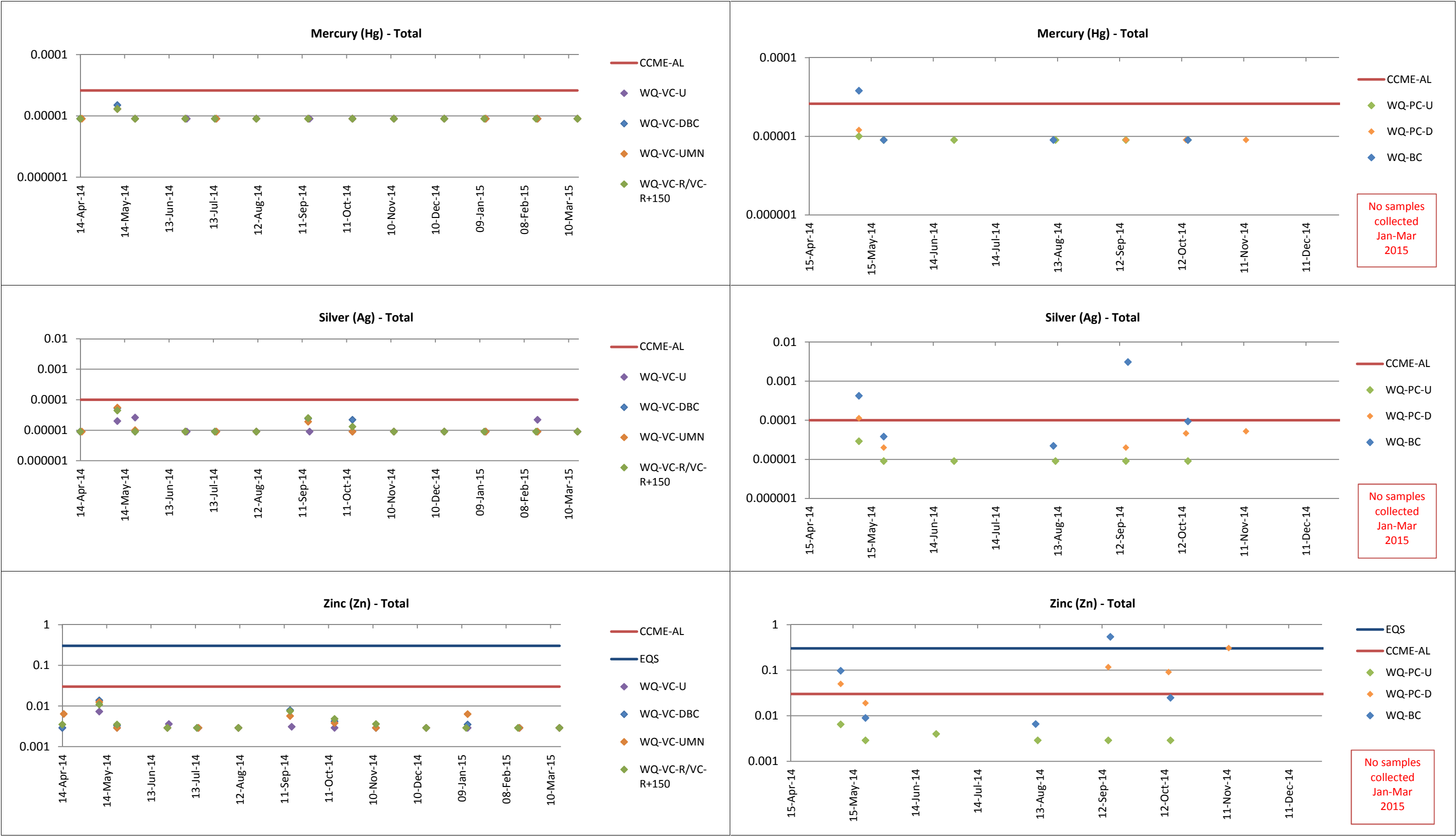




Table E-1. Summary of Water Quality Results for the January 12-14, 2015 Trip.

Analyte	Units	CCME-WATER-F-AL	Mount Nansen Effluent Discharge Standards	Sample ID WQ Site ID Date Sampled Detection Limit	0455-150114-003 WQ-DC-DX+105 14-Jan-15	0455-150113-001 WQ-TP 13-Jan-15	0455-150112-006 WQ-SEEP 12-Jan-15	0455-150112-004 WQ-DC-U 12-Jan-15	0455-150113-008 WQ-VC-U 13-Jan-15	0455-150113-005 WQ-VC-DBC 13-Jan-15	0455-150112-007 WQ-VC-R+150 12-Jan-15
Temperature (in-situ)	°C	-	-	-	0.4	3.1	0.2	0.0	0.1	0.1	0.2
Specific Conductivity (in-situ)	µS/cm	-	-	-	1171	1826	1724	1616	219.1	228.9	241.8
pH (in-situ)	pH	6.5 - 9.0	6.0 - 8.5	-	6.9	6.99	7.15	7.02	7.33	7.22	6.61
Turbidity (In-situ)	NTU	-	-	-	5.93	4.67	9.83	1.52	0.82	0.54	0.11
Dissolved Oxygen (in-situ - Pit only)	mg/L	-	-	-	-	-	-	-	-	-	-
Colour, True	CU	15	-	5	-	-	-	-	-	-	-
Conductivity	µS/cm	-	-	2	1150	1780	1690	1620	229	231	244
Hardness (as CaCO3)	mg/L	-	-	0.5	704	1090	966	945	119	121	125
pH (lab)	pH	6.5 - 9.0	6.0 - 8.5	0.1	7.91	7.93	7.65	7.83	7.83	7.95	7.89
Total Suspended Solids	mg/L	-	50	3	14	<3.0	24.7	4.7	<3.0	<3.0	<3.0
Total Dissolved Solids	mg/L	-	-	1	846	1510	1360	1290	127	124	137
Alkalinity, Bicarbonate (as CaCO3)	mg/L	-	-	1	278	134	205	225	97.6	91	96.3
Alkalinity, Carbonate (as CaCO3)	mg/L	-	-	1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Alkalinity, Hydroxide (as CaCO3)	mg/L	-	-	1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Alkalinity, Total (as CaCO3)	mg/L	-	-	1	278	134	205	225	97.6	91	96.3
Ammonia, Total (as N)	mg/L	0.75	-	0.005	0.0187	0.707	4.03	3.41	<0.0050	<0.0050	<0.0050
Chloride (Cl)	mg/L	120	-	0.5	<1.0	<2.5	<2.5	<2.5	<0.50	<0.50	<0.50
Fluoride (F)	mg/L	0.12	-	0.02	0.217	0.29	0.12	0.15	0.05	0.052	0.054
Nitrate (as N)	mg/L	13	-	0.005	<0.010	0.317	0.825	0.539	0.115	0.113	0.175
Nitrite (as N)	mg/L	0.06	-	0.001	<0.0020	<0.0050	0.0319	0.0231	<0.0010	<0.0010	<0.0010
Sulfate (SO4)	mg/L	-	-	0.5	426	989	827	763	23.2	23.1	31.8
Cyanide, Weak Acid Diss	mg/L	-	0.1	0.005	<0.0050	<0.0050	<0.0050	0.021	<0.0050	<0.0050	<0.0050
Cyanide, Total	mg/L	-	0.3	0.005	<0.0050	<0.0050	0.0263	0.0441	<0.0050	<0.0050	<0.0050
Cyanate	mg/L	-	-	0.2	<0.20	0.3	<0.20	<0.20	<0.20	<0.20	<0.20
Thiocyanate (SCN)	mg/L	-	-	0.5	<0.50	<0.50	3.2	2.15	<0.50	<0.50	<0.50
Aluminum (Al)-Total	mg/L	0.1	-	0.003	0.0913	0.0161	0.0136	0.0118	0.0108	0.0181	0.0126
Antimony (Sb)-Total	mg/L	-	0.15	0.0001	0.01	0.0308	0.00084	0.00049	0.00011	0.00011	0.0005
Arsenic (As)-Total	mg/L	0.005	-	0.0001	0.0577	0.2	0.0468	0.0272	0.00027	0.00034	0.00115
Barium (Ba)-Total	mg/L	-	1.0	0.00005	0.0129	0.0216	0.0502	0.0659	0.0828	0.0824	0.0752
Beryllium (Be)-Total	mg/L	-	-	0.0001	<0.00010	<0.00020	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth (Bi)-Total	mg/L	-	-	0.0005	<0.00050	<0.0010	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)-Total	mg/L	-	-	0.01	<0.010	0.109	0.068	0.055	<0.010	<0.010	<0.010
Cadmium (Cd)-Total	mg/L	0.00009	0.02	0.00001	0.00357	0.00248	0.00136	0.000561	0.000043	0.000055	0.000011
Calcium (Ca)-Total	mg/L	-	-	0.05	173	323	278	255	31.2	31.3	31.2
Chromium (Cr)-Total	mg/L	0.0089	0.04	0.0001	0.00023	0.00022	0.00051	0.00034	0.00019	0.00018	0.00013
Cobalt (Co)-Total	mg/L	-	-	0.0001	0.00075	0.001	0.0103	0.00748	<0.00010	<0.00010	<0.00010
Copper (Cu)-Total	mg/L	0.002	0.2	0.0005	0.00098	0.0272	0.00441	0.00179	0.00118	0.00129	0.00102
Iron (Fe)-Total	mg/L	0.3	1.0	0.01	0.863	0.442	11.7	3.44	0.019	0.018	0.019
Lead (Pb)-Total	mg/L	0.001	0.1	0.00005	0.000512	0.00536	0.000101	<0.000050	<0.000050	<0.000050	<0.000050
Lithium (Li)-Total	mg/L	-	-	0.0005	0.00846	0.0106	0.00154	0.00142	0.00066	0.00073	0.00163
Magnesium (Mg)-Total	mg/L	-	-	0.1	59.8	65	65.4	64.7	9.83	10.2	10.9
Manganese (Mn)-Total	mg/L	-	0.5	0.00005	1.25	2.06	8.59	7.23	0.0919	0.0939	0.00424
Mercury (Hg)-Total	mg/L	0.000026	0.005	0.00001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)-Total	mg/L	0.0073	-	0.00005	0.00038	0.00218	0.00116	0.000888	0.000351	0.000351	0.000409
Nickel (Ni)-Total	mg/L	0.025	0.3	0.0005	0.00172	0.0026	0.00477	0.00319	<0.00050	0.00053	<0.00050
Phosphorus (P)-Total	mg/L	-	-	0.05	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Potassium (K)-Total	mg/L	-	-	0.1	3.41	19.8	6.63	6.04	0.88	0.97	0.87
Selenium (Se)-Total	mg/L	0.001	-	0.0001	<0.00010	<0.00020	0.00024	0.00018	<0.00010	<0.00010	<0.00010
Silicon (Si)-Total	mg/L	-	-	0.05	6.38	2.43	7.66	7.14	6.72	6.84	6.36
Silver (Ag)-Total	mg/L	0.0001	0.1	0.00001	0.000011	0.000118	0.000038	0.000017	<0.000010	<0.000010	<0.000010
Sodium (Na)-Total	mg/L	-	-	0.05	4.88	23.6	34.2	28.8	2.75	2.84	3.31
Strontium (Sr)-Total	mg/L	-	-	0.0002	0.396	0.819	0.781	0.713	0.294	0.301	0.273
Sulfur (S)-Total	mg/L	-	-	0.5	137	319	268	240	7.86	7.91	10.7
Thallium (Tl)-Total	mg/L	0.0008	-	0.00001	0.000096	0.000292	0.000011	<0.000010	<0.000010	<0.000010	<0.000010
Tin (Sn)-Total	mg/L	-	-	0.0001	<0.00010	<0.00020	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)-Total	mg/L	-	-	0.01	<0.010	<0.020	<0.010	<0.010	<0.010	<0.010	<0.010



Table E-1. Summary of Water Quality Results for the January 12-14, 2015 Trip.

Analyte	Units	CCME-WATER-F-AL	Mount Nansen Effluent Discharge Standards	Sample ID WQ Site ID Date Sampled Detection Limit	0455-150114-003 WQ-DC-DX+105 14-Jan-15	0455-150113-001 WQ-TP 13-Jan-15	0455-150112-006 WQ-SEEP 12-Jan-15	0455-150112-004 WQ-DC-U 12-Jan-15	0455-150113-008 WQ-VC-U 13-Jan-15	0455-150113-005 WQ-VC-DBC 13-Jan-15	0455-150112-007 WQ-VC-R+150 12-Jan-15
Uranium (U)-Total	mg/L	0.015	-	0.00001	0.00423	0.00145	0.00232	0.00181	0.000497	0.000533	0.000549
Vanadium (V)-Total	mg/L	-	-	0.001	<0.0010	<0.0020	0.0017	<0.0010	<0.0010	<0.0010	<0.0010
Zinc (Zn)-Total	mg/L	0.03	0.3	0.003	0.812	0.259	0.08	0.0355	<0.0030	0.0035	<0.0030
Dissolved Metals Filtration Location		-	-	n/a	FIELD	FIELD	FIELD	FIELD	FIELD	FIELD	FIELD
Aluminum (Al)-Dissolved	mg/L	0.1	-	0.001	<0.0010	<0.0020	0.0087	0.0068	0.0066	0.006	0.0045
Antimony (Sb)-Dissolved	mg/L	-	-	0.0001	0.00991	0.0293	0.00073	0.00049	<0.00010	<0.00010	0.00045
Arsenic (As)-Dissolved	mg/L	0.005	0.15	0.0001	0.0172	0.112	0.036	0.0266	0.00026	0.00029	0.0011
Barium (Ba)-Dissolved	mg/L	-	-	0.00005	0.0115	0.0208	0.0504	0.0674	0.0838	0.0821	0.0746
Beryllium (Be)-Dissolved	mg/L	-	-	0.0001	<0.00010	<0.00020	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth (Bi)-Dissolved	mg/L	-	-	0.0005	<0.00050	<0.0010	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)-Dissolved	mg/L	-	-	0.01	<0.010	0.101	0.058	0.051	<0.010	<0.010	<0.010
Cadmium (Cd)-Dissolved	mg/L	0.00009	-	0.00001	0.00106	0.00227	0.000706	0.00009	0.000036	0.000052	0.000013
Calcium (Ca)-Dissolved	mg/L	-	-	0.05	181	330	281	267	31.3	31.7	31.7
Chromium (Cr)-Dissolved	mg/L	0.0089	-	0.0001	<0.00010	<0.00020	0.00037	0.0002	<0.00010	<0.00010	<0.00010
Cobalt (Co)-Dissolved	mg/L	-	-	0.0001	0.00065	0.00088	0.0101	0.00753	<0.00010	<0.00010	<0.00010
Copper (Cu)-Dissolved	mg/L	0.002	-	0.0002	<0.00020	0.0234	0.00172	0.00116	0.00117	0.00115	0.00094
Iron (Fe)-Dissolved	mg/L	0.3	-	0.01	0.263	0.022	11.1	3.37	<0.010	<0.010	<0.010
Lead (Pb)-Dissolved	mg/L	0.001	-	0.00005	<0.000050	0.00018	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Lithium (Li)-Dissolved	mg/L	-	-	0.0005	0.00839	0.0103	0.0013	0.00129	0.00063	0.00073	0.00156
Magnesium (Mg)-Dissolved	mg/L	-	-	0.1	61.2	65	64.4	67.4	9.85	10.1	11
Manganese (Mn)-Dissolved	mg/L	-	-	0.00005	1.17	1.98	8.53	7.35	0.0909	0.0908	0.00341
Mercury (Hg)-Dissolved	mg/L	0.000026	-	0.00001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)-Dissolved	mg/L	0.0073	-	0.00005	0.000355	0.00203	0.00103	0.000859	0.00031	0.000345	0.000378
Nickel (Ni)-Dissolved	mg/L	0.025	-	0.0005	0.0016	0.0025	0.00471	0.00331	<0.00050	<0.00050	<0.00050
Phosphorus (P)-Dissolved	mg/L	-	-	0.05	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Potassium (K)-Dissolved	mg/L	-	-	0.1	3.5	19.7	6.68	6.29	0.9	0.98	0.89
Selenium (Se)-Dissolved	mg/L	0.001	-	0.0001	<0.00010	<0.00020	0.00021	0.00017	<0.00010	<0.00010	<0.00010
Silicon (Si)-Dissolved	mg/L	-	-	0.05	6.35	2.42	7.59	7.39	6.66	6.71	6.36
Silver (Ag)-Dissolved	mg/L	0.0001	-	0.00001	<0.000010	0.000023	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)-Dissolved	mg/L	-	-	0.05	4.76	23.5	33.6	29.5	2.71	2.77	3.3
Strontium (Sr)-Dissolved	mg/L	-	-	0.0002	0.395	0.783	0.739	0.74	0.292	0.315	0.267
Sulfur (S)-Dissolved	mg/L	-	-	0.5	136	313	262	247	7.73	7.79	10.5
Thallium (Tl)-Dissolved	mg/L	0.0008	-	0.00001	0.00008	0.000271	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Tin (Sn)-Dissolved	mg/L	-	-	0.0001	<0.00010	<0.00020	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)-Dissolved	mg/L	-	-	0.01	<0.010	<0.020	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium (U)-Dissolved	mg/L	0.015	-	0.00001	0.00411	0.00136	0.00208	0.00181	0.000477	0.000531	0.000525
Vanadium (V)-Dissolved	mg/L	-	-	0.001	<0.0010	<0.0020	0.0014	<0.0010	<0.0010	<0.0010	<0.0010
Zinc (Zn)-Dissolved	mg/L	0.03	-	0.001	0.774	0.240	0.0773	0.0381	0.0026	0.0026	<0.0010

Applied Guidelines: 'Federal CCME Canadian Environmental Quality Guidelines (May 2014), CCME: Freshwater Aquatic Life
'Mount Nansen Effluent Discharge Standards

COLOUR KEY:
Exceeds CCME Guideline
Exceeds MN Effluent Discharge Standards
Exceeds both CCME and MN Standards
Data flag for Detection Limit Adjustment --> Please refer to the lab COA report and lab excel report for more info
Exceeds 10% difference threshold for QA/QC replicate samples. Note <DL = below detection limit

For those guidelines that are hardness dependent (Cd, Cu, Pb, Ni), the most conservative guideline has been applied. Same for guidelines that are pH and temperature dependent (Ammonia and Aluminum), unless otherwise noted.

Notes:

* WQ-PW is a drinking water sample and the analysis package has different detection limits than all other samples. The results are also compared to the Guidelines for Canadian Drinking Water Quality (Health Canada, October 2014) versus the CCME or MN Effluent Quality Standards.
QA/QC - the average percent difference of the replicate sample (WQ-VC-UMN-r) was 4% (max 34%, min 0%)



Table E-1. Summary of Water Quality Results for the January 12-14, 2015 Trip.

Analyte	Units	CCME-WATER-F-AL	Mount Nansen Effluent Discharge Standards	Sample ID WQ Site ID Date Sampled Detection Limit	0455-150113-010 WQ-VC-UMN-r 13-Jan-15	0455-150113-009 WQ-VC-UMN 13-Jan-15	QA/QC WQ-VC-UMN Replicate	0455-150113-012 WQ-PIT-1 (Top) 13-Jan-15 Depth: 0.30 m	0455-150113-011 WQ-PIT-2 (Middle) 13-Jan-15 Depth: 3.0 m	0455-150113-013 WQ-PIT-3 (Bottom) 13-Jan-15 Depth: 6.5 m	0455-150114-014 WQ-PW * 13-Jan-15
Temperature (in-situ)	°C	-	-	-	-	0.2	-	0.2	2.0	4.4	0.1
Specific Conductivity (in-situ)	µS/cm	-	-	-	-	272	-	1790	1790	2416	397.8
pH (in-situ)	pH	6.5 - 9.0	6.0 - 8.5	-	-	7.09	-	7.33	7.37	7.06	7.61
Turbidity (In-situ)	NTU	-	-	-	-	0.21	-	1.60	2.30	7.75	0.00
Dissolved Oxygen (in-situ - Pit only)	mg/L	-	-	-	-	-	-	6.53	5.62	0.81	-
Colour, True	CU	15	-	5	-	-	-	-	-	-	<5.0
Conductivity	µS/cm	-	-	2	291	273	6%	1770	1790	2440	405
Hardness (as CaCO3)	mg/L	-	-	0.5	141	142	1%	1130	1140	1680	212
pH (lab)	pH	6.5 - 9.0	6.0 - 8.5	0.1	7.86	7.86	0%	8.02	8.02	7.77	7.69
Total Suspended Solids	mg/L	-	50	3	<3.0	<3.0	<DL	<3.0	<3.0	<3.0	-
Total Dissolved Solids	mg/L	-	-	1	160	157	2%	1490	1500	2280	230
Alkalinity, Bicarbonate (as CaCO3)	mg/L	-	-	1	115	108	6%	185	202	211	-
Alkalinity, Carbonate (as CaCO3)	mg/L	-	-	1	<1.0	<1.0	<DL	<1.0	<1.0	<1.0	-
Alkalinity, Hydroxide (as CaCO3)	mg/L	-	-	1	<1.0	<1.0	<DL	<1.0	<1.0	<1.0	-
Alkalinity, Total (as CaCO3)	mg/L	-	-	1	115	108	6%	185	202	211	185
Ammonia, Total (as N)	mg/L	0.75	-	0.005	<0.0050	<0.0050	<DL	0.0056	0.006	0.0395	-
Chloride (Cl)	mg/L	120	-	0.5	<0.50	<0.50	<DL	<2.5	<2.5	<5.0	<0.50
Fluoride (F)	mg/L	0.12	-	0.02	0.053	0.052	2%	0.38	0.36	0.56	0.1
Nitrate (as N)	mg/L	13	-	0.005	0.0972	0.101	4%	0.156	0.128	<0.050	0.128
Nitrite (as N)	mg/L	0.06	-	0.001	<0.0010	<0.0010	<DL	<0.0050	<0.0050	<0.010	<0.0010
Sulfate (SO4)	mg/L	-	-	0.5	36.7	37.6	2%	962	964	1530	41.4
Cyanide, Weak Acid Diss	mg/L	-	0.1	0.005	<0.0050	<0.0050	<DL	-	-	-	-
Cyanide, Total	mg/L	-	0.3	0.005	<0.0050	<0.0050	<DL	-	-	-	-
Cyanate	mg/L	-	-	0.2	<0.20	<0.20	<DL	-	-	-	-
Thiocyanate (SCN)	mg/L	-	-	0.5	<0.50	<0.50	<DL	-	-	-	-
Aluminum (Al)-Total	mg/L	0.1	-	0.003	0.0136	0.0139	2%	<0.0060	0.0069	0.0084	<0.010
Antimony (Sb)-Total	mg/L	-	0.15	0.0001	0.00064	0.00062	3%	0.00423	0.00405	0.00157	<0.00050
Arsenic (As)-Total	mg/L	0.005	-	0.0001	0.00168	0.00155	8%	0.0116	0.0113	0.0152	0.00041
Barium (Ba)-Total	mg/L	-	1.0	0.00005	0.0758	0.076	0%	0.0127	0.0127	0.00684	0.092
Beryllium (Be)-Total	mg/L	-	-	0.0001	<0.00010	<0.00010	<DL	<0.00020	<0.00020	<0.00020	-
Bismuth (Bi)-Total	mg/L	-	-	0.0005	<0.00050	<0.00050	<DL	<0.0010	<0.0010	<0.0010	-
Boron (B)-Total	mg/L	-	-	0.01	<0.010	<0.010	<DL	<0.020	<0.020	<0.020	<0.10
Cadmium (Cd)-Total	mg/L	0.00009	0.02	0.00001	0.000060	0.000059	2%	0.00395	0.00355	0.0142	<0.00020
Calcium (Ca)-Total	mg/L	-	-	0.05	36.8	36.5	1%	312	315	474	49.1
Chromium (Cr)-Total	mg/L	0.0089	0.04	0.0001	0.00015	0.00019	27%	<0.00020	<0.00020	<0.00020	<0.0020
Cobalt (Co)-Total	mg/L	-	-	0.0001	<0.00010	<0.00010	<DL	<0.00020	<0.00020	0.0023	-
Copper (Cu)-Total	mg/L	0.002	0.2	0.0005	0.0012	0.00119	1%	0.0041	0.004	0.003	<0.0010
Iron (Fe)-Total	mg/L	0.3	1.0	0.01	0.036	0.033	8%	0.034	0.03	0.086	<0.030
Lead (Pb)-Total	mg/L	0.001	0.1	0.00005	0.000057	<0.000050	<DL	0.00031	0.00036	0.00051	0.00069
Lithium (Li)-Total	mg/L	-	-	0.0005	0.00097	0.00093	4%	0.0095	0.0093	0.0101	-
Magnesium (Mg)-Total	mg/L	-	-	0.1	11.9	11.9	0%	83.3	87.2	108	21.7
Manganese (Mn)-Total	mg/L	-	0.5	0.00005	0.0309	0.0297	4%	0.0879	0.0721	3.36	<0.0020
Mercury (Hg)-Total	mg/L	0.000026	0.005	0.00001	<0.000010	<0.000010	<DL	<0.000010	<0.000010	<0.000010	<0.00020
Molybdenum (Mo)-Total	mg/L	0.0073	-	0.00005	0.000329	0.000319	3%	0.00014	<0.00010	<0.00010	-
Nickel (Ni)-Total	mg/L	0.025	0.3	0.0005	<0.00050	<0.00050	<DL	<0.0010	<0.0010	0.0015	-
Phosphorus (P)-Total	mg/L	-	-	0.05	<0.050	<0.050	<DL	<0.050	<0.050	<0.050	-
Potassium (K)-Total	mg/L	-	-	0.1	1.1	1.12	2%	3.51	3.6	4.6	0.92
Selenium (Se)-Total	mg/L	0.001	-	0.0001	<0.00010	<0.00010	<DL	<0.00020	0.00026	<0.00020	<0.0010
Silicon (Si)-Total	mg/L	-	-	0.05	7.15	7.14	0%	3.99	3.9	3.72	-
Silver (Ag)-Total	mg/L	0.0001	0.1	0.00001	<0.000010	<0.000010	<DL	<0.000020	<0.000020	<0.000020	-
Sodium (Na)-Total	mg/L	-	-	0.05	3.7	3.69	0%	12.6	12.4	13.8	5.1
Strontium (Sr)-Total	mg/L	-	-	0.0002	0.305	0.307	1%	1.05	1.07	1.23	-
Sulfur (S)-Total	mg/L	-	-	0.5	12.7	12.8	1%	297	311	478	-
Thallium (Tl)-Total	mg/L	0.0008	-	0.00001	<0.000010	<0.000010	<DL	0.000064	0.000064	0.000116	-
Tin (Sn)-Total	mg/L	-	-	0.0001	<0.00010	<0.00010	<DL	<0.00020	<0.00020	<0.00020	-
Titanium (Ti)-Total	mg/L	-	-	0.01	<0.010	<0.010	<DL	<0.020	<0.020	<0.020	-



Table E-1. Summary of Water Quality Results for the January 12-14, 2015 Trip.

Analyte	Units	CCME-WATER-F-AL	Mount Nansen Effluent Discharge Standards	Sample ID WQ Site ID Date Sampled Detection Limit	0455-150113-010 WQ-VC-UMN-r 13-Jan-15	0455-150113-009 WQ-VC-UMN 13-Jan-15	QA/QC WQ-VC-UMN Replicate	0455-150113-012 WQ-PIT-1 (Top) 13-Jan-15 Depth: 0.30 m	0455-150113-011 WQ-PIT-2 (Middle) 13-Jan-15 Depth: 3.0 m	0455-150113-013 WQ-PIT-3 (Bottom) 13-Jan-15 Depth: 6.5 m	0455-150114-014 WQ-PW * 13-Jan-15
Uranium (U)-Total	mg/L	0.015	-	0.00001	0.000532	0.000534	0%	0.00437	0.00432	0.00361	0.00215
Vanadium (V)-Total	mg/L	-	-	0.001	<0.0010	<0.0010	<DL	<0.0020	<0.0020	<0.0020	-
Zinc (Zn)-Total	mg/L	0.03	0.3	0.003	0.0061	0.0063	3%	0.514	0.475	1.11	<0.050
Dissolved Metals Filtration Location		-	-	n/a	FIELD	FIELD	-	FIELD	FIELD	FIELD	-
Aluminum (Al)-Dissolved	mg/L	0.1	-	0.001	0.0050	0.0067	34%	<0.0020	<0.0020	0.0023	-
Antimony (Sb)-Dissolved	mg/L	-	-	0.0001	0.00058	0.0006	3%	0.00427	0.00381	0.00144	-
Arsenic (As)-Dissolved	mg/L	0.005	0.15	0.0001	0.00148	0.00158	7%	0.00945	0.0092	0.0101	-
Barium (Ba)-Dissolved	mg/L	-	-	0.00005	0.076	0.0811	7%	0.0125	0.0124	0.00694	-
Beryllium (Be)-Dissolved	mg/L	-	-	0.0001	<0.00010	<0.00010	<DL	<0.00020	<0.00020	<0.00020	-
Bismuth (Bi)-Dissolved	mg/L	-	-	0.0005	<0.00050	<0.00050	<DL	<0.0010	<0.0010	<0.0010	-
Boron (B)-Dissolved	mg/L	-	-	0.01	<0.010	<0.010	<DL	<0.020	<0.020	<0.020	-
Cadmium (Cd)-Dissolved	mg/L	0.00009	-	0.00001	0.000058	0.000066	14%	0.00385	0.00324	0.0142	-
Calcium (Ca)-Dissolved	mg/L	-	-	0.05	36.8	37.3	1%	316	319	501	-
Chromium (Cr)-Dissolved	mg/L	0.0089	-	0.0001	<0.00010	<0.00010	<DL	<0.00020	<0.00020	<0.00020	-
Cobalt (Co)-Dissolved	mg/L	-	-	0.0001	<0.00010	<0.00010	<DL	<0.00020	<0.00020	0.00225	-
Copper (Cu)-Dissolved	mg/L	0.002	-	0.0002	0.00111	0.00115	4%	0.00308	0.00292	0.00167	-
Iron (Fe)-Dissolved	mg/L	0.3	-	0.01	0.018	0.02	11%	<0.010	<0.010	<0.010	-
Lead (Pb)-Dissolved	mg/L	0.001	-	0.00005	<0.000050	<0.000050	<DL	<0.00010	<0.00010	<0.00010	-
Lithium (Li)-Dissolved	mg/L	-	-	0.0005	0.00097	0.00091	6%	0.0087	0.0092	0.0099	-
Magnesium (Mg)-Dissolved	mg/L	-	-	0.1	11.9	11.8	1%	82.4	84.1	104	-
Manganese (Mn)-Dissolved	mg/L	-	-	0.00005	0.0301	0.0288	4%	0.0533	0.0296	3.29	-
Mercury (Hg)-Dissolved	mg/L	0.000026	-	0.00001	<0.000010	<0.000010	<DL	<0.000010	<0.000010	<0.000010	-
Molybdenum (Mo)-Dissolved	mg/L	0.0073	-	0.00005	0.000293	0.000291	1%	0.00015	0.00015	<0.00010	-
Nickel (Ni)-Dissolved	mg/L	0.025	-	0.0005	<0.00050	<0.00050	<DL	<0.0010	<0.0010	0.0014	-
Phosphorus (P)-Dissolved	mg/L	-	-	0.05	<0.050	<0.050	<DL	<0.050	<0.050	<0.050	-
Potassium (K)-Dissolved	mg/L	-	-	0.1	1.1	1.08	2%	3.66	3.6	4.64	-
Selenium (Se)-Dissolved	mg/L	0.001	-	0.0001	<0.00010	<0.00010	<DL	<0.00020	<0.00020	<0.00020	-
Silicon (Si)-Dissolved	mg/L	-	-	0.05	7.03	7.05	0%	4.02	3.84	3.85	-
Silver (Ag)-Dissolved	mg/L	0.0001	-	0.00001	<0.000010	<0.000010	<DL	<0.000020	<0.000020	<0.000020	-
Sodium (Na)-Dissolved	mg/L	-	-	0.05	3.67	3.82	4%	12.3	12	13.6	-
Strontium (Sr)-Dissolved	mg/L	-	-	0.0002	0.303	0.299	1%	1.07	1.02	1.18	-
Sulfur (S)-Dissolved	mg/L	-	-	0.5	12.5	12.4	1%	287	294	480	-
Thallium (Tl)-Dissolved	mg/L	0.0008	-	0.00001	<0.000010	<0.000010	<DL	0.000078	0.000062	0.000118	-
Tin (Sn)-Dissolved	mg/L	-	-	0.0001	<0.00010	<0.00010	<DL	<0.00020	<0.00020	<0.00020	-
Titanium (Ti)-Dissolved	mg/L	-	-	0.01	<0.010	<0.010	<DL	<0.020	<0.020	<0.020	-
Uranium (U)-Dissolved	mg/L	0.015	-	0.00001	0.000497	0.000495	0%	0.00444	0.00417	0.00344	-
Vanadium (V)-Dissolved	mg/L	-	-	0.001	<0.0010	<0.0010	<DL	<0.0020	<0.0020	<0.0020	-
Zinc (Zn)-Dissolved	mg/L	0.03	-	0.001	0.0065	0.0065	0%	0.501	0.458	1.1	-

Applied Guidelines: 'Federal CCME Canadian Environmental Quality Guidelines (May 2014), CCME: Freshwater Aquatic Life
'Mount Nansen Effluent Discharge Standards

COLOUR KEY:
Exceeds CCME Guideline
Exceeds MN Effluent Discharge Standards
Exceeds both CCME and MN Standards
Data flag for Detection Limit Adjustment --> Please refer to the lab COA report and lab excel report for more info
Exceeds 10% difference threshold for QA/QC replicate samples. Note <DL = below detection limit

For those guidelines that are hardness dependent (Cd, Cu, Pb, Ni), the most conservative guideline has been applied. Same for guidelines that are pH and temperature dependent (Ammonia and Aluminum), unless otherwise noted.



Table E-1. Summary of Water Quality Results for the January 12-14, 2015 Trip.

Analyte	Units	CCME-WATER-F-AL	Mount Nansen Effluent Discharge Standards	Sample ID WQ Site ID Date Sampled Detection Limit	0455-1501-FIELD-BLANK FIELD BLANK 14-Jan-15	0455-1501-TRAVEL-BLANK TRAVEL BLANK n/a
Temperature (in-situ)	°C	-	-	-	-	-
Specific Conductivity (in-situ)	µS/cm	-	-	-	-	-
pH (in-situ)	pH	6.5 - 9.0	6.0 - 8.5	-	-	-
Turbidity (In-situ)	NTU	-	-	-	-	-
Dissolved Oxygen (in-situ - Pit only)	mg/L	-	-	-	-	-
Colour, True	CU	15	-	5	-	-
Conductivity	µS/cm	-	-	2	<2.0	<2.0
Hardness (as CaCO3)	mg/L	-	-	0.5	<0.50	-
pH (lab)	pH	6.5 - 9.0	6.0 - 8.5	0.1	5.45	5.46
Total Suspended Solids	mg/L	-	50	3	<3.0	<3.0
Total Dissolved Solids	mg/L	-	-	1	<1.0	<1.0
Alkalinity, Bicarbonate (as CaCO3)	mg/L	-	-	1	<1.0	<1.0
Alkalinity, Carbonate (as CaCO3)	mg/L	-	-	1	<1.0	<1.0
Alkalinity, Hydroxide (as CaCO3)	mg/L	-	-	1	<1.0	<1.0
Alkalinity, Total (as CaCO3)	mg/L	-	-	1	<1.0	<1.0
Ammonia, Total (as N)	mg/L	0.75	-	0.005	<0.0050	<0.0050
Chloride (Cl)	mg/L	120	-	0.5	<0.50	<0.50
Fluoride (F)	mg/L	0.12	-	0.02	<0.020	<0.020
Nitrate (as N)	mg/L	13	-	0.005	<0.0050	<0.0050
Nitrite (as N)	mg/L	0.06	-	0.001	<0.0010	<0.0010
Sulfate (SO4)	mg/L	-	-	0.5	<0.30	<0.30
Cyanide, Weak Acid Diss	mg/L	-	0.1	0.005	<0.0050	<0.0050
Cyanide, Total	mg/L	-	0.3	0.005	<0.0050	<0.0050
Cyanate	mg/L	-	-	0.2	<0.20	<0.20
Thiocyanate (SCN)	mg/L	-	-	0.5	<0.50	<0.50
Aluminum (Al)-Total	mg/L	0.1	-	0.003	<0.0030	<0.0030
Antimony (Sb)-Total	mg/L	-	0.15	0.0001	<0.00010	<0.00010
Arsenic (As)-Total	mg/L	0.005	-	0.0001	<0.00010	<0.00010
Barium (Ba)-Total	mg/L	-	1.0	0.00005	<0.000050	<0.000050
Beryllium (Be)-Total	mg/L	-	-	0.0001	<0.00010	<0.00010
Bismuth (Bi)-Total	mg/L	-	-	0.0005	<0.00050	<0.00050
Boron (B)-Total	mg/L	-	-	0.01	<0.010	<0.010
Cadmium (Cd)-Total	mg/L	0.00009	0.02	0.00001	<0.000010	<0.000010
Calcium (Ca)-Total	mg/L	-	-	0.05	<0.050	<0.050
Chromium (Cr)-Total	mg/L	0.0089	0.04	0.0001	<0.00010	<0.00010
Cobalt (Co)-Total	mg/L	-	-	0.0001	<0.00010	<0.00010
Copper (Cu)-Total	mg/L	0.002	0.2	0.0005	<0.00050	<0.00050
Iron (Fe)-Total	mg/L	0.3	1.0	0.01	<0.010	<0.010
Lead (Pb)-Total	mg/L	0.001	0.1	0.00005	<0.000050	<0.000050
Lithium (Li)-Total	mg/L	-	-	0.0005	<0.00050	<0.00050
Magnesium (Mg)-Total	mg/L	-	-	0.1	<0.10	<0.10
Manganese (Mn)-Total	mg/L	-	0.5	0.00005	<0.000050	<0.000050
Mercury (Hg)-Total	mg/L	0.000026	0.005	0.00001	<0.000010	<0.000010
Molybdenum (Mo)-Total	mg/L	0.0073	-	0.00005	<0.000050	<0.000050
Nickel (Ni)-Total	mg/L	0.025	0.3	0.0005	<0.00050	<0.00050
Phosphorus (P)-Total	mg/L	-	-	0.05	<0.050	<0.050
Potassium (K)-Total	mg/L	-	-	0.1	<0.10	<0.10
Selenium (Se)-Total	mg/L	0.001	-	0.0001	<0.00010	<0.00010
Silicon (Si)-Total	mg/L	-	-	0.05	<0.050	<0.050
Silver (Ag)-Total	mg/L	0.0001	0.1	0.00001	<0.000010	<0.000010
Sodium (Na)-Total	mg/L	-	-	0.05	<0.050	<0.050
Strontium (Sr)-Total	mg/L	-	-	0.0002	<0.00020	<0.00020
Sulfur (S)-Total	mg/L	-	-	0.5	<0.50	<0.50
Thallium (Tl)-Total	mg/L	0.0008	-	0.00001	<0.000010	<0.000010
Tin (Sn)-Total	mg/L	-	-	0.0001	<0.00010	<0.00010
Titanium (Ti)-Total	mg/L	-	-	0.01	<0.010	<0.010



Table E-1. Summary of Water Quality Results for the January 12-14, 2015 Trip.

Analyte	Units	CCME-WATER-F-AL	Mount Nansen Effluent Discharge Standards	Sample ID WQ Site ID Date Sampled Detection Limit	0455-1501-FIELD-BLANK FIELD BLANK 14-Jan-15	0455-1501-TRAVEL-BLANK TRAVEL BLANK n/a
Uranium (U)-Total	mg/L	0.015	-	0.00001	<0.000010	<0.000010
Vanadium (V)-Total	mg/L	-	-	0.001	<0.0010	<0.0010
Zinc (Zn)-Total	mg/L	0.03	0.3	0.003	<0.0030	<0.0030
Dissolved Metals Filtration Location		-	-	n/a	FIELD	-
Aluminum (Al)-Dissolved	mg/L	0.1	-	0.001	<0.0010	-
Antimony (Sb)-Dissolved	mg/L	-	-	0.0001	<0.00010	-
Arsenic (As)-Dissolved	mg/L	0.005	0.15	0.0001	<0.00010	-
Barium (Ba)-Dissolved	mg/L	-	-	0.00005	<0.000050	-
Beryllium (Be)-Dissolved	mg/L	-	-	0.0001	<0.00010	-
Bismuth (Bi)-Dissolved	mg/L	-	-	0.0005	<0.00050	-
Boron (B)-Dissolved	mg/L	-	-	0.01	<0.010	-
Cadmium (Cd)-Dissolved	mg/L	0.00009	-	0.00001	<0.000010	-
Calcium (Ca)-Dissolved	mg/L	-	-	0.05	<0.050	-
Chromium (Cr)-Dissolved	mg/L	0.0089	-	0.0001	<0.00010	-
Cobalt (Co)-Dissolved	mg/L	-	-	0.0001	<0.00010	-
Copper (Cu)-Dissolved	mg/L	0.002	-	0.0002	<0.00020	-
Iron (Fe)-Dissolved	mg/L	0.3	-	0.01	<0.010	-
Lead (Pb)-Dissolved	mg/L	0.001	-	0.00005	<0.000050	-
Lithium (Li)-Dissolved	mg/L	-	-	0.0005	<0.00050	-
Magnesium (Mg)-Dissolved	mg/L	-	-	0.1	<0.10	-
Manganese (Mn)-Dissolved	mg/L	-	-	0.00005	<0.000050	-
Mercury (Hg)-Dissolved	mg/L	0.000026	-	0.00001	<0.000010	-
Molybdenum (Mo)-Dissolved	mg/L	0.0073	-	0.00005	<0.000050	-
Nickel (Ni)-Dissolved	mg/L	0.025	-	0.0005	<0.00050	-
Phosphorus (P)-Dissolved	mg/L	-	-	0.05	<0.050	-
Potassium (K)-Dissolved	mg/L	-	-	0.1	<0.10	-
Selenium (Se)-Dissolved	mg/L	0.001	-	0.0001	<0.00010	-
Silicon (Si)-Dissolved	mg/L	-	-	0.05	<0.050	-
Silver (Ag)-Dissolved	mg/L	0.0001	-	0.00001	<0.000010	-
Sodium (Na)-Dissolved	mg/L	-	-	0.05	<0.050	-
Strontium (Sr)-Dissolved	mg/L	-	-	0.0002	<0.00020	-
Sulfur (S)-Dissolved	mg/L	-	-	0.5	<0.50	-
Thallium (Tl)-Dissolved	mg/L	0.0008	-	0.00001	<0.000010	-
Tin (Sn)-Dissolved	mg/L	-	-	0.0001	<0.00010	-
Titanium (Ti)-Dissolved	mg/L	-	-	0.01	<0.010	-
Uranium (U)-Dissolved	mg/L	0.015	-	0.00001	<0.000010	-
Vanadium (V)-Dissolved	mg/L	-	-	0.001	<0.0010	-
Zinc (Zn)-Dissolved	mg/L	0.03	-	0.001	<0.0010	-

Applied Guidelines: 'Federal CCME Canadian Environmental Quality Guidelines (May 2014), CCME: Freshwater Aquatic Life
'Mount Nansen Effluent Discharge Standards

COLOUR KEY:
Exceeds CCME Guideline
Exceeds MN Effluent Discharge Standards
Exceeds both CCME and MN Standards
Data flag for Detection Limit Adjustment --> Please refer to the lab COA report and lab excel report for more info
Exceeds 10% difference threshold for QA/QC replicate samples. Note <DL = below detection limit

For those guidelines that are hardness dependent (Cd, Cu, Pb, Ni), the most conservative guideline has been applied. Same for guidelines that are pH and temperature dependent (Ammonia and Aluminum), unless otherwise noted.



Table E-2. Summary of Water Quality Results for the February 16-17, 2015 Trip.

Analyte	Units	CCME-WATER-F-AL	Mount Nansen Effluent Discharge Standards	Sample ID WQ Site ID Date Sampled Detection Limit	0455-150216-007 WQ-DC-DX+105 16-Feb-15	0455-150216-009 WQ-TP-r 16-Feb-15	0455-150216-008 WQ-TP 16-Feb-15	QA/QC WQ-TP-r **** Field Replicate	0455-150216-010 WQ-SEEP 16-Feb-15	0455-150217-002 WQ-VC-U 17-Feb-15
Temperature (in-situ)	°C	-	-	-	0.2	-	0.6	-	1.1	0.1
Specific Conductivity (in-situ)	µS/cm	-	-	-	1073	-	2018	-	1638	246.7
pH (in-situ)	pH	6.5 - 9.0	6.0 - 8.5	-	7.2	-	7.3	-	6.9	6.99
Turbidity (In-situ)	NTU	-	-	-	-	-	5.32	-	18.06	0.00
Dissolved Oxygen (in-situ - Pit only)	mg/L	-	-	-	-	-	-	-	-	-
Colour, True	CU	15	-	5	-	-	-	-	-	-
Conductivity	µS/cm	-	-	2	1130	2080	2140	3%	1680	245
Hardness (as CaCO3)	mg/L	-	-	0.5	684	1300	1190	8%	945	125
pH (lab)	pH	6.5 - 9.0	6.0 - 8.5	0.1	8.03	8.01	8.03	0%	7.79	7.93
Total Suspended Solids	mg/L	-	50	3	4.6	<3.0	<3.0	<DL	38	<3.0
Total Dissolved Solids	mg/L	-	-	1	807	1810	1720	5%	1330	132
Alkalinity, Bicarbonate (as CaCO3)	mg/L	-	-	1	268	196	177	10%	227	100
Alkalinity, Carbonate (as CaCO3)	mg/L	-	-	1	<1.0	<1.0	<1.0	<DL	<1.0	<1.0
Alkalinity, Hydroxide (as CaCO3)	mg/L	-	-	1	<1.0	<1.0	<1.0	<DL	<1.0	<1.0
Alkalinity, Total (as CaCO3)	mg/L	-	-	1	268	196	177	10%	227	100
Ammonia, Total (as N)	mg/L	0.75	-	0.005	0.0264	1.2	1.16	3%	4.31	<0.0050
Chloride (Cl)	mg/L	120	-	0.5	<1.0	<2.5	<2.5	<DL	<2.5	<0.50
Fluoride (F)	mg/L	0.12	-	0.02	0.197	0.35	0.30	14%	0.12	0.046
Nitrate (as N)	mg/L	13	-	0.005	<0.010	0.096	0.077	20%	0.513	0.12
Nitrite (as N)	mg/L	0.06	-	0.001	<0.0020	<0.0050	<0.0050	<DL	0.0332	<0.0010
Sulfate (SO4)	mg/L	-	-	0.5	401	1160	1120	3%	788	23.4
Cyanide, Weak Acid Diss	mg/L	-	0.1	0.005	<0.0050	<0.0050	<0.0050	<DL	0.0179	<0.0050
Cyanide, Total	mg/L	-	0.3	0.005	<0.0050	<0.0050	<0.0050	<DL	0.0978	<0.0050
Cyanate	mg/L	-	-	0.2	<0.20	<0.20	<0.20	<DL	<0.20	<0.20
Thiocyanate (SCN)	mg/L	-	-	0.5	<0.50	<0.50	<0.50	<DL	3.83	<0.50
Aluminum (Al)-Total	mg/L	0.1	-	0.003	0.0147	0.0124	0.012	3%	0.0177	0.0095
Antimony (Sb)-Total	mg/L	-	0.15	0.0001	0.00907	0.0252	0.0253	0%	0.00087	0.00012
Arsenic (As)-Total	mg/L	0.005	-	0.0001	0.0411	0.191	0.191	0%	0.0561	0.00032
Barium (Ba)-Total	mg/L	-	1.0	0.00005	0.0125	0.0295	0.0291	1%	0.0574	0.0978
Beryllium (Be)-Total	mg/L	-	-	0.0001	<0.00010	<0.00020	<0.00020	<DL	<0.00010	<0.00010
Bismuth (Bi)-Total	mg/L	-	-	0.0005	<0.00050	<0.0010	<0.0010	<DL	<0.00050	<0.00050
Boron (B)-Total	mg/L	-	-	0.01	<0.010	0.132	0.13	2%	0.068	<0.010
Cadmium (Cd)-Total	mg/L	0.00009	0.02	0.00001	0.00295	0.0041	0.0039	5%	0.00142	0.000061
Calcium (Ca)-Total	mg/L	-	-	0.05	172	389	385	1%	281	32.5
Chromium (Cr)-Total	mg/L	0.0089	0.04	0.0001	0.00011	0.00029	0.00407	1303%	0.0006	0.00016
Cobalt (Co)-Total	mg/L	-	-	0.0001	0.00067	0.00142	0.00144	1%	0.00945	<0.00010
Copper (Cu)-Total	mg/L	0.002	0.2	0.0005	<0.00050	0.031	0.0316	2%	0.00483	0.00138
Iron (Fe)-Total	mg/L	0.3	1.0	0.01	0.554	0.513	0.501	2%	15.5	0.013
Lead (Pb)-Total	mg/L	0.001	0.1	0.00005	0.000157	0.00424	0.00414	2%	0.000178	<0.000050
Lithium (Li)-Total	mg/L	-	-	0.0005	0.00786	0.0119	0.0115	3%	0.00113	<0.00050
Magnesium (Mg)-Total	mg/L	-	-	0.1	58.2	79.5	77	3%	66.1	10.5
Manganese (Mn)-Total	mg/L	-	0.5	0.00005	1.33	4.82	4.84	0%	8.96	0.163
Mercury (Hg)-Total	mg/L	0.000026	0.005	0.00001	<0.000010	<0.000010	<0.000010	<DL	<0.000010	<0.000010
Molybdenum (Mo)-Total	mg/L	0.0073	-	0.00005	0.000425	0.00333	0.00328	2%	0.00123	0.000313
Nickel (Ni)-Total	mg/L	0.025	0.3	0.0005	0.00156	0.0047	0.0056	19%	0.00438	0.00065
Phosphorus (P)-Total	mg/L	-	-	0.05	<0.050	<0.050	<0.050	<DL	<0.050	<0.050
Potassium (K)-Total	mg/L	-	-	0.1	3.57	25.7	25	3%	7.04	0.84
Selenium (Se)-Total	mg/L	0.001	-	0.0001	<0.00010	<0.00020	<0.00020	<DL	0.00025	<0.00010
Silicon (Si)-Total	mg/L	-	-	0.05	6.43	3	2.94	2%	8.07	6.85
Silver (Ag)-Total	mg/L	0.0001	0.1	0.00001	<0.000010	0.00012	0.000112	7%	0.000044	0.000022
Sodium (Na)-Total	mg/L	-	-	0.05	5.14	29.3	29.1	1%	37.3	3.07
Strontium (Sr)-Total	mg/L	-	-	0.0002	0.43	1.07	1.05	2%	0.854	0.352
Sulfur (S)-Total	mg/L	-	-	0.5	131	380	371	2%	269	7.8
Thallium (Tl)-Total	mg/L	0.0008	-	0.00001	0.000088	0.000349	0.000345	1%	0.000012	<0.000010
Tin (Sn)-Total	mg/L	-	-	0.0001	<0.00010	<0.00020	<0.00020	<DL	<0.00010	<0.00010
Titanium (Ti)-Total	mg/L	-	-	0.01	<0.010	<0.020	<0.020	<DL	<0.010	<0.010
Uranium (U)-Total	mg/L	0.015	-	0.00001	0.00431	0.00178	0.00179	1%	0.00214	0.00056
Vanadium (V)-Total	mg/L	-	-	0.001	<0.0010	<0.0020	<0.0020	<DL	0.002	<0.0010
Zinc (Zn)-Total	mg/L	0.03	0.3	0.003	0.697	0.379	0.37	2%	0.0857	<0.0030



Table E-2. Summary of Water Quality Results for the February 16-17, 2015 Trip.

Analyte	Units	CCME-WATER-F-AL	Mount Nansen Effluent Discharge Standards	Sample ID WQ Site ID Date Sampled Detection Limit	0455-150216-007 WQ-DC-DX+105 16-Feb-15	0455-150216-009 WQ-TP-r 16-Feb-15	0455-150216-008 WQ-TP 16-Feb-15	QA/QC WQ-TP-r **** Field Replicate	0455-150216-010 WQ-SEEP 16-Feb-15	0455-150217-002 WQ-VC-U 17-Feb-15
Dissolved Metals Filtration Location		-	-	n/a	FIELD	FIELD	FIELD	-	FIELD	FIELD
Aluminum (Al)-Dissolved	mg/L	0.1	-	0.001	<0.0010	<0.0020	<0.0020	<DL	0.0104	0.007
Antimony (Sb)-Dissolved	mg/L	-	-	0.0001	0.00893	0.0249	0.024	4%	0.00075	<0.00010
Arsenic (As)-Dissolved	mg/L	0.005	0.15	0.0001	0.0199	0.0849	0.0819	4%	0.0383	0.00028
Barium (Ba)-Dissolved	mg/L	-	-	0.00005	0.0121	0.0283	0.0279	1%	0.0559	0.098
Beryllium (Be)-Dissolved	mg/L	-	-	0.0001	<0.00010	<0.00020	<0.00020	<DL	<0.00010	<0.00010
Bismuth (Bi)-Dissolved	mg/L	-	-	0.0005	<0.00050	<0.0010	<0.0010	<DL	<0.00050	<0.00050
Boron (B)-Dissolved	mg/L	-	-	0.01	<0.010	0.124	0.118	5%	0.06	<0.010
Cadmium (Cd)-Dissolved	mg/L	0.00009	-	0.00001	0.000668	0.00376	0.00378	1%	0.000803	0.00006
Calcium (Ca)-Dissolved	mg/L	-	-	0.05	175	388	355	9%	271	32.8
Chromium (Cr)-Dissolved	mg/L	0.0089	-	0.0001	<0.00010	<0.00020	<0.00020	<DL	0.0004	<0.00010
Cobalt (Co)-Dissolved	mg/L	-	-	0.0001	0.00066	0.00134	0.00132	1%	0.00918	<0.00010
Copper (Cu)-Dissolved	mg/L	0.002	-	0.0002	<0.00020	0.0273	0.0271	1%	0.00176	0.00126
Iron (Fe)-Dissolved	mg/L	0.3	-	0.01	0.344	0.027	0.023	15%	13.2	<0.010
Lead (Pb)-Dissolved	mg/L	0.001	-	0.00005	<0.000050	0.00016	0.00013	19%	<0.000050	<0.000050
Lithium (Li)-Dissolved	mg/L	-	-	0.0005	0.00799	0.0117	0.0116	1%	0.00094	<0.00050
Magnesium (Mg)-Dissolved	mg/L	-	-	0.1	59.9	81.1	73.5	9%	65.3	10.6
Manganese (Mn)-Dissolved	mg/L	-	-	0.00005	1.3	4.69	4.43	6%	8.78	0.159
Mercury (Hg)-Dissolved	mg/L	0.000026	-	0.00001	<0.000010	<0.000010	<0.000010	<DL	<0.000010	<0.000010
Molybdenum (Mo)-Dissolved	mg/L	0.0073	-	0.00005	0.000393	0.00318	0.00355	12%	0.00116	0.000291
Nickel (Ni)-Dissolved	mg/L	0.025	-	0.0005	0.00139	0.0038	0.004	5%	0.00438	0.00066
Phosphorus (P)-Dissolved	mg/L	-	-	0.05	<0.050	<0.050	<0.050	<DL	<0.050	<0.050
Potassium (K)-Dissolved	mg/L	-	-	0.1	3.65	25.7	23.6	8%	6.64	0.85
Selenium (Se)-Dissolved	mg/L	0.001	-	0.0001	<0.00010	<0.00020	<0.00020	<DL	0.00022	<0.00010
Silicon (Si)-Dissolved	mg/L	-	-	0.05	6.55	2.97	2.74	8%	7.68	6.94
Silver (Ag)-Dissolved	mg/L	0.0001	-	0.00001	<0.000010	0.000022	0.000028	27%	0.00001	<0.000010
Sodium (Na)-Dissolved	mg/L	-	-	0.05	5.12	29.3	28.7	2%	37.2	3
Strontium (Sr)-Dissolved	mg/L	-	-	0.0002	0.419	1.06	1.03	3%	0.821	0.343
Sulfur (S)-Dissolved	mg/L	-	-	0.5	130	372	348	6%	256	7.87
Thallium (Tl)-Dissolved	mg/L	0.0008	-	0.00001	0.000078	0.000342	0.000347	1%	0.000011	<0.000010
Tin (Sn)-Dissolved	mg/L	-	-	0.0001	<0.00010	<0.00020	<0.00020	<DL	<0.00010	<0.00010
Titanium (Ti)-Dissolved	mg/L	-	-	0.01	<0.010	<0.020	<0.020	<DL	<0.010	<0.010
Uranium (U)-Dissolved	mg/L	0.015	-	0.00001	0.00421	0.00178	0.0018	1%	0.00206	0.000551
Vanadium (V)-Dissolved	mg/L	-	-	0.001	<0.0010	<0.0020	<0.0020	<DL	0.0015	<0.0010
Zinc (Zn)-Dissolved	mg/L	0.03	-	0.001	0.674	0.356	0.365	3%	0.085	0.002

Applied Guidelines: 'Federal CCME Canadian Environmental Quality Guidelines (January 2015), CCME: Freshwater Aquatic Life'
'Mount Nansen Effluent Discharge Standards'

COLOUR KEY:
Exceeds CCME Guideline
Exceeds MN Effluent Discharge Standards
Exceeds both CCME and MN Standards
Data flag for Detection Limit Adjustment --> Please refer to the lab COA report and lab excel report for more info
Exceeds 10% difference threshold for QA/QC replicate samples. Note <DL = below detection limit

For those guidelines that are hardness dependent (Cd, Cu, Pb, Ni), the most conservative guideline has been applied. Same for guidelines that are pH and temperature dependent (Ammonia and Aluminum), unless otherwise noted.

Notes:

- * WQ-PW is a drinking water sample and the analysis package has different detection limits than all other samples. The results are also compared to the *Guidelines for Canadian Drinking Water Quality* (Health Canada, October 2014) versus the CCME or MN Effluent Quality Standards.
- ** Field Blank sample had dissolved zinc above the detection limit, but below guideline and standard criteria. This may be a result of field contamination from air/dust or an improperly tightened lid. The data from the sample collected at the same time as the field blank was reviewed (WQ-VC-R+150), and data was found to be within expected ranges.
- *** Travel Blank sample had an ammonia concentration above the detection limit - this typically occurs when sample provided by lab is older, and contamination from actual travel is unlikely.
- **** QA/QC replicate sample was on average 27% different than the original sample. Note some of the WQ-TP sample bottles were frozen in the field (including the routine, total and dissolved metals and cyanide). While the lab did not expect this to cause any concerns, it may be the reason for the large differences as the WQ-TP-r samples did not freeze.



Table E-2. Summary of Water Quality Results for the February 16-17, 2015 Trip.

Analyte	Units	CCME-WATER-F-AL	Mount Nansen Effluent Discharge Standards	Sample ID WQ Site ID Date Sampled Detection Limit	0455-150217-003 WQ-VC-DBC 17-Feb-15	0455-150217-011 WQ-VC-UMN 17-Feb-15	0455-150217-006 WQ-VC-R+150 16-Feb-15	0455-150217-014 WQ-PIT-1 (Top) 17-Feb-15 Depth: 0.30 m	0455-150217-012 WQ-PIT-2 (Middle) 17-Feb-15 Depth: 2.5 m	0455-150217-013 WQ-PIT-3 (Bottom) 17-Feb-15 Depth 5.0 m	0455-150217-015 WQ-PW 17-Feb-15
Temperature (in-situ)	°C	-	-	-	0.1	0.5	0.1	1.3	2.2	3.9	0.3
Specific Conductivity (in-situ)	µS/cm	-	-	-	249.1	298.5	237.8	1865	1869	1938	403.9
pH (in-situ)	pH	6.5 - 9.0	6.0 - 8.5	-	6.98	6.85	6.87	7.32	7.3	7.19	7.48
Turbidity (In-situ)	NTU	-	-	-	0.18	0.00	0.11	0.83	0.66	0.56	0.10
Dissolved Oxygen (in-situ - Pit only)	mg/L	-	-	-	-	-	-	5.47	4.5	0.95	-
Colour, True	CU	15	-	5	-	-	-	-	-	-	<5.0
Conductivity	µS/cm	-	-	2	248	294	255	1820	1790	1950	422
Hardness (as CaCO3)	mg/L	-	-	0.5	126	147	128	1220	1170	1240	211
pH (lab)	pH	6.5 - 9.0	6.0 - 8.5	0.1	7.96	8.00	8.00	8.14	8.14	8.11	7.69
Total Suspended Solids	mg/L	-	50	3	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	-
Total Dissolved Solids	mg/L	-	-	1	128	168	143	1520	1510	1640	228
Alkalinity, Bicarbonate (as CaCO3)	mg/L	-	-	1	93.8	115	101	208	199	216	-
Alkalinity, Carbonate (as CaCO3)	mg/L	-	-	1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	-
Alkalinity, Hydroxide (as CaCO3)	mg/L	-	-	1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	-
Alkalinity, Total (as CaCO3)	mg/L	-	-	1	93.8	115	101	208	199	216	184
Ammonia, Total (as N)	mg/L	0.75	-	0.005	<0.0050	<0.0050	<0.0050	0.0105	0.0129	0.0197	-
Chloride (Cl)	mg/L	120	-	0.5	<0.50	<0.50	<0.50	<2.5	<2.5	<2.5	<0.50
Fluoride (F)	mg/L	0.12	-	0.02	0.046	0.05	0.054	0.33	0.32	0.3	0.096
Nitrate (as N)	mg/L	13	-	0.005	0.119	0.149	0.169	0.143	0.137	0.052	0.127
Nitrite (as N)	mg/L	0.06	-	0.001	<0.0010	<0.0010	<0.0010	<0.0050	<0.0050	<0.0050	<0.0010
Sulfate (SO4)	mg/L	-	-	0.5	23.6	41.8	33.2	948	963	1050	40.3
Cyanide, Weak Acid Diss	mg/L	-	0.1	0.005	<0.0050	<0.0050	<0.0050	-	-	-	-
Cyanide, Total	mg/L	-	0.3	0.005	<0.0050	<0.0050	<0.0050	-	-	-	-
Cyanate	mg/L	-	-	0.2	<0.20	<0.20	<0.20	-	-	-	-
Thiocyanate (SCN)	mg/L	-	-	0.5	<0.50	<0.50	<0.50	-	-	-	-
Aluminum (Al)-Total	mg/L	0.1	-	0.003	0.0096	0.0088	0.008	<0.0060	<0.0060	<0.0060	<0.010
Antimony (Sb)-Total	mg/L	-	0.15	0.0001	0.00012	0.00061	0.0005	0.00411	0.00388	0.00156	<0.00050
Arsenic (As)-Total	mg/L	0.005	-	0.0001	0.00033	0.00096	0.00104	0.0112	0.0112	0.0109	0.00039
Barium (Ba)-Total	mg/L	-	1.0	0.00005	0.0974	0.086	0.0811	0.0137	0.0131	0.00868	0.093
Beryllium (Be)-Total	mg/L	-	-	0.0001	<0.00010	<0.00010	<0.00010	<0.00020	<0.00020	<0.00020	-
Bismuth (Bi)-Total	mg/L	-	-	0.0005	<0.00050	<0.00050	<0.00050	<0.0010	<0.0010	<0.0010	-
Boron (B)-Total	mg/L	-	-	0.01	<0.010	<0.010	<0.010	<0.020	<0.020	<0.020	<0.10
Cadmium (Cd)-Total	mg/L	0.00009	0.02	0.00001	0.000058	0.000035	0.000016	0.00373	0.0037	0.00437	<0.00020
Calcium (Ca)-Total	mg/L	-	-	0.05	33.3	32.6	316	326	316	340	48.2
Chromium (Cr)-Total	mg/L	0.0089	0.04	0.0001	0.00018	0.00016	0.00021	<0.00020	<0.00020	<0.00020	<0.0020
Cobalt (Co)-Total	mg/L	-	-	0.0001	<0.00010	<0.00010	<0.00010	<0.00020	<0.00020	0.00025	-
Copper (Cu)-Total	mg/L	0.002	0.2	0.0005	0.00133	0.00121	0.00105	0.004	0.0041	0.0022	<0.0010
Iron (Fe)-Total	mg/L	0.3	1.0	0.01	0.014	<0.010	0.025	0.025	0.025	0.039	<0.030
Lead (Pb)-Total	mg/L	0.001	0.1	0.00005	<0.000050	<0.000050	<0.000050	0.00025	0.00024	0.00016	0.00068
Lithium (Li)-Total	mg/L	-	-	0.0005	0.00051	0.00107	0.00105	0.0084	0.0079	0.0072	-
Magnesium (Mg)-Total	mg/L	-	-	0.1	10.9	12.6	11.5	89	85.6	92.2	21.9
Manganese (Mn)-Total	mg/L	-	0.5	0.00005	0.171	0.0317	0.00265	0.0942	0.1	0.42	<0.0020
Mercury (Hg)-Total	mg/L	0.000026	0.005	0.00001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.00020
Molybdenum (Mo)-Total	mg/L	0.0073	-	0.00005	0.000332	0.000286	0.000472	0.00017	0.00019	<0.00010	-
Nickel (Ni)-Total	mg/L	0.025	0.3	0.0005	0.00066	<0.00050	<0.00050	<0.0010	<0.0010	<0.0010	-
Phosphorus (P)-Total	mg/L	-	-	0.05	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	-
Potassium (K)-Total	mg/L	-	-	0.1	0.86	1.05	0.93	4.14	3.78	3.79	0.94
Selenium (Se)-Total	mg/L	0.001	-	0.0001	<0.00010	<0.00010	<0.00010	<0.00020	<0.00020	<0.00020	<0.0010
Silicon (Si)-Total	mg/L	-	-	0.05	6.93	7.19	6.26	4.04	3.94	3.52	-
Silver (Ag)-Total	mg/L	0.0001	0.1	0.00001	<0.000010	<0.000010	<0.000010	<0.000020	<0.000020	<0.000020	-
Sodium (Na)-Total	mg/L	-	-	0.05	3.05	4.23	3.56	13.7	13.5	14.1	5.1
Strontium (Sr)-Total	mg/L	-	-	0.0002	0.357	0.344	0.305	1.25	1.21	1.22	-
Sulfur (S)-Total	mg/L	-	-	0.5	7.99	13.7	11	319	325	353	-
Thallium (Tl)-Total	mg/L	0.0008	-	0.00001	<0.000010	<0.000010	<0.000010	0.000071	0.00007	0.000054	-
Tin (Sn)-Total	mg/L	-	-	0.0001	<0.00010	<0.00010	<0.00010	<0.00020	<0.00020	<0.00020	-
Titanium (Ti)-Total	mg/L	-	-	0.01	<0.010	<0.010	<0.010	<0.020	<0.020	<0.020	-
Uranium (U)-Total	mg/L	0.015	-	0.00001	0.000631	0.000583	0.000651	0.00465	0.00441	0.0044	0.00199
Vanadium (V)-Total	mg/L	-	-	0.001	<0.0010	<0.0010	<0.0010	<0.0020	<0.0020	<0.0020	-
Zinc (Zn)-Total	mg/L	0.03	0.3	0.003	<0.0030	<0.0030	<0.0030	0.536	0.529	0.452	<0.050



Table E-2. Summary of Water Quality Results for the February 16-17, 2015 Trip.

Analyte	Units	CCME-WATER-F-AL	Mount Nansen Effluent Discharge Standards	Sample ID WQ Site ID Date Sampled Detection Limit	0455-150217-003 WQ-VC-DBC 17-Feb-15	0455-150217-011 WQ-VC-UMN 17-Feb-15	0455-150217-006 WQ-VC-R+150 16-Feb-15	0455-150217-014 WQ-PIT-1 (Top) 17-Feb-15 Depth: 0.30 m	0455-150217-012 WQ-PIT-2 (Middle) 17-Feb-15 Depth: 2.5 m	0455-150217-013 WQ-PIT-3 (Bottom) 17-Feb-15 Depth 5.0 m	0455-150217-015 WQ-PW 17-Feb-15
Dissolved Metals Filtration Location		-	-	n/a	FIELD	FIELD	FIELD	FIELD	FIELD	FIELD	-
Aluminum (Al)-Dissolved	mg/L	0.1	-	0.001	0.0068	0.0054	0.004	<0.0020	<0.0020	<0.0020	-
Antimony (Sb)-Dissolved	mg/L	-	-	0.0001	<0.00010	0.00061	0.0005	0.00401	0.00382	0.00143	-
Arsenic (As)-Dissolved	mg/L	0.005	0.15	0.0001	0.00029	0.0009	0.00099	0.00966	0.00965	0.00888	-
Barium (Ba)-Dissolved	mg/L	-	-	0.00005	0.0906	0.0854	0.0807	0.0132	0.0129	0.00846	-
Beryllium (Be)-Dissolved	mg/L	-	-	0.0001	<0.00010	<0.00010	<0.00010	<0.00020	<0.00020	<0.00020	-
Bismuth (Bi)-Dissolved	mg/L	-	-	0.0005	<0.00050	<0.00050	<0.00050	<0.0010	<0.0010	<0.0010	-
Boron (B)-Dissolved	mg/L	-	-	0.01	<0.010	<0.010	<0.010	<0.020	<0.020	<0.020	-
Cadmium (Cd)-Dissolved	mg/L	0.00009	-	0.00001	0.000055	0.000029	0.000013	0.00354	0.00355	0.00421	-
Calcium (Ca)-Dissolved	mg/L	-	-	0.05	32.9	38.2	32.5	337	326	342	-
Chromium (Cr)-Dissolved	mg/L	0.0089	-	0.0001	<0.00010	<0.00010	<0.00010	<0.00020	<0.00020	<0.00020	-
Cobalt (Co)-Dissolved	mg/L	-	-	0.0001	<0.00010	<0.00010	<0.00010	<0.00020	<0.00020	<0.00020	-
Copper (Cu)-Dissolved	mg/L	0.002	-	0.0002	0.00117	0.00115	0.00093	0.00314	0.0031	0.00169	-
Iron (Fe)-Dissolved	mg/L	0.3	-	0.01	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	-
Lead (Pb)-Dissolved	mg/L	0.001	-	0.00005	<0.000050	<0.000050	<0.000050	<0.00010	<0.00010	<0.00010	-
Lithium (Li)-Dissolved	mg/L	-	-	0.0005	0.00056	0.00104	0.00124	0.0083	0.0079	0.0072	-
Magnesium (Mg)-Dissolved	mg/L	-	-	0.1	10.7	12.6	11.4	91	86.8	94.8	-
Manganese (Mn)-Dissolved	mg/L	-	-	0.00005	0.159	0.031	0.0023	0.0504	0.0575	0.347	-
Mercury (Hg)-Dissolved	mg/L	0.000026	-	0.00001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	-
Molybdenum (Mo)-Dissolved	mg/L	0.0073	-	0.00005	0.000313	0.000289	0.000414	0.00017	0.00016	<0.00010	-
Nickel (Ni)-Dissolved	mg/L	0.025	-	0.0005	0.00058	<0.00050	<0.00050	<0.0010	<0.0010	<0.0010	-
Phosphorus (P)-Dissolved	mg/L	-	-	0.05	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	-
Potassium (K)-Dissolved	mg/L	-	-	0.1	0.83	1.06	0.9	4.03	3.84	3.74	-
Selenium (Se)-Dissolved	mg/L	0.001	-	0.0001	<0.00010	<0.00010	<0.00010	<0.00020	<0.00020	<0.00020	-
Silicon (Si)-Dissolved	mg/L	-	-	0.05	6.87	7.29	6.31	4.05	4.05	3.55	-
Silver (Ag)-Dissolved	mg/L	0.0001	-	0.00001	<0.000010	<0.000010	<0.000010	<0.000020	<0.000020	<0.000020	-
Sodium (Na)-Dissolved	mg/L	-	-	0.05	2.91	4.12	3.52	13.6	13.5	14.2	-
Strontium (Sr)-Dissolved	mg/L	-	-	0.0002	0.35	0.362	0.309	1.19	1.21	1.17	-
Sulfur (S)-Dissolved	mg/L	-	-	0.5	7.85	13.7	11.1	322	314	345	-
Thallium (Tl)-Dissolved	mg/L	0.0008	-	0.00001	<0.000010	<0.000010	<0.000010	0.000068	0.000073	0.000062	-
Tin (Sn)-Dissolved	mg/L	-	-	0.0001	<0.00010	<0.00010	<0.00010	<0.00020	<0.00020	<0.00020	-
Titanium (Ti)-Dissolved	mg/L	-	-	0.01	<0.010	<0.010	<0.010	<0.020	<0.020	<0.020	-
Uranium (U)-Dissolved	mg/L	0.015	-	0.00001	0.000611	0.000597	0.00068	0.00448	0.00437	0.00429	-
Vanadium (V)-Dissolved	mg/L	-	-	0.001	<0.0010	<0.0010	<0.0010	<0.0020	<0.0020	<0.0020	-
Zinc (Zn)-Dissolved	mg/L	0.03	-	0.001	0.0014	0.0019	<0.0010	0.524	0.519	0.441	-

Applied Guidelines: 'Federal CCME Canadian Environmental Quality Guidelines (January 2015), CCME: Freshwater Aquatic Life'
'Mount Nansen Effluent Discharge Standards

COLOUR KEY:
Exceeds CCME Guideline
Exceeds MN Effluent Discharge Standards
Exceeds both CCME and MN Standards
Data flag for Detection Limit Adjustment --> Please refer to the lab COA report and lab excel report for more info
Exceeds 10% difference threshold for QA/QC replicate samples. Note <DL = below detection limit

For those guidelines that are hardness dependent (Cd, Cu, Pb, Ni), the most conservative guideline has been applied. Same for guidelines that are pH and temperature dependent (Ammonia and Aluminum), unless otherwise noted.



Table E-2. Summary of Water Quality Results for the February 16-17, 2015 Trip.

Analyte	Units	CCME-WATER-F-AL	Mount Nansen Effluent Discharge Standards	Sample ID WQ Site ID Date Sampled Detection Limit	0455-1502 FIELD BLANK FIELD BLANK ** 16-Feb-15	0455-1502 TRAVEL BLANK TRAVEL BLANK ***
Temperature (in-situ)	°C	-	-	-	-	-
Specific Conductivity (in-situ)	µS/cm	-	-	-	-	-
pH (in-situ)	pH	6.5 - 9.0	6.0 - 8.5	-	-	-
Turbidity (In-situ)	NTU	-	-	-	-	-
Dissolved Oxygen (in-situ - Pit only)	mg/L	-	-	-	-	-
Colour, True	CU	15	-	5	-	-
Conductivity	µS/cm	-	-	2	<2.0	<2.0
Hardness (as CaCO3)	mg/L	-	-	0.5	<0.50	-
pH (lab)	pH	6.5 - 9.0	6.0 - 8.5	0.1	5.47	5.50
Total Suspended Solids	mg/L	-	50	3	<3.0	<3.0
Total Dissolved Solids	mg/L	-	-	1	<1.0	<1.0
Alkalinity, Bicarbonate (as CaCO3)	mg/L	-	-	1	<1.0	<1.0
Alkalinity, Carbonate (as CaCO3)	mg/L	-	-	1	<1.0	<1.0
Alkalinity, Hydroxide (as CaCO3)	mg/L	-	-	1	<1.0	<1.0
Alkalinity, Total (as CaCO3)	mg/L	-	-	1	<1.0	<1.0
Ammonia, Total (as N)	mg/L	0.75	-	0.005	<0.0050	0.0054
Chloride (Cl)	mg/L	120	-	0.5	<0.50	<0.50
Fluoride (F)	mg/L	0.12	-	0.02	<0.020	<0.020
Nitrate (as N)	mg/L	13	-	0.005	<0.0050	<0.0050
Nitrite (as N)	mg/L	0.06	-	0.001	<0.0010	<0.0010
Sulfate (SO4)	mg/L	-	-	0.5	<0.30	<0.30
Cyanide, Weak Acid Diss	mg/L	-	0.1	0.005	<0.0050	<0.0050
Cyanide, Total	mg/L	-	0.3	0.005	<0.0050	<0.0050
Cyanate	mg/L	-	-	0.2	<0.20	<0.20
Thiocyanate (SCN)	mg/L	-	-	0.5	<0.50	<0.50
Aluminum (Al)-Total	mg/L	0.1	-	0.003	<0.0030	<0.0030
Antimony (Sb)-Total	mg/L	-	0.15	0.0001	<0.00010	<0.00010
Arsenic (As)-Total	mg/L	0.005	-	0.0001	<0.00010	<0.00010
Barium (Ba)-Total	mg/L	-	1.0	0.00005	<0.000050	<0.000050
Beryllium (Be)-Total	mg/L	-	-	0.0001	<0.00010	<0.00010
Bismuth (Bi)-Total	mg/L	-	-	0.0005	<0.00050	<0.00050
Boron (B)-Total	mg/L	-	-	0.01	<0.010	<0.010
Cadmium (Cd)-Total	mg/L	0.00009	0.02	0.00001	<0.000010	<0.000010
Calcium (Ca)-Total	mg/L	-	-	0.05	<0.050	<0.050
Chromium (Cr)-Total	mg/L	0.0089	0.04	0.0001	<0.00010	<0.00010
Cobalt (Co)-Total	mg/L	-	-	0.0001	<0.00010	<0.00010
Copper (Cu)-Total	mg/L	0.002	0.2	0.0005	<0.00050	<0.00050
Iron (Fe)-Total	mg/L	0.3	1.0	0.01	<0.010	<0.010
Lead (Pb)-Total	mg/L	0.001	0.1	0.00005	<0.000050	<0.000050
Lithium (Li)-Total	mg/L	-	-	0.0005	<0.00050	<0.00050
Magnesium (Mg)-Total	mg/L	-	-	0.1	<0.10	<0.10
Manganese (Mn)-Total	mg/L	-	0.5	0.00005	<0.000050	<0.000050
Mercury (Hg)-Total	mg/L	0.000026	0.005	0.00001	<0.000010	<0.000010
Molybdenum (Mo)-Total	mg/L	0.0073	-	0.00005	<0.000050	<0.000050
Nickel (Ni)-Total	mg/L	0.025	0.3	0.0005	<0.00050	<0.00050
Phosphorus (P)-Total	mg/L	-	-	0.05	<0.050	<0.050
Potassium (K)-Total	mg/L	-	-	0.1	<0.10	<0.10
Selenium (Se)-Total	mg/L	0.001	-	0.0001	<0.00010	<0.00010
Silicon (Si)-Total	mg/L	-	-	0.05	<0.050	<0.050
Silver (Ag)-Total	mg/L	0.0001	0.1	0.00001	<0.000010	<0.000010
Sodium (Na)-Total	mg/L	-	-	0.05	<0.050	<0.050
Strontium (Sr)-Total	mg/L	-	-	0.0002	<0.00020	<0.00020
Sulfur (S)-Total	mg/L	-	-	0.5	<0.50	<0.50
Thallium (Tl)-Total	mg/L	0.0008	-	0.00001	<0.000010	<0.000010
Tin (Sn)-Total	mg/L	-	-	0.0001	<0.00010	<0.00010
Titanium (Ti)-Total	mg/L	-	-	0.01	<0.010	<0.010
Uranium (U)-Total	mg/L	0.015	-	0.00001	<0.000010	<0.000010
Vanadium (V)-Total	mg/L	-	-	0.001	<0.0010	<0.0010
Zinc (Zn)-Total	mg/L	0.03	0.3	0.003	<0.0030	<0.0030



Table E-2. Summary of Water Quality Results for the February 16-17, 2015 Trip.

Analyte	Units	CCME-WATER-F-AL	Mount Nansen Effluent Discharge Standards	Sample ID WQ Site ID Date Sampled Detection Limit	0455-1502 FIELD BLANK FIELD BLANK ** 16-Feb-15	0455-1502 TRAVEL BLANK TRAVEL BLANK ***
Dissolved Metals Filtration Location		-	-	n/a	FIELD	-
Aluminum (Al)-Dissolved	mg/L	0.1	-	0.001	<0.0010	-
Antimony (Sb)-Dissolved	mg/L	-	-	0.0001	<0.00010	-
Arsenic (As)-Dissolved	mg/L	0.005	0.15	0.0001	<0.00010	-
Barium (Ba)-Dissolved	mg/L	-	-	0.00005	<0.000050	-
Beryllium (Be)-Dissolved	mg/L	-	-	0.0001	<0.00010	-
Bismuth (Bi)-Dissolved	mg/L	-	-	0.0005	<0.00050	-
Boron (B)-Dissolved	mg/L	-	-	0.01	<0.010	-
Cadmium (Cd)-Dissolved	mg/L	0.00009	-	0.00001	<0.000010	-
Calcium (Ca)-Dissolved	mg/L	-	-	0.05	<0.050	-
Chromium (Cr)-Dissolved	mg/L	0.0089	-	0.0001	<0.00010	-
Cobalt (Co)-Dissolved	mg/L	-	-	0.0001	<0.00010	-
Copper (Cu)-Dissolved	mg/L	0.002	-	0.0002	<0.00020	-
Iron (Fe)-Dissolved	mg/L	0.3	-	0.01	<0.010	-
Lead (Pb)-Dissolved	mg/L	0.001	-	0.00005	<0.000050	-
Lithium (Li)-Dissolved	mg/L	-	-	0.0005	<0.00050	-
Magnesium (Mg)-Dissolved	mg/L	-	-	0.1	<0.10	-
Manganese (Mn)-Dissolved	mg/L	-	-	0.00005	<0.000050	-
Mercury (Hg)-Dissolved	mg/L	0.000026	-	0.00001	<0.000010	-
Molybdenum (Mo)-Dissolved	mg/L	0.0073	-	0.00005	<0.000050	-
Nickel (Ni)-Dissolved	mg/L	0.025	-	0.0005	<0.00050	-
Phosphorus (P)-Dissolved	mg/L	-	-	0.05	<0.050	-
Potassium (K)-Dissolved	mg/L	-	-	0.1	<0.10	-
Selenium (Se)-Dissolved	mg/L	0.001	-	0.0001	<0.00010	-
Silicon (Si)-Dissolved	mg/L	-	-	0.05	<0.050	-
Silver (Ag)-Dissolved	mg/L	0.0001	-	0.00001	<0.000010	-
Sodium (Na)-Dissolved	mg/L	-	-	0.05	<0.050	-
Strontium (Sr)-Dissolved	mg/L	-	-	0.0002	<0.00020	-
Sulfur (S)-Dissolved	mg/L	-	-	0.5	<0.50	-
Thallium (Tl)-Dissolved	mg/L	0.0008	-	0.00001	<0.000010	-
Tin (Sn)-Dissolved	mg/L	-	-	0.0001	<0.00010	-
Titanium (Ti)-Dissolved	mg/L	-	-	0.01	<0.010	-
Uranium (U)-Dissolved	mg/L	0.015	-	0.00001	<0.000010	-
Vanadium (V)-Dissolved	mg/L	-	-	0.001	<0.0010	-
Zinc (Zn)-Dissolved	mg/L	0.03	-	0.001	0.0037	-

Applied Guidelines: 'Federal CCME Canadian Environmental Quality Guidelines (January 2015), CCME: Freshwater Aquatic Life'
'Mount Nansen Effluent Discharge Standards

COLOUR KEY:
Exceeds CCME Guideline
Exceeds MN Effluent Discharge Standards
Exceeds both CCME and MN Standards
Data flag for Detection Limit Adjustment --> Please refer to the lab COA report and lab excel report for more info
Exceeds 10% difference threshold for QA/QC replicate samples. Note <DL = below detection limit

For those guidelines that are hardness dependent (Cd, Cu, Pb, Ni), the most conservative guideline has been applied. Same for guidelines that are pH and temperature dependent (Ammonia and Aluminum), unless otherwise noted.



Table E-3. Summary of Water Quality Results for the March 16-17, 2015 Trip.

Analyte	Units	CCME-WATER-F-AL	Mount Nansen Effluent Discharge Standards	Sample ID WQ Site ID Date Sampled Detection Limit	0455-150316-010 WQ-VC-U 16-Mar-15	0455-150316-012 WQ-VC-DBC 16-Mar-15	0455-150316-014 WQ-VC-UMN 16-Mar-15	0455-150316-013 WQ-VC-UMN-r 16-Mar-15	QA/QC WQ-VC-UMN-r REPLICATE ANALYSIS	0455-150316-015 WQ-VC-R+150 16-Mar-15
Temperature (in-situ)	°C	-	-	-	0.2	0.1	0.2	-	-	0.1
Specific Conductivity (in-situ)	µS/cm	-	-	-	245	251.6	300.3	-	-	264.8
pH (in-situ)	pH	6.5 - 9.0	6.0 - 8.5	-	6.66	6.70	6.72	-	-	7.23
Turbidity (In-situ)	NTU	-	-	-	0.00	0.00	0.35	-	-	3.9
Dissolved Oxygen (in-situ - Pit only)	mg/L	-	-	-	-	-	-	-	-	-
Colour, True	CU	15	-	5	-	-	-	-	-	-
Conductivity	µS/cm	-	-	2	219	248	293	296	1%	256
Hardness (as CaCO3)	mg/L	-	-	0.5	126	130	151	153	1%	132
pH (lab)	pH	6.5 - 9.0	6.0 - 8.5	0.1	7.70	7.79	7.81	7.81	0%	7.90
Total Suspended Solids	mg/L	-	50	3	<3.0	<3.0	<3.0	<3.0	<DL	<3.0
Total Dissolved Solids	mg/L	-	-	1	134	139	169	168	1%	145
Alkalinity, Bicarbonate (as CaCO3)	mg/L	-	-	1	102	106	112	110	2%	101
Alkalinity, Carbonate (as CaCO3)	mg/L	-	-	1	<1.0	<1.0	<1.0	<1.0	<DL	<1.0
Alkalinity, Hydroxide (as CaCO3)	mg/L	-	-	1	<1.0	<1.0	<1.0	<1.0	<DL	<1.0
Alkalinity, Total (as CaCO3)	mg/L	-	-	1	102	106	112	110	2%	101
Ammonia, Total (as N)	mg/L	0.75	-	0.005	<0.0050	<0.0050	<0.0050	<0.0050	<DL	<0.0050
Chloride (Cl)	mg/L	120	-	0.5	<0.50	<0.50	<0.50	<0.50	<DL	<0.50
Fluoride (F)	mg/L	0.12	-	0.02	0.043	0.044	0.045	0.047	4%	0.05
Nitrate (as N)	mg/L	13	-	0.005	0.116	0.115	0.127	0.124	2%	0.192
Nitrite (as N)	mg/L	0.06	-	0.001	<0.0010	<0.0010	<0.0010	<0.0010	<DL	<0.0010
Sulfate (SO4)	mg/L	-	-	0.5	24.6	25.6	43.8	43.9	0%	33.6
Cyanide, Weak Acid Diss	mg/L	-	0.1	0.005	<0.0050	<0.0050	<0.0050	<0.0050	<DL	<0.0050
Cyanide, Total	mg/L	-	0.3	0.005	<0.0050	<0.0050	<0.0050	<0.0050	<DL	<0.0050
Cyanate	mg/L	-	-	0.2	<0.20	<0.20	<0.20	<0.20	<DL	0.21
Thiocyanate (SCN)	mg/L	-	-	0.5	<0.50	<0.50	<0.50	<0.50	<DL	<0.50
Aluminum (Al)-Total	mg/L	0.1	-	0.003	0.0085	0.0078	0.0166	0.0137	17%	0.0073
Antimony (Sb)-Total	mg/L	-	0.15	0.0001	<0.00010	0.00011	0.00055	0.0006	9%	0.00046
Arsenic (As)-Total	mg/L	0.005	-	0.0001	0.00028	0.00032	0.0008	0.00069	14%	0.00097
Barium (Ba)-Total	mg/L	-	1.0	0.00005	0.101	0.103	0.0885	0.0882	0%	0.0836
Beryllium (Be)-Total	mg/L	-	-	0.0001	<0.00010	<0.00010	<0.00010	<0.00010	<DL	<0.00010
Bismuth (Bi)-Total	mg/L	-	-	0.0005	<0.00050	<0.00050	<0.00050	<0.00050	<DL	<0.00050
Boron (B)-Total	mg/L	-	-	0.01	<0.010	<0.010	<0.010	<0.010	<DL	<0.010
Cadmium (Cd)-Total	mg/L	0.00009	0.02	0.00001	0.000053	0.000091	0.000025	0.000015	40%	0.000014
Calcium (Ca)-Total	mg/L	-	-	0.05	33.6	34.2	40.2	39.5	2%	33.7
Chromium (Cr)-Total	mg/L	0.0089	0.04	0.0001	0.00012	0.00012	0.00013	0.00011	15%	0.0001
Cobalt (Co)-Total	mg/L	-	-	0.0001	<0.00010	<0.00010	<0.00010	<0.00010	<DL	<0.00010
Copper (Cu)-Total	mg/L	0.002	0.2	0.0005	0.0014	0.00141	0.00212	0.00115	46%	0.00227
Iron (Fe)-Total	mg/L	0.3	1.0	0.01	0.013	0.011	0.027	0.021	22%	<0.010
Lead (Pb)-Total	mg/L	0.001	0.1	0.00005	<0.000050	<0.000050	0.00023	0.000052	77%	<0.000050
Lithium (Li)-Total	mg/L	-	-	0.0005	<0.00050	<0.00050	0.00079	<0.00050	<DL	0.001
Magnesium (Mg)-Total	mg/L	-	-	0.1	10.4	10.6	13	12.8	2%	11.6
Manganese (Mn)-Total	mg/L	-	0.5	0.00005	0.218	0.239	0.021	0.0199	5%	0.00272
Mercury (Hg)-Total	mg/L	0.000026	0.005	0.00001	<0.000010	<0.000010	<0.000010	<0.000010	<DL	<0.000010
Molybdenum (Mo)-Total	mg/L	0.0073	-	0.00005	0.000276	0.000332	0.000256	0.00027	5%	0.000415
Nickel (Ni)-Total	mg/L	0.025	0.3	0.0005	0.0008	0.00084	<0.00050	<0.00050	<DL	<0.00050
Phosphorus (P)-Total	mg/L	-	-	0.05	<0.050	<0.050	<0.050	<0.050	<DL	<0.050
Potassium (K)-Total	mg/L	-	-	0.1	0.82	0.8	0.99	0.97	2%	0.93
Selenium (Se)-Total	mg/L	0.001	-	0.0001	<0.00010	<0.00010	0.00011	<0.00010	<DL	<0.00010
Silicon (Si)-Total	mg/L	-	-	0.05	6.7	6.5	6.86	6.77	1%	6.24
Silver (Ag)-Total	mg/L	0.0001	0.1	0.00001	<0.000010	<0.000010	<0.000010	<0.000010	<DL	<0.000010
Sodium (Na)-Total	mg/L	-	-	0.05	3.08	3.13	4.04	3.97	2%	3.56
Strontium (Sr)-Total	mg/L	-	-	0.0002	0.335	0.342	0.329	0.366	11%	0.31
Sulfur (S)-Total	mg/L	-	-	0.5	8.69	8.94	15.1	15	1%	11.6
Thallium (Tl)-Total	mg/L	0.0008	-	0.00001	<0.000010	<0.000010	<0.000010	<0.000010	<DL	<0.000010



Table E-3. Summary of Water Quality Results for the March 16-17, 2015 Trip.

Analyte	Units	CCME-WATER-F-AL	Mount Nansen Effluent Discharge Standards	Sample ID WQ Site ID Date Sampled Detection Limit	0455-150316-010 WQ-VC-U 16-Mar-15	0455-150316-012 WQ-VC-DBC 16-Mar-15	0455-150316-014 WQ-VC-UMN 16-Mar-15	0455-150316-013 WQ-VC-UMN-r 16-Mar-15	QA/QC WQ-VC-UMN-r REPLICATE ANALYSIS	0455-150316-015 WQ-VC-R+150 16-Mar-15
Tin (Sn)-Total	mg/L	-	-	0.0001	<0.00010	<0.00010	<0.00010	<0.00010	<DL	<0.00010
Titanium (Ti)-Total	mg/L	-	-	0.01	<0.010	<0.010	<0.010	<0.010	<DL	<0.010
Uranium (U)-Total	mg/L	0.015	-	0.00001	0.000596	0.000722	0.000586	0.000652	11%	0.000627
Vanadium (V)-Total	mg/L	-	-	0.001	<0.0010	<0.0010	<0.0010	<0.0010	<DL	<0.0010
Zinc (Zn)-Total	mg/L	0.03	0.3	0.003	<0.0030	<0.0030	<0.0030	<0.0030	<DL	<0.0030
Dissolved Metals Filtration Location		-	-	n/a	FIELD	FIELD	FIELD	FIELD	-	FIELD
Aluminum (Al)-Dissolved	mg/L	0.1	-	0.001	0.008	0.0071	0.0055	0.0051	7%	0.0038
Antimony (Sb)-Dissolved	mg/L	-	-	0.0001	<0.00010	<0.00010	0.00058	0.00057	2%	0.00047
Arsenic (As)-Dissolved	mg/L	0.005	0.15	0.0001	0.00025	0.00029	0.00076	0.00066	13%	0.00097
Barium (Ba)-Dissolved	mg/L	-	-	0.00005	0.102	0.105	0.0876	0.0865	1%	0.0826
Beryllium (Be)-Dissolved	mg/L	-	-	0.0001	<0.00010	<0.00010	<0.00010	<0.00010	<DL	<0.00010
Bismuth (Bi)-Dissolved	mg/L	-	-	0.0005	<0.00050	<0.00050	<0.00050	<0.00050	<DL	<0.00050
Boron (B)-Dissolved	mg/L	-	-	0.01	<0.010	<0.010	<0.010	<0.010	<DL	<0.010
Cadmium (Cd)-Dissolved	mg/L	0.00009	-	0.00001	0.00004	0.000071	0.000013	0.00001	23%	<0.000010
Calcium (Ca)-Dissolved	mg/L	-	-	0.05	33.4	34.3	39.4	40.1	2%	33.6
Chromium (Cr)-Dissolved	mg/L	0.0089	-	0.0001	<0.00010	<0.00010	<0.00010	0.00012	<DL	<0.00010
Cobalt (Co)-Dissolved	mg/L	-	-	0.0001	<0.00010	<0.00010	<0.00010	<0.00010	<DL	<0.00010
Copper (Cu)-Dissolved	mg/L	0.002	-	0.0002	0.00135	0.00134	0.0011	0.00108	2%	0.00097
Iron (Fe)-Dissolved	mg/L	0.3	-	0.01	<0.010	0.01	<0.010	<0.010	<DL	<0.010
Lead (Pb)-Dissolved	mg/L	0.001	-	0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<DL	<0.000050
Lithium (Li)-Dissolved	mg/L	-	-	0.0005	<0.00050	<0.00050	0.00099	0.0007	29%	0.00162
Magnesium (Mg)-Dissolved	mg/L	-	-	0.1	10.3	10.7	12.7	13	2%	11.6
Manganese (Mn)-Dissolved	mg/L	-	-	0.00005	0.213	0.236	0.0186	0.0204	10%	0.00226
Mercury (Hg)-Dissolved	mg/L	0.000026	-	0.00001	<0.000010	<0.000010	<0.000010	<0.000010	<DL	<0.000010
Molybdenum (Mo)-Dissolved	mg/L	0.0073	-	0.00005	0.000249	0.000285	0.000251	0.000243	3%	0.000381
Nickel (Ni)-Dissolved	mg/L	0.025	-	0.0005	0.00081	0.0008	<0.00050	<0.00050	<DL	<0.00050
Phosphorus (P)-Dissolved	mg/L	-	-	0.05	<0.050	<0.050	<0.050	<0.050	<DL	<0.050
Potassium (K)-Dissolved	mg/L	-	-	0.1	0.8	0.78	0.95	0.98	3%	0.91
Selenium (Se)-Dissolved	mg/L	0.001	-	0.0001	<0.00010	<0.00010	<0.00010	<0.00010	<DL	<0.00010
Silicon (Si)-Dissolved	mg/L	-	-	0.05	6.68	6.57	6.77	6.83	1%	6.19
Silver (Ag)-Dissolved	mg/L	0.0001	-	0.00001	<0.000010	<0.000010	<0.000010	<0.000010	<DL	<0.000010
Sodium (Na)-Dissolved	mg/L	-	-	0.05	3.05	3.13	4.01	3.89	3%	3.61
Strontium (Sr)-Dissolved	mg/L	-	-	0.0002	0.32	0.33	0.35	0.347	1%	0.303
Sulfur (S)-Dissolved	mg/L	-	-	0.5	8.43	8.81	14.7	14.6	1%	11.3
Thallium (Tl)-Dissolved	mg/L	0.0008	-	0.00001	<0.000010	<0.000010	<0.000010	<0.000010	<DL	<0.000010
Tin (Sn)-Dissolved	mg/L	-	-	0.0001	<0.00010	<0.00010	<0.00010	<0.00010	<DL	<0.00010
Titanium (Ti)-Dissolved	mg/L	-	-	0.01	<0.010	<0.010	<0.010	<0.010	<DL	<0.010
Uranium (U)-Dissolved	mg/L	0.015	-	0.00001	0.000568	0.000677	0.000592	0.000602	2%	0.000591
Vanadium (V)-Dissolved	mg/L	-	-	0.001	<0.0010	<0.0010	<0.0010	<0.0010	<DL	<0.0010
Zinc (Zn)-Dissolved	mg/L	0.03	-	0.001	0.0022	0.001	<0.0010	<0.0010	<DL	0.0013

Applied Guidelines: 'Federal CCME Canadian Environmental Quality Guidelines (January 2015), CCME: Freshwater Aquatic Life
'Mount Nansen Effluent Discharge Standards

COLOUR KEY:
Exceeds CCME Guideline
Exceeds MN Effluent Discharge Standards
Exceeds both CCME and MN Standards
Data flag for Detection Limit Adjustment --> Please refer to the lab COA report and lab excel report for more info
Exceeds 10% difference threshold for QA/QC replicate samples. Note <DL = below detection limit

For those guidelines that are hardness dependent (Cd, Cu, Pb, Ni), the most conservative guideline has been applied. Same for guidelines that are pH and temperature dependent (Ammonia and Aluminum), unless otherwise noted.

Notes:

* WQ-PW is a drinking water sample and the analysis package has different detection limits than all other samples. The results are also compared to the *Guidelines for Canadian Drinking Water Quality* (Health Canada, October 2014) versus the CCME or MN Effluent Quality Standards.

QA/QC - the average percent difference of the replicate sample (WQ-VC-UMN-r a) was 9% (max differenes were 77%).



Table E-3. Summary of Water Quality Results for the March 16-17, 2015 Trip.

Analyte	Units	CCME-WATER-F-AL	Mount Nansen Effluent Discharge Standards	Sample ID WQ Site ID Date Sampled Detection Limit	0455-150317-002 WQ-TP 17-Mar-15	0455-150317-007 WQ-SEEP 17-Mar-15	0455-150317-019 WQ-PW * 17-Mar-15	0455-150317-018 WQ-PIT-1 (Top) 17-Mar-15 (Depth: 0.3 m)	0455-150317-017 WQ-PIT-2 (Middle) 17-Mar-15 (Depth: 2.5 m)	0455-150317-016 WQ-PIT-3 (Bottom) 17-Mar-15 (Depth: 4.0 m)
Temperature (in-situ)	°C	-	-	-	1.4	2.8	0.5	0.2	1.4	1.3
Specific Conductivity (in-situ)	µS/cm	-	-	-	2370	1735	391	1949	1925	1934
pH (in-situ)	pH	6.5 - 9.0	6.0 - 8.5	-	7.67	7.88	7.72	7.35	7.36	7.44
Turbidity (In-situ)	NTU	-	-	-	10.19	17.3	0.25	0.37	0.42	0.74
Dissolved Oxygen (in-situ - Pit only)	mg/L	-	-	-	-	-	-	4.91	4.60	0.80
Colour, True	CU	15	-	5	-	-	<5.0	-	-	-
Conductivity	µS/cm	-	-	2	2350	1700	376	1930	1920	2150
Hardness (as CaCO3)	mg/L	-	-	0.5	1480	1010	211	1270	1260	1480
pH (lab)	pH	6.5 - 9.0	6.0 - 8.5	0.1	7.97	7.60	7.68	8.02	8.00	7.90
Total Suspended Solids	mg/L	-	50	3	4.7	46.7	-	<3.0	<3.0	<3.0
Total Dissolved Solids	mg/L	-	-	1	2120	1390	224	1620	1610	1900
Alkalinity, Bicarbonate (as CaCO3)	mg/L	-	-	1	231	244	-	232	234	220
Alkalinity, Carbonate (as CaCO3)	mg/L	-	-	1	<1.0	<1.0	-	<1.0	<1.0	<1.0
Alkalinity, Hydroxide (as CaCO3)	mg/L	-	-	1	<1.0	<1.0	-	<1.0	<1.0	<1.0
Alkalinity, Total (as CaCO3)	mg/L	-	-	1	231	244	179	232	234	220
Ammonia, Total (as N)	mg/L	0.75	-	0.005	1.77	5.13	-	<0.0050	<0.0050	0.0197
Chloride (Cl)	mg/L	120	-	0.5	<5.0	2.6	<0.50	<2.5	<2.5	<5.0
Fluoride (F)	mg/L	0.12	-	0.02	0.3	<0.10	0.094	0.27	0.26	<0.20
Nitrate (as N)	mg/L	13	-	0.005	<0.050	0.359	0.128	0.134	0.127	0.069
Nitrite (as N)	mg/L	0.06	-	0.001	<0.010	0.0159	<0.0010	<0.0050	<0.0050	<0.010
Sulfate (SO4)	mg/L	-	-	0.5	1370	800	38.6	1010	1010	1230
Cyanide, Weak Acid Diss	mg/L	-	0.1	0.005	<0.0050	0.0162	-	-	-	-
Cyanide, Total	mg/L	-	0.3	0.005	<0.0050	0.108	-	-	-	-
Cyanate	mg/L	-	-	0.2	0.24	<0.20	-	-	-	-
Thiocyanate (SCN)	mg/L	-	-	0.5	<0.50	4.67	-	-	-	-
Aluminum (Al)-Total	mg/L	0.1	-	0.003	0.0194	0.0188	<0.010	<0.0060	<0.0060	<0.0060
Antimony (Sb)-Total	mg/L	-	0.15	0.0001	0.0199	0.00071	<0.00050	0.00351	0.00365	0.00155
Arsenic (As)-Total	mg/L	0.005	-	0.0001	0.256	0.0765	0.00037	0.0105	0.0112	0.0191
Barium (Ba)-Total	mg/L	-	1.0	0.00005	0.0408	0.0634	0.09	0.0146	0.0151	0.00809
Beryllium (Be)-Total	mg/L	-	-	0.0001	<0.00020	<0.00010	-	<0.00020	<0.00020	<0.00020
Bismuth (Bi)-Total	mg/L	-	-	0.0005	<0.0010	<0.00050	-	<0.0010	<0.0010	<0.0010
Boron (B)-Total	mg/L	-	-	0.01	0.14	0.063	<0.10	<0.020	<0.020	<0.020
Cadmium (Cd)-Total	mg/L	0.00009	0.02	0.00001	0.00381	0.000917	<0.00020	0.00369	0.0038	0.00838
Calcium (Ca)-Total	mg/L	-	-	0.05	447	287	49.9	351	361	415
Chromium (Cr)-Total	mg/L	0.0089	0.04	0.0001	<0.00020	0.0006	<0.0020	<0.00020	<0.00020	<0.00020
Cobalt (Co)-Total	mg/L	-	-	0.0001	0.00298	0.00946	-	<0.00020	<0.00020	0.00089
Copper (Cu)-Total	mg/L	0.002	0.2	0.0005	0.0311	0.00378	<0.0010	0.003	0.003	0.0027
Iron (Fe)-Total	mg/L	0.3	1.0	0.01	1.27	20.4	<0.030	0.025	0.024	0.153
Lead (Pb)-Total	mg/L	0.001	0.1	0.00005	0.00787	0.000172	0.00063	0.00031	0.00021	0.00025
Lithium (Li)-Total	mg/L	-	-	0.0005	0.0129	0.00079	-	0.0081	0.0088	0.0099
Magnesium (Mg)-Total	mg/L	-	-	0.1	90.4	64.3	20.9	93.8	95.8	105
Manganese (Mn)-Total	mg/L	-	0.5	0.00005	9.55	8.14	<0.0020	0.136	0.154	1.9
Mercury (Hg)-Total	mg/L	0.000026	0.005	0.00001	<0.000010	<0.000010	<0.00020	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)-Total	mg/L	0.0073	-	0.00005	0.00462	0.00117	-	0.00015	0.00019	0.00022
Nickel (Ni)-Total	mg/L	0.025	0.3	0.0005	0.0052	0.00382	-	<0.0010	<0.0010	0.001
Phosphorus (P)-Total	mg/L	-	-	0.05	<0.050	<0.050	-	<0.050	<0.050	<0.050
Potassium (K)-Total	mg/L	-	-	0.1	28.8	6.93	0.9	4.06	4.2	4.13
Selenium (Se)-Total	mg/L	0.001	-	0.0001	<0.00020	0.00024	<0.0010	<0.00020	<0.00020	<0.00020
Silicon (Si)-Total	mg/L	-	-	0.05	3.4	8.41	-	4.24	4.41	3.82
Silver (Ag)-Total	mg/L	0.0001	0.1	0.00001	0.000186	0.000044	-	<0.000020	0.00005	<0.000020
Sodium (Na)-Total	mg/L	-	-	0.05	34.4	37.7	5.2	13.8	14.6	14.5
Strontium (Sr)-Total	mg/L	-	-	0.0002	1.21	0.859	-	1.22	1.23	1.27
Sulfur (S)-Total	mg/L	-	-	0.5	442	268	-	339	343	404
Thallium (Tl)-Total	mg/L	0.0008	-	0.00001	0.00039	<0.000010	-	0.000067	0.000079	0.000087



Table E-3. Summary of Water Quality Results for the March 16-17, 2015 Trip.

Analyte	Units	CCME-WATER-F-AL	Mount Nansen Effluent Discharge Standards	Sample ID WQ Site ID Date Sampled Detection Limit	0455-150317-002 WQ-TP 17-Mar-15	0455-150317-007 WQ-SEEP 17-Mar-15	0455-150317-019 WQ-PW * 17-Mar-15	0455-150317-018 WQ-PIT-1 (Top) 17-Mar-15 (Depth: 0.3 m)	0455-150317-017 WQ-PIT-2 (Middle) 17-Mar-15 (Depth: 2.5 m)	0455-150317-016 WQ-PIT-3 (Bottom) 17-Mar-15 (Depth: 4.0 m)
Tin (Sn)-Total	mg/L	-	-	0.0001	<0.00020	<0.00010	-	<0.00020	<0.00020	<0.00020
Titanium (Ti)-Total	mg/L	-	-	0.01	<0.020	<0.010	-	<0.020	<0.020	<0.020
Uranium (U)-Total	mg/L	0.015	-	0.00001	0.00229	0.00173	0.00208	0.00458	0.00474	0.00457
Vanadium (V)-Total	mg/L	-	-	0.001	<0.0020	0.0024	-	<0.0020	<0.0020	<0.0020
Zinc (Zn)-Total	mg/L	0.03	0.3	0.003	0.345	0.0523	<0.050	0.595	0.61	0.80
Dissolved Metals Filtration Location		-	-	n/a	FIELD	FIELD	-	FIELD	FIELD	FIELD
Aluminum (Al)-Dissolved	mg/L	0.1	-	0.001	0.0022	0.011	-	<0.0020	<0.0020	0.0045
Antimony (Sb)-Dissolved	mg/L	-	-	0.0001	0.0173	0.00063	-	0.00357	0.00342	0.00143
Arsenic (As)-Dissolved	mg/L	0.005	0.15	0.0001	0.0433	0.0474	-	0.0093	0.00971	0.0153
Barium (Ba)-Dissolved	mg/L	-	-	0.00005	0.0396	0.0627	-	0.0148	0.0143	0.00825
Beryllium (Be)-Dissolved	mg/L	-	-	0.0001	<0.00020	<0.00010	-	<0.00020	<0.00020	<0.00020
Bismuth (Bi)-Dissolved	mg/L	-	-	0.0005	<0.0010	<0.00050	-	<0.0010	<0.0010	<0.0010
Boron (B)-Dissolved	mg/L	-	-	0.01	0.127	0.059	-	<0.020	<0.020	<0.020
Cadmium (Cd)-Dissolved	mg/L	0.00009	-	0.00001	0.00348	0.000672	-	0.00368	0.0038	0.00866
Calcium (Ca)-Dissolved	mg/L	-	-	0.05	446	299	-	359	354	414
Chromium (Cr)-Dissolved	mg/L	0.0089	-	0.0001	<0.00020	0.00047	-	<0.00020	<0.00020	<0.00020
Cobalt (Co)-Dissolved	mg/L	-	-	0.0001	0.00293	0.00914	-	<0.00020	<0.00020	0.00083
Copper (Cu)-Dissolved	mg/L	0.002	-	0.0002	0.0238	0.00125	-	0.0025	0.00241	0.00176
Iron (Fe)-Dissolved	mg/L	0.3	-	0.01	0.018	19.8	-	<0.010	<0.010	0.082
Lead (Pb)-Dissolved	mg/L	0.001	-	0.00005	<0.00010	<0.000050	-	<0.00010	<0.00010	<0.00010
Lithium (Li)-Dissolved	mg/L	-	-	0.0005	0.0108	0.00075	-	0.0083	0.0084	0.0083
Magnesium (Mg)-Dissolved	mg/L	-	-	0.1	88.5	65.2	-	90.9	92	107
Manganese (Mn)-Dissolved	mg/L	-	-	0.00005	9.31	7.84	-	0.102	0.167	1.88
Mercury (Hg)-Dissolved	mg/L	0.000026	-	0.00001	<0.000010	<0.000010	-	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)-Dissolved	mg/L	0.0073	-	0.00005	0.00452	0.00106	-	0.00018	0.00019	0.00017
Nickel (Ni)-Dissolved	mg/L	0.025	-	0.0005	0.0052	0.00364	-	<0.0010	<0.0010	0.0011
Phosphorus (P)-Dissolved	mg/L	-	-	0.05	<0.050	<0.050	-	<0.050	<0.050	<0.050
Potassium (K)-Dissolved	mg/L	-	-	0.1	28.7	7.28	-	4.09	3.97	4.02
Selenium (Se)-Dissolved	mg/L	0.001	-	0.0001	<0.00020	0.00024	-	<0.00020	<0.00020	<0.00020
Silicon (Si)-Dissolved	mg/L	-	-	0.05	3.28	8.47	-	4.29	4.18	3.75
Silver (Ag)-Dissolved	mg/L	0.0001	-	0.00001	<0.000020	<0.000010	-	<0.000020	<0.000020	<0.000020
Sodium (Na)-Dissolved	mg/L	-	-	0.05	33.1	36.9	-	14.1	13.9	14.7
Strontium (Sr)-Dissolved	mg/L	-	-	0.0002	1.17	0.85	-	1.23	1.22	1.28
Sulfur (S)-Dissolved	mg/L	-	-	0.5	418	268	-	325	328	400
Thallium (Tl)-Dissolved	mg/L	0.0008	-	0.00001	0.000358	<0.000010	-	0.000069	0.000071	0.000084
Tin (Sn)-Dissolved	mg/L	-	-	0.0001	<0.00020	<0.00010	-	<0.00020	<0.00020	<0.00020
Titanium (Ti)-Dissolved	mg/L	-	-	0.01	<0.020	<0.010	-	<0.020	<0.020	<0.020
Uranium (U)-Dissolved	mg/L	0.015	-	0.00001	0.00217	0.0017	-	0.00465	0.00453	0.00444
Vanadium (V)-Dissolved	mg/L	-	-	0.001	<0.0020	0.0017	-	<0.0020	<0.0020	<0.0020
Zinc (Zn)-Dissolved	mg/L	0.03	-	0.001	0.307	0.050	-	0.607	0.6	0.831

Applied Guidelines: 'Federal CCME Canadian Environmental Quality Guidelines (January 2015), CCME: Freshwater Aquatic Life
'Mount Nansen Effluent Discharge Standards

COLOUR KEY:
Exceeds CCME Guideline
Exceeds MN Effluent Discharge Standards
Exceeds both CCME and MN Standards
Data flag for Detection Limit Adjustment --> Please refer to the lab COA report and lab excel report for more info
Exceeds 10% difference threshold for QA/QC replicate samples. Note <DL = below detection limit

For those guidelines that are hardness dependent (Cd, Cu, Pb, Ni), the most conservative guideline has been applied. Same for guidelines that are pH and temperature dependent (Ammonia and Aluminum), unless otherwise noted.



Table E-3. Summary of Water Quality Results for the March 16-17, 2015 Trip.

Analyte	Units	CCME-WATER-F-AL	Mount Nansen Effluent Discharge Standards	Sample ID WQ Site ID Date Sampled Detection Limit	0455-150317-FIELD BLANK FIELD BLANK 17-Mar-15	0455-1503-TRAVEL BLANK TRAVEL BLANK n/a
Temperature (in-situ)	°C	-	-	-	-	-
Specific Conductivity (in-situ)	µS/cm	-	-	-	-	-
pH (in-situ)	pH	6.5 - 9.0	6.0 - 8.5	-	-	-
Turbidity (In-situ)	NTU	-	-	-	-	-
Dissolved Oxygen (in-situ - Pit only)	mg/L	-	-	-	-	-
Colour, True	CU	15	-	5	-	-
Conductivity	µS/cm	-	-	2	<2.0	2.6
Hardness (as CaCO3)	mg/L	-	-	0.5	<0.50	-
pH (lab)	pH	6.5 - 9.0	6.0 - 8.5	0.1	5.56	6.95
Total Suspended Solids	mg/L	-	50	3	<3.0	<3.0
Total Dissolved Solids	mg/L	-	-	1	<1.0	<1.0
Alkalinity, Bicarbonate (as CaCO3)	mg/L	-	-	1	<1.0	<1.0
Alkalinity, Carbonate (as CaCO3)	mg/L	-	-	1	<1.0	<1.0
Alkalinity, Hydroxide (as CaCO3)	mg/L	-	-	1	<1.0	<1.0
Alkalinity, Total (as CaCO3)	mg/L	-	-	1	<1.0	<1.0
Ammonia, Total (as N)	mg/L	0.75	-	0.005	<0.0050	<0.0050
Chloride (Cl)	mg/L	120	-	0.5	<0.50	<0.50
Fluoride (F)	mg/L	0.12	-	0.02	<0.020	<0.020
Nitrate (as N)	mg/L	13	-	0.005	<0.0050	<0.0050
Nitrite (as N)	mg/L	0.06	-	0.001	<0.0010	<0.0010
Sulfate (SO4)	mg/L	-	-	0.5	<0.30	<0.30
Cyanide, Weak Acid Diss	mg/L	-	0.1	0.005	<0.0050	<0.0050
Cyanide, Total	mg/L	-	0.3	0.005	<0.0050	<0.0050
Cyanate	mg/L	-	-	0.2	<0.20	<0.20
Thiocyanate (SCN)	mg/L	-	-	0.5	<0.50	<0.50
Aluminum (Al)-Total	mg/L	0.1	-	0.003	<0.0030	<0.0030
Antimony (Sb)-Total	mg/L	-	0.15	0.0001	<0.00010	<0.00010
Arsenic (As)-Total	mg/L	0.005	-	0.0001	<0.00010	<0.00010
Barium (Ba)-Total	mg/L	-	1.0	0.00005	<0.000050	<0.000050
Beryllium (Be)-Total	mg/L	-	-	0.0001	<0.00010	<0.00010
Bismuth (Bi)-Total	mg/L	-	-	0.0005	<0.00050	<0.00050
Boron (B)-Total	mg/L	-	-	0.01	<0.010	<0.010
Cadmium (Cd)-Total	mg/L	0.00009	0.02	0.00001	<0.000010	<0.000010
Calcium (Ca)-Total	mg/L	-	-	0.05	<0.050	<0.050
Chromium (Cr)-Total	mg/L	0.0089	0.04	0.0001	<0.00010	<0.00010
Cobalt (Co)-Total	mg/L	-	-	0.0001	<0.00010	<0.00010
Copper (Cu)-Total	mg/L	0.002	0.2	0.0005	<0.00050	<0.00050
Iron (Fe)-Total	mg/L	0.3	1.0	0.01	<0.010	<0.010
Lead (Pb)-Total	mg/L	0.001	0.1	0.00005	<0.000050	<0.000050
Lithium (Li)-Total	mg/L	-	-	0.0005	<0.00050	<0.00050
Magnesium (Mg)-Total	mg/L	-	-	0.1	<0.10	<0.10
Manganese (Mn)-Total	mg/L	-	0.5	0.00005	<0.000050	<0.000050
Mercury (Hg)-Total	mg/L	0.000026	0.005	0.00001	<0.000010	<0.000010
Molybdenum (Mo)-Total	mg/L	0.0073	-	0.00005	<0.000050	<0.000050
Nickel (Ni)-Total	mg/L	0.025	0.3	0.0005	<0.00050	<0.00050
Phosphorus (P)-Total	mg/L	-	-	0.05	<0.050	<0.050
Potassium (K)-Total	mg/L	-	-	0.1	<0.10	<0.10
Selenium (Se)-Total	mg/L	0.001	-	0.0001	<0.00010	<0.00010
Silicon (Si)-Total	mg/L	-	-	0.05	<0.050	<0.050
Silver (Ag)-Total	mg/L	0.0001	0.1	0.00001	<0.000010	<0.000010
Sodium (Na)-Total	mg/L	-	-	0.05	<0.050	<0.050
Strontium (Sr)-Total	mg/L	-	-	0.0002	<0.00020	<0.00020
Sulfur (S)-Total	mg/L	-	-	0.5	<0.50	<0.50
Thallium (Tl)-Total	mg/L	0.0008	-	0.00001	<0.000010	<0.000010



Table E-3. Summary of Water Quality Results for the March 16-17, 2015 Trip.

Analyte	Units	CCME-WATER-F-AL	Mount Nansen Effluent Discharge Standards	Sample ID WQ Site ID Date Sampled Detection Limit	0455-150317-FIELD BLANK FIELD BLANK 17-Mar-15	0455-1503-TRAVEL BLANK TRAVEL BLANK n/a
Tin (Sn)-Total	mg/L	-	-	0.0001	<0.00010	<0.00010
Titanium (Ti)-Total	mg/L	-	-	0.01	<0.010	<0.010
Uranium (U)-Total	mg/L	0.015	-	0.00001	<0.000010	<0.000010
Vanadium (V)-Total	mg/L	-	-	0.001	<0.0010	<0.0010
Zinc (Zn)-Total	mg/L	0.03	0.3	0.003	<0.0030	<0.0030
Dissolved Metals Filtration Location		-	-	n/a	FIELD	-
Aluminum (Al)-Dissolved	mg/L	0.1	-	0.001	<0.0010	-
Antimony (Sb)-Dissolved	mg/L	-	-	0.0001	<0.00010	-
Arsenic (As)-Dissolved	mg/L	0.005	0.15	0.0001	<0.00010	-
Barium (Ba)-Dissolved	mg/L	-	-	0.00005	<0.000050	-
Beryllium (Be)-Dissolved	mg/L	-	-	0.0001	<0.00010	-
Bismuth (Bi)-Dissolved	mg/L	-	-	0.0005	<0.00050	-
Boron (B)-Dissolved	mg/L	-	-	0.01	<0.010	-
Cadmium (Cd)-Dissolved	mg/L	0.00009	-	0.00001	<0.000010	-
Calcium (Ca)-Dissolved	mg/L	-	-	0.05	<0.050	-
Chromium (Cr)-Dissolved	mg/L	0.0089	-	0.0001	<0.00010	-
Cobalt (Co)-Dissolved	mg/L	-	-	0.0001	<0.00010	-
Copper (Cu)-Dissolved	mg/L	0.002	-	0.0002	<0.00020	-
Iron (Fe)-Dissolved	mg/L	0.3	-	0.01	<0.010	-
Lead (Pb)-Dissolved	mg/L	0.001	-	0.00005	<0.000050	-
Lithium (Li)-Dissolved	mg/L	-	-	0.0005	<0.00050	-
Magnesium (Mg)-Dissolved	mg/L	-	-	0.1	<0.10	-
Manganese (Mn)-Dissolved	mg/L	-	-	0.00005	<0.000050	-
Mercury (Hg)-Dissolved	mg/L	0.000026	-	0.00001	<0.000010	-
Molybdenum (Mo)-Dissolved	mg/L	0.0073	-	0.00005	<0.000050	-
Nickel (Ni)-Dissolved	mg/L	0.025	-	0.0005	<0.00050	-
Phosphorus (P)-Dissolved	mg/L	-	-	0.05	<0.050	-
Potassium (K)-Dissolved	mg/L	-	-	0.1	<0.10	-
Selenium (Se)-Dissolved	mg/L	0.001	-	0.0001	<0.00010	-
Silicon (Si)-Dissolved	mg/L	-	-	0.05	<0.050	-
Silver (Ag)-Dissolved	mg/L	0.0001	-	0.00001	<0.000010	-
Sodium (Na)-Dissolved	mg/L	-	-	0.05	<0.050	-
Strontium (Sr)-Dissolved	mg/L	-	-	0.0002	<0.00020	-
Sulfur (S)-Dissolved	mg/L	-	-	0.5	<0.50	-
Thallium (Tl)-Dissolved	mg/L	0.0008	-	0.00001	<0.000010	-
Tin (Sn)-Dissolved	mg/L	-	-	0.0001	<0.00010	-
Titanium (Ti)-Dissolved	mg/L	-	-	0.01	<0.010	-
Uranium (U)-Dissolved	mg/L	0.015	-	0.00001	<0.000010	-
Vanadium (V)-Dissolved	mg/L	-	-	0.001	<0.0010	-
Zinc (Zn)-Dissolved	mg/L	0.03	-	0.001	<0.0010	-

Applied Guidelines: 'Federal CCME Canadian Environmental Quality Guidelines (January 2015), CCME: Freshwater Aquatic Life
'Mount Nansen Effluent Discharge Standards

COLOUR KEY:
Exceeds CCME Guideline
Exceeds MN Effluent Discharge Standards
Exceeds both CCME and MN Standards
Data flag for Detection Limit Adjustment --> Please refer to the lab COA report and lab excel report for more info
Exceeds 10% difference threshold for QA/QC replicate samples. Note <DL = below detection limit

For those guidelines that are hardness dependent (Cd, Cu, Pb, Ni), the most conservative guideline has been applied. Same for guidelines that are pH and temperature dependent (Ammonia and Aluminum), unless otherwise noted.



APPENDIX F. METEOROLOGICAL DATA

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Table F-1. Mount Nansen Daily Average Meteorological Data (January 1 to March 31, 2015).

Date	Air Temperature (°C)			Ground Temperature (°C)			Rain (mm)	Snow Depth (cm)	Wind Direction (degrees)	Wind Speed (m/s)		Radiative Fluxes (W/m ²)			Relative Humidity (%)
	Min	Max	Mean	Max	Min	Mean				Max Gust	Mean	Mean SW	Mean LW	Mean Net	
01-Jan-15	-13.5	-3.1	-6.8	-5.4	-3.0	-3.6	0	41.2	92	9.2	4.8	-0.5	-26.8	-27.3	79.0
02-Jan-15	-20.7	-13.5	-17.7	-8.9	-5.4	-8.2	0	40.4	30	9.2	5.7	-3.6	-67.6	-71.2	48.6
03-Jan-15	-20.4	-16.5	-18.9	-8.9	-8.2	-8.5	0	40.2	88	2.9	1.2	-2.9	-46.6	-49.5	52.3
04-Jan-15	-18.7	-11.5	-16.1	-8.5	-7.9	-8.2	0	40.2	183	0.7	0.1	-2.5	-36.1	-38.6	36.6
05-Jan-15	-20.6	-13.8	-16.4	-9.9	-8.0	-8.5	0	40.2	116	4.7	1.5	-2.9	-46.8	-49.7	43.4
06-Jan-15	-20.9	-17.4	-19.8	-11.1	-9.9	-10.8	0	40.3	41	5.8	4.5	-1.8	-46.6	-48.4	69.1
07-Jan-15	-19.4	-17.3	-18.4	-10.3	-8.9	-9.6	0	40.3	47	5.4	3.2	-1.4	-35.7	-37.1	70.1
08-Jan-15	-17.3	-13.3	-15.6	-10.3	-8.1	-9.3	0	40.3	35	5.4	4.6	0.7	-7.1	-6.4	83.8
09-Jan-15	-13.3	-10.4	-11.7	-8.1	-5.4	-6.5	0	40.3	111	4.3	1.5	1.0	-2.0	-1.0	89.7
10-Jan-15	-13.6	-6.7	-10.3	-5.9	-4.6	-5.4	0	40.3	164	1.0	0.2	2.8	-0.9	2.0	92.4
11-Jan-15	-7.9	-5.5	-6.5	-4.6	-3.6	-4.0	0	41.5	199	2.0	0.4	-0.5	0.8	0.3	95.4
12-Jan-15	-7.0	-5.0	-6.1	-4.1	-3.9	-4.0	0	41.3	175	2.8	1.9	-1.1	3.4	2.2	94.5
13-Jan-15	-6.1	-0.2	-2.7	-4.1	-2.9	-3.4	0	47.5	183	5.4	3.1	-1.0	5.2	2.4	89.1
14-Jan-15	-2.8	-0.7	-1.7	-3.0	-2.7	-2.9	0	47.5	157	4.6	2.6	-0.3	-24.0	-24.3	78.9
15-Jan-15	-1.4	-0.2	-0.9	-2.7	-2.5	-2.6	0	47.1	161	5.6	3.0	-0.4	-28.9	-29.3	80.8
16-Jan-15	-4.0	-1.2	-2.8	-2.5	-2.3	-2.4	0	51.7	212	6.2	3.4	0.1	-19.6	-19.5	73.5
17-Jan-15	-4.1	-1.7	-3.0	-2.5	-2.5	-2.5	0	51.2	210	3.6	2.3	0.2	-34.7	-34.5	80.3
18-Jan-15	-8.4	-3.9	-5.9	-3.3	-2.5	-2.9	0	50.5	182	1.5	0.4	-0.8	-40.0	-40.8	75.2
19-Jan-15	-9.3	-6.8	-8.3	-3.5	-3.2	-3.4	0	50.0	67	2.1	1.4	1.7	-27.6	-25.9	86.4
20-Jan-15	-9.9	-4.9	-7.5	-3.2	-2.9	-3.1	0	50.5	113	4.8	2.7	0.0	-13.6	-13.7	93.9
21-Jan-15	-15.7	-6.7	-11.6	-3.3	-2.9	-3.1	0	50.3	165	3.5	0.7	-0.5	-9.9	-10.5	91.1
22-Jan-15	-13.8	-0.8	-8.1	-3.3	-3.0	-3.2	0	50.3	117	2.8	1.0	0.1	0.5	0.6	91.4
23-Jan-15	-2.9	-0.4	-1.5	-3.0	-2.5	-2.7	0	50.2	169	4.8	2.3	-0.4	6.5	6.0	79.3
24-Jan-15	-5.5	-1.5	-2.9	-2.6	-2.5	-2.5	0	49.4	153	4.7	3.0	0.5	-33.6	-33.2	79.2
25-Jan-15	-24.2	-4.8	-15.8	-3.9	-2.6	-3.0	0	49.5	171	2.7	1.0	2.0	-10.6	-8.7	86.5
26-Jan-15	-28.7	-24.2	-26.1	-6.1	-3.9	-5.3	0	48.7	167	0.7	0.2	10.3	-21.7	-11.5	77.7
27-Jan-15	-26.0	-19.8	-23.4	-6.8	-6.1	-6.4	0	48.6	161	1.3	0.3	7.6	-17.2	-9.6	78.3
28-Jan-15	-24.2	-15.8	-21.4	-7.1	-6.2	-6.8	0	50.7	120	3.3	1.0	11.1	-11.1	-0.1	82.3
29-Jan-15	-19.5	-16.8	-18.4	-6.2	-5.2	-5.6	0	51.7	152	2.4	0.3	0.5	-0.1	0.4	85.1
30-Jan-15	-22.7	-17.7	-20.0	-5.8	-5.2	-5.4	0	50.6	161	0.7	0.2	7.8	2.5	10.3	82.2
31-Jan-15	-22.8	-13.6	-18.3	-6.3	-5.8	-6.1	0	50.4	175	1.3	0.4	10.7	5.3	15.9	74.2
01-Feb-15	-17.8	-12.1	-15.3	-6.0	-5.7	-5.9	0	50.5	185	2.5	0.7	3.3	16.1	19.4	65.0
02-Feb-15	-17.9	-12.0	-15.3	-6.4	-5.9	-6.2	0	50.3	109	3.1	1.0	-3.5	3.6	-5.4	44.1
03-Feb-15	-20.9	-15.3	-17.4	-6.7	-6.0	-6.5	0	50.3	175	3.7	0.8	3.2	-40.4	-37.3	50.9
04-Feb-15	-20.3	-13.0	-17.0	-6.7	-6.3	-6.5	0	50.6	189	3.7	1.0	4.1	-39.7	-35.6	69.1
05-Feb-15	-26.2	-20.3	-23.1	-9.6	-6.7	-7.7	0	50.0	117	6.5	2.6	18.3	-50.1	-31.8	66.5



Mount Nansen Water Resources Investigations Quarterly Report (Q4): January- March 2015

Date	Air Temperature (°C)			Ground Temperature (°C)			Rain (mm)	Snow Depth (cm)	Wind Direction (degrees)	Wind Speed (m/s)		Radiative Fluxes (W / m ^ 2)			Relative Humidity (%)
	Min	Max	Mean	Max	Min	Mean				Max Gust	Mean	Mean SW	Mean LW	Mean Net	
06-Feb-15	-28.5	-26.2	-27.6	-12.2	-9.6	-11.4	0	50.3	39	7.2	5.1	4.8	-54.9	-50.1	56.8
07-Feb-15	-31.9	-28.3	-29.9	-11.6	##	-11.0	0	50.4	121	3.1	0.9	11.5	-0.5	11.1	65.9
08-Feb-15	-30.4	-27.9	-29.2	-12.4	##	-11.7	0	50.9	34	4.5	3.4	6.3	-9.2	-2.9	66.4
09-Feb-15	-29.3	-22.8	-26.4	-11.1	-9.4	-10.2	0	50.9	95	2.2	0.7	12.1	-29.5	-17.4	68.4
10-Feb-15	-25.1	-14.9	-19.0	-9.5	-8.3	-8.8	0	50.9	93	6.0	2.8	11.0	-21.9	-11.0	79.9
11-Feb-15	-16.7	-7.2	-12.9	-8.3	-6.3	-7.4	0	51.5	92	6.0	2.6	4.6	-8.8	-4.2	85.2
12-Feb-15	-8.1	-3.8	-5.7	-6.3	-5.2	-5.8	0	50.9	113	3.6	1.6	4.7	-18.6	-13.9	88.2
13-Feb-15	-8.1	-4.0	-6.1	-5.2	-4.4	-4.8	0	54.4	124	2.9	1.1	3.3	-2.7	0.6	94.9
14-Feb-15	-6.6	-0.4	-3.7	-4.4	-4.1	-4.3	0.2	52.5	219	5.0	2.0	17.0	-17.8	-0.8	82.7
15-Feb-15	-4.8	-0.5	-3.0	-4.1	-3.9	-4.0	0	52.5	210	3.9	2.3	7.1	-39.2	-32.1	65.4
16-Feb-15	-5.0	0.3	-2.5	-4.0	-3.5	-3.9	0	52.2	114	4.9	2.5	4.8	-20.0	-15.2	72.2
17-Feb-15	-1.1	2.9	0.1	-3.6	-3.2	-3.4	0.7	52.1	166	4.1	1.9	7.8	-36.3	-28.5	73.8
18-Feb-15	-3.9	-0.4	-2.0	-3.3	-3.1	-3.2	0.1	51.8	166	2.1	0.8	6.5	-19.8	-13.3	83.4
19-Feb-15	-7.5	-2.5	-4.6	-3.2	-3.0	-3.1	0	51.3	210	3.2	1.2	9.6	-24.4	-14.7	89.2
20-Feb-15	-7.5	-2.6	-5.7	-3.4	-3.2	-3.3	0.3	51.0	167	2.7	1.6	4.3	-23.8	-19.5	95.2
21-Feb-15	-6.0	2.3	-1.2	-3.5	-3.1	-3.3	0.9	51.0	103	4.0	1.2	5.2	-30.1	-24.9	68.3
22-Feb-15	0.6	3.5	1.6	-3.1	-2.5	-2.8	1.1	51.6	193	4.4	2.2	4.9	-26.7	-21.7	78.8
23-Feb-15	-2.9	4.8	1.7	-2.5	-2.2	-2.4	0.3	51.6	225	6.1	3.4	14.8	-53.0	-38.3	65.5
24-Feb-15	-4.8	-0.5	-3.2	-3.0	-2.4	-2.8	0	51.4	248	4.1	1.9	16.0	-55.0	-39.0	76.8
25-Feb-15	-7.5	-4.8	-6.2	-3.6	-3.0	-3.4	0	51.2	175	2.2	0.8	6.4	-23.8	-17.4	82.6
26-Feb-15	-11.2	-6.2	-8.5	-3.9	-3.4	-3.7	0	51.8	210	3.6	1.7	25.1	-46.2	-21.1	77.3
27-Feb-15	-9.7	-1.9	-5.7	-4.4	-3.9	-4.1	0	52.5	222	4.4	1.9	15.6	-44.5	-28.9	49.0
28-Feb-15	-4.0	1.4	-1.8	-3.9	-3.3	-3.6	0	52.3	222	3.5	1.7	17.2	-31.8	-14.6	41.5
01-Mar-15	-11.1	-1.4	-6.9	-4.6	-3.3	-3.8	0	51.5	272	4.9	3.2	16.8	-54.4	-37.5	50.9
02-Mar-15	-12.1	-4.7	-8.5	-5.2	-4.4	-4.8	0	50.7	149	3.1	0.9	18.7	-49.4	-30.7	43.4
03-Mar-15	-8.1	-1.6	-5.2	-4.8	-3.8	-4.4	0	51.1	175	3.3	0.9	14.7	-22.5	-7.7	45.4
04-Mar-15	-5.0	-0.7	-3.4	-4.0	-3.4	-3.7	0	51.0	202	3.4	1.5	16.1	-41.5	-25.4	74.8
05-Mar-15	-6.5	-2.3	-4.4	-3.6	-3.1	-3.3	0.5	51.8	204	2.0	0.8	0.9	7.8	8.7	88.9
06-Mar-15	-6.3	0.2	-4.0	-3.3	-3.0	-3.2	0	51.8	235	4.0	2.3	15.6	-16.4	-0.8	77.1
07-Mar-15	-4.7	0.3	-2.3	-3.3	-2.7	-3.1	0	51.9	224	3.4	2.7	12.8	-22.3	-9.4	64.1
08-Mar-15	-11.8	-2.7	-6.4	-3.5	-2.8	-3.1	0	51.9	229	3.1	1.8	18.7	-29.5	-10.8	71.7
09-Mar-15	-20.1	-11.8	-14.8	-4.4	-3.5	-4.1	0	53.9	185	4.3	2.4	9.7	-13.2	-3.5	78.5
10-Mar-15	-22.1	-17.9	-20.4	-5.4	-4.4	-5.0	0	53.9	286	3.7	2.5	21.2	-35.9	-14.6	69.0
11-Mar-15	-24.1	-18.1	-20.6	-6.4	-5.4	-5.9	0	53.6	59	5.4	3.3	35.0	-43.7	-8.6	72.9
12-Mar-15	-19.0	-12.8	-17.1	-6.4	-5.3	-6.0	0	54.7	71	4.9	3.4	15.6	-9.2	6.4	79.0
13-Mar-15	-18.4	-10.3	-13.9	-5.3	-4.7	-5.0	0	54.2	148	7.8	3.6	23.3	-22.6	0.7	76.4
14-Mar-15	-23.3	-17.6	-20.7	-5.1	-4.7	-4.8	0	53.2	149	2.3	0.9	27.9	7.8	35.7	71.8
15-Mar-15	-25.8	-12.6	-19.6	-5.5	-5.1	-5.4	0	53.2	187	2.8	0.7	33.2	11.0	44.1	65.7



Mount Nansen Water Resources Investigations Quarterly Report (Q4): January- March 2015

Date	Air Temperature (°C)			Ground Temperature (°C)			Rain (mm)	Snow Depth (cm)	Wind Direction (degrees)	Wind Speed (m/s)		Radiative Fluxes (W / m ^ 2)			Relative Humidity (%)
	Min	Max	Mean	Max	Min	Mean				Max Gust	Mean	Mean SW	Mean LW	Mean Net	
16-Mar-15	-12.6	-2.0	-7.3	-5.4	-4.8	-5.2	0	53.3	171	5.0	2.1	23.5	-16.3	7.3	66.1
17-Mar-15	-6.3	-0.8	-4.2	-4.8	-4.2	-4.5	0.7	53.2	152	4.2	1.9	25.8	-44.6	-18.8	61.7
18-Mar-15	-6.5	-1.0	-4.2	-4.2	-3.7	-4.0	0.3	53.6	54	4.3	3.1	24.8	-27.5	-2.7	81.9
19-Mar-15	-4.8	0.6	-2.2	-3.7	-3.2	-3.5	0	53.6	73	4.1	2.8	19.6	-31.9	-12.3	77.9
20-Mar-15	-5.0	-0.9	-2.8	-3.2	-3.0	-3.1	0	53.4	58	5.1	3.5	35.5	-40.9	-5.3	67.4
21-Mar-15	-7.8	1.0	-3.4	-3.1	-2.8	-3.0	0.1	53.1	127	4.1	2.3	37.1	-38.8	-1.7	72.7
22-Mar-15	-5.8	0.7	-3.1	-3.1	-2.9	-3.0	0	52.9	215	2.3	1.3	28.6	-36.9	-8.3	73.5
23-Mar-15	-7.0	-0.5	-4.2	-3.1	-2.9	-3.0	0	53.0	232	2.0	1.1	38.1	-56.0	-17.9	63.1
24-Mar-15	-8.3	-0.1	-4.4	-3.4	-3.1	-3.3	0	52.9	156	1.9	0.7	43.6	-54.7	-11.1	61.7
25-Mar-15	-6.5	0.1	-3.1	-3.5	-3.2	-3.4	0	53.0	105	4.9	2.5	45.8	-61.5	-15.6	52.9
26-Mar-15	-4.4	3.1	-1.3	-3.3	-2.9	-3.2	0	53.0	170	7.5	3.5	32.3	-47.9	-15.6	61.1
27-Mar-15	-4.3	0.8	-2.1	-3.0	-2.6	-2.8	0	53.0	240	3.8	2.3	27.5	-26.6	0.9	68.1
28-Mar-15	-6.7	0.4	-3.0	-2.8	-2.6	-2.7	0	52.8	175	4.0	2.1	46.3	-52.7	-6.4	63.4
29-Mar-15	-4.9	2.9	-1.3	-2.8	-2.4	-2.6	0	52.8	189	5.4	3.0	44.7	-47.7	-2.9	67.0
30-Mar-15	-5.0	3.3	-1.1	-2.7	-2.3	-2.5	0	52.7	180	3.5	2.3	54.6	-60.2	-5.6	58.3
31-Mar-15	-3.6	2.5	-0.9	-2.8	-1.7	-2.4	0	52.0	104	3.9	2.5	41.4	-47.4	-6.0	56.8

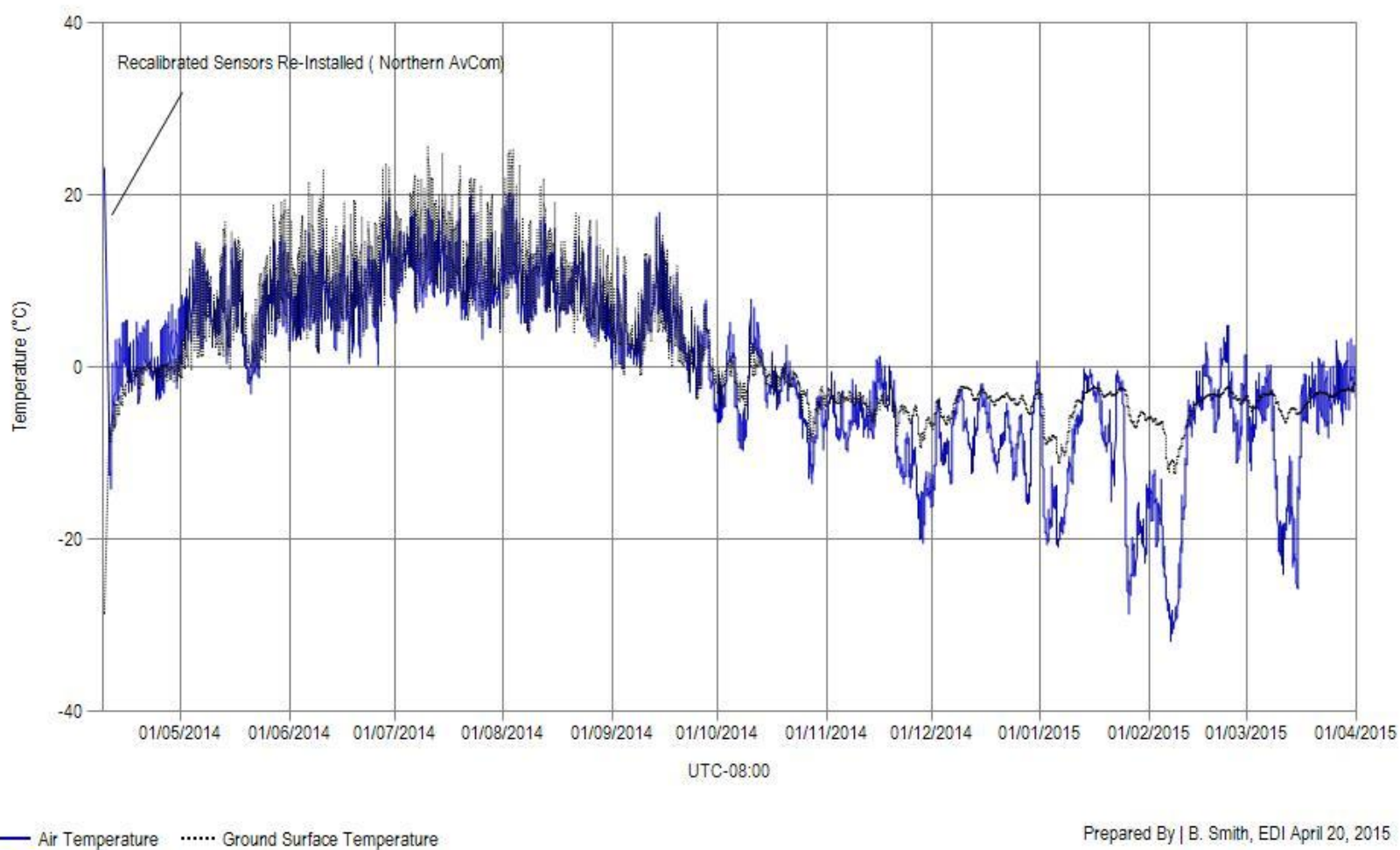
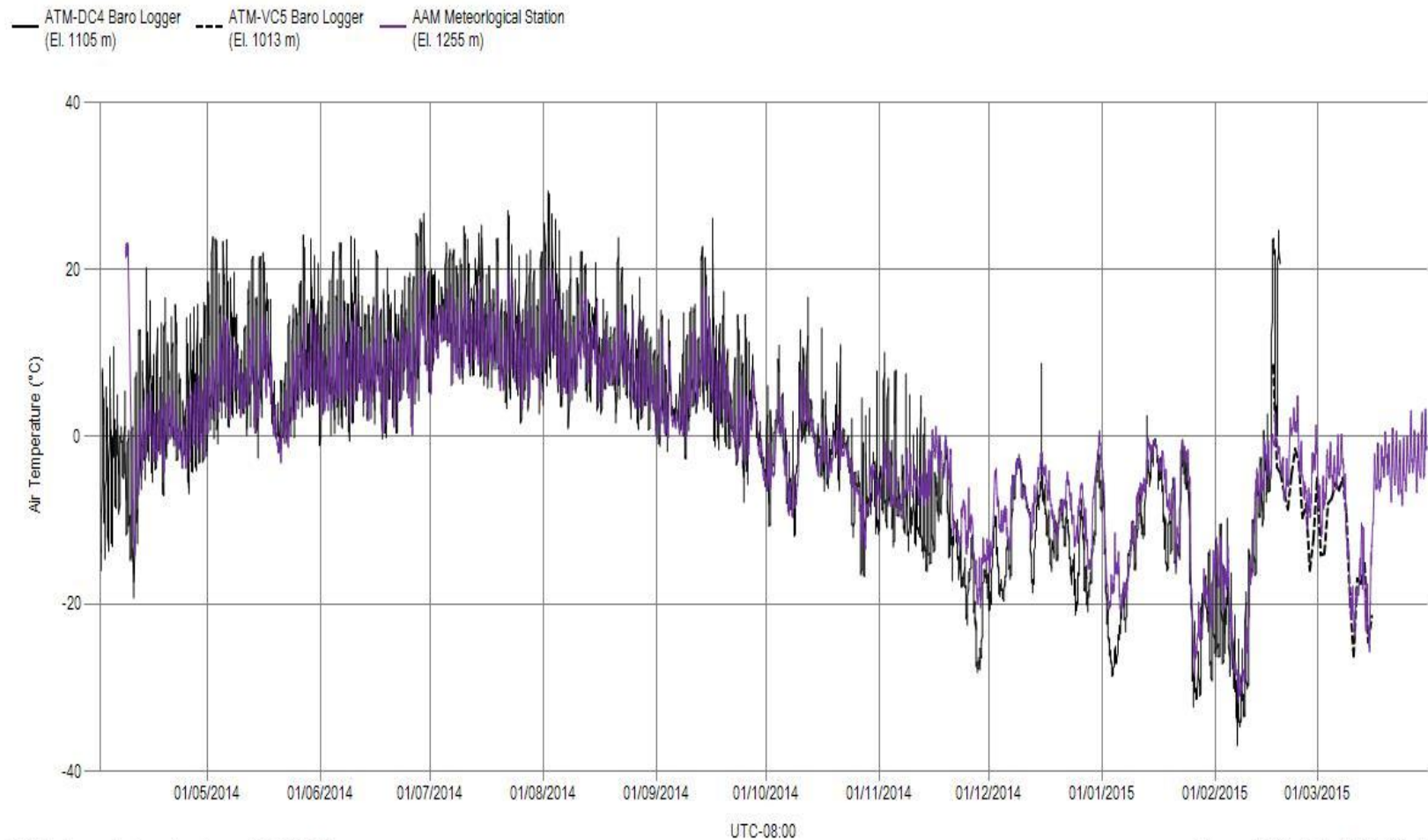


Figure F-1. Mount Nansen mean hourly air and ground temperature, April 1, 2014 to March 31, 2015.



Note: Winter temperature inversions observed in 2014/2015

Prepared By | B. Smith, EDI April 21, 2015

Figure F-2. Mount Nansen mean hourly air temperature compared for the ATM-ROAD AAM station and the ATM-DC-4 and ATM-VCR stations, April 1, 2014 to March 31, 2015.

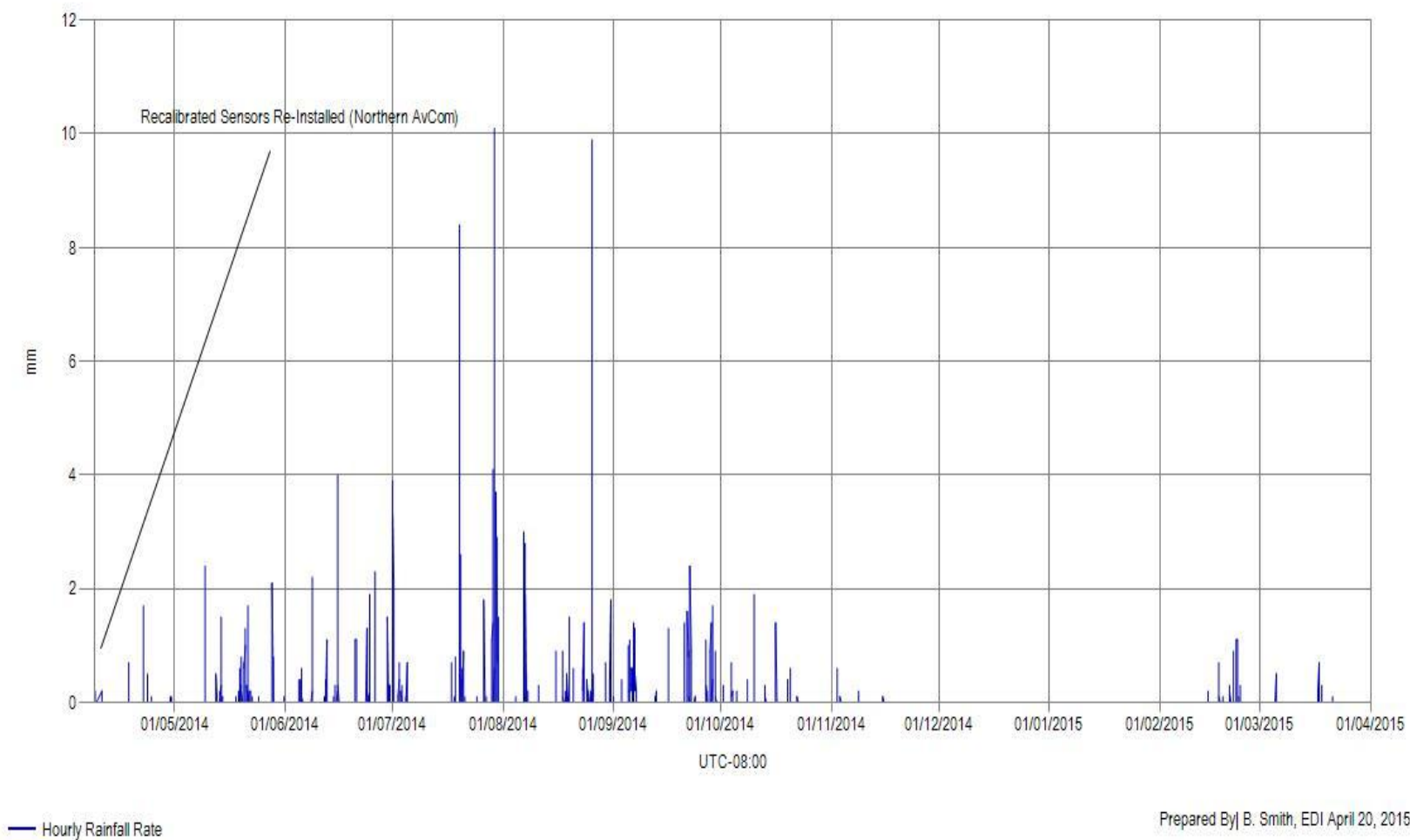


Figure F-3. Mount Nansen cumulative hourly precipitation as rainfall, April 1, 2014 to March 31, 2015.

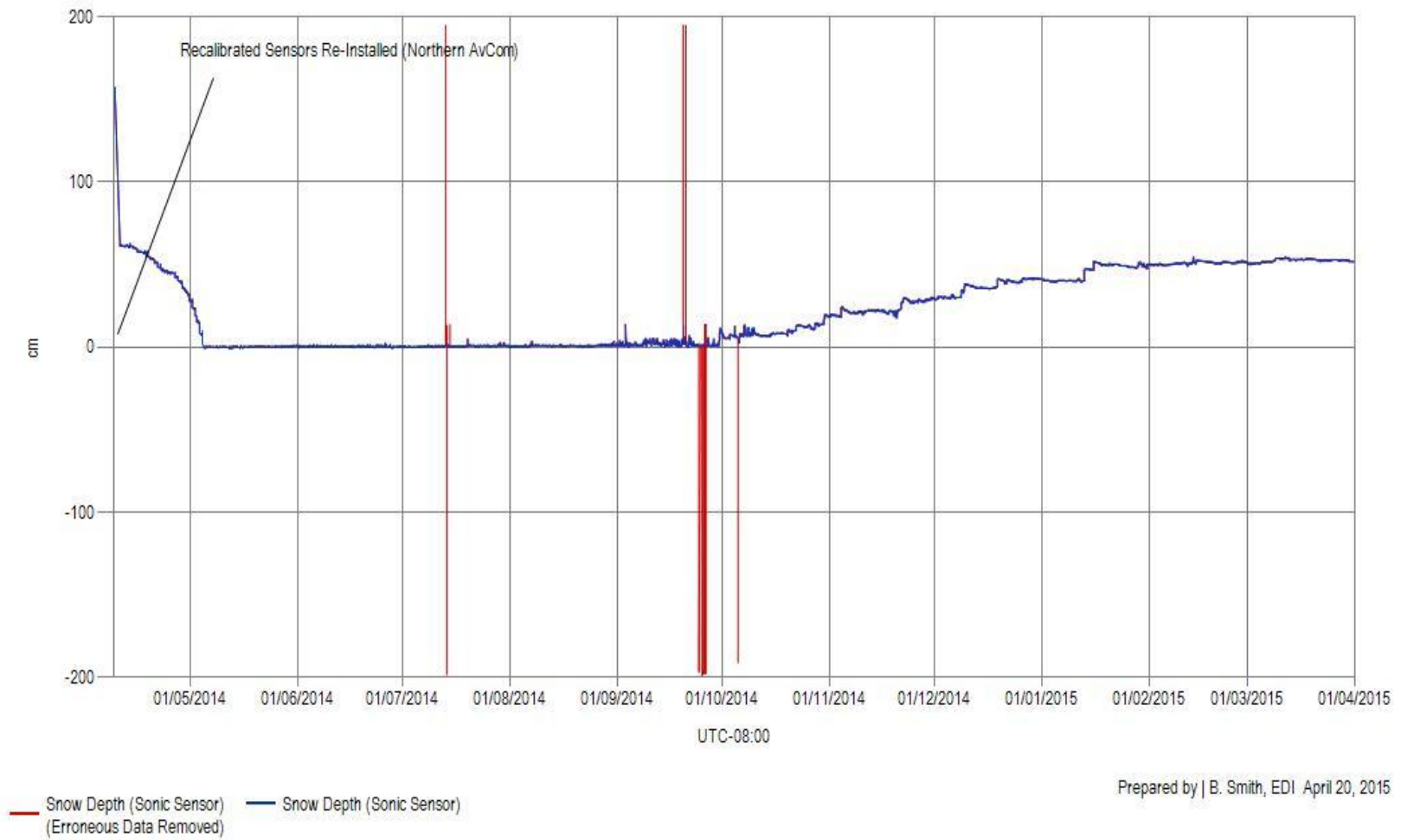


Figure F-4. Mount Nansen cumulative daily snow depth, April 1, 2014 to March 31, 2015.

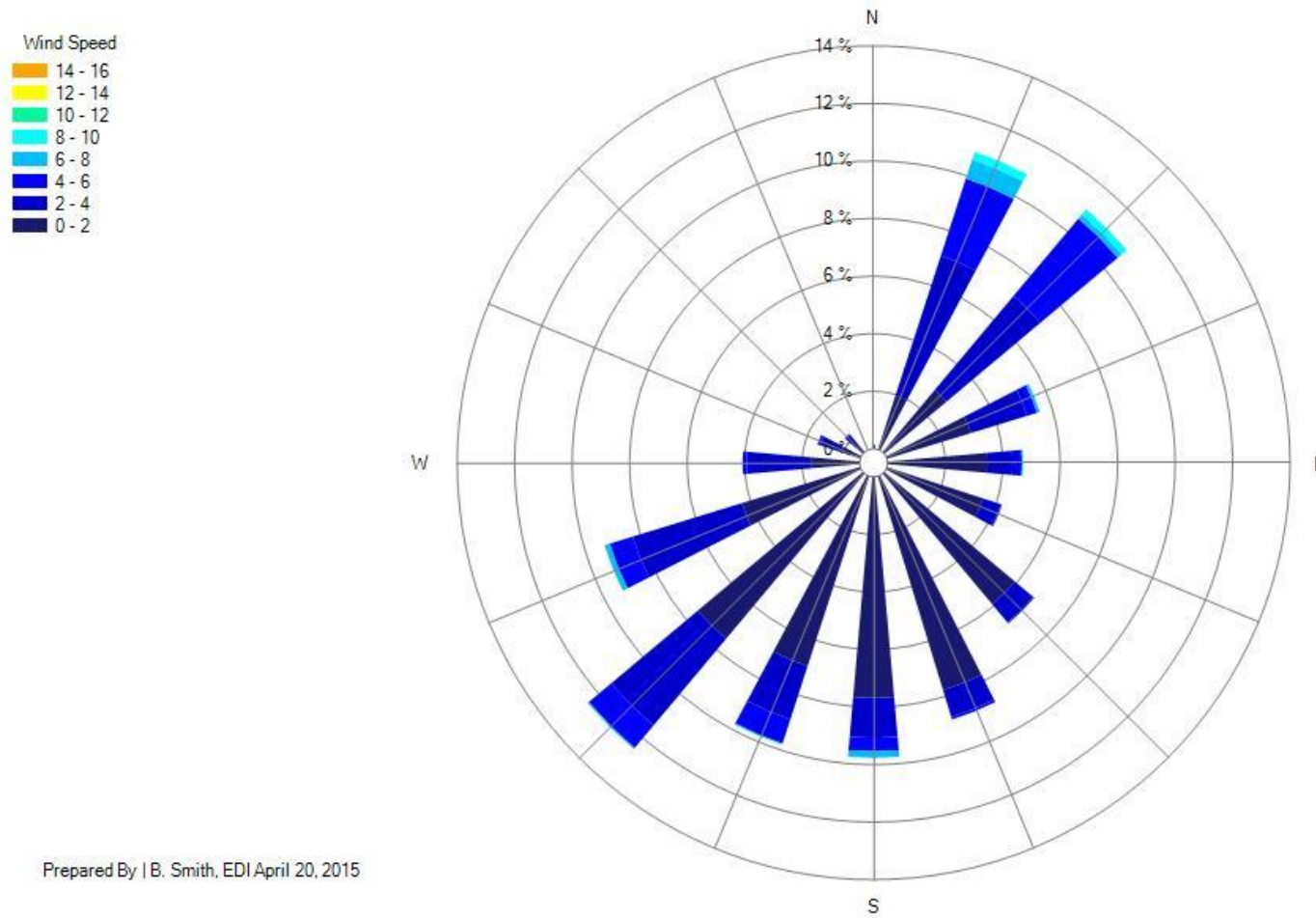


Figure F-5. Mount Nansen mean hourly wind speed (m/s) and direction (wind rose diagram), January 1 to March 31, 2015.

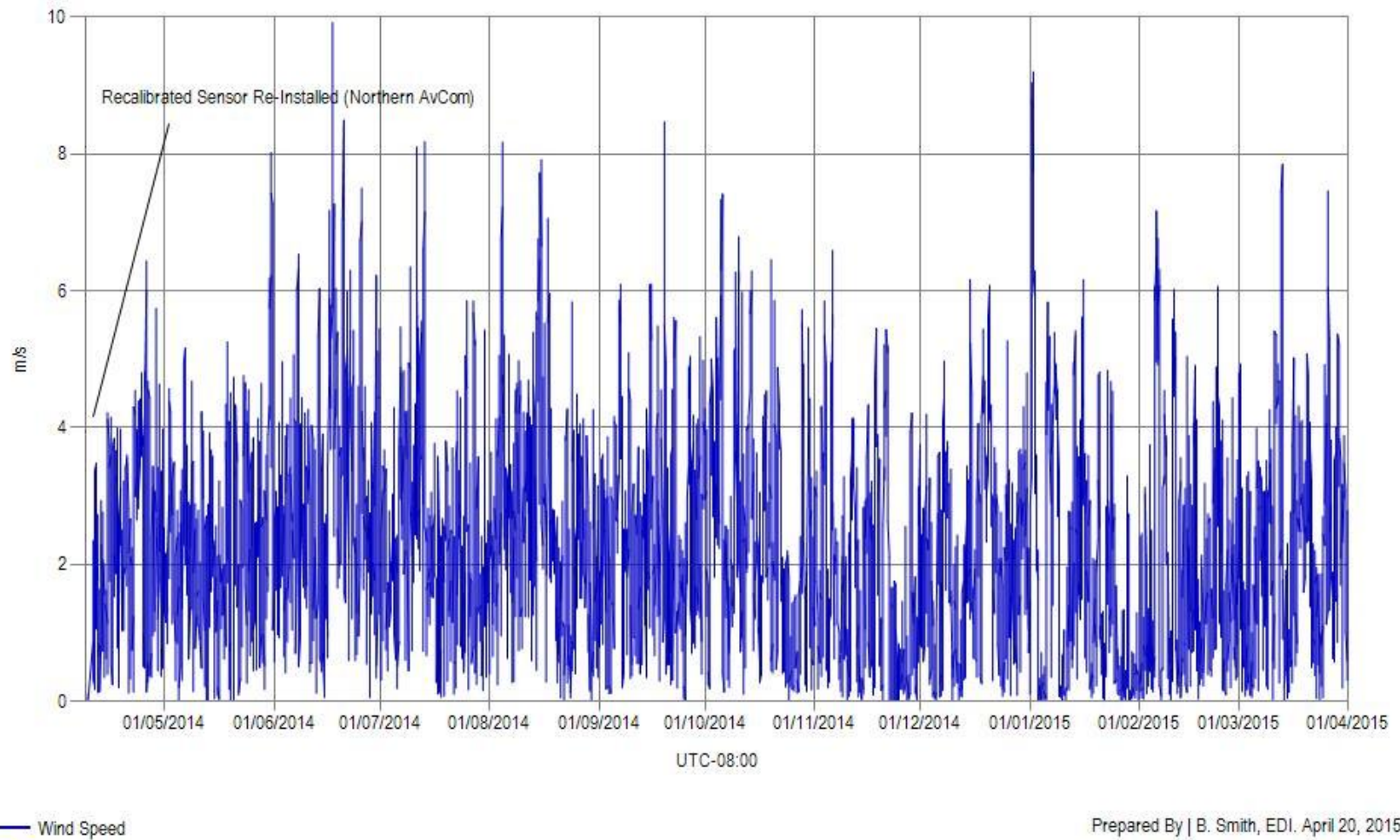


Figure F-6. Mount Nansen mean hourly wind speed, April 1, 2014 to March 31, 2015.

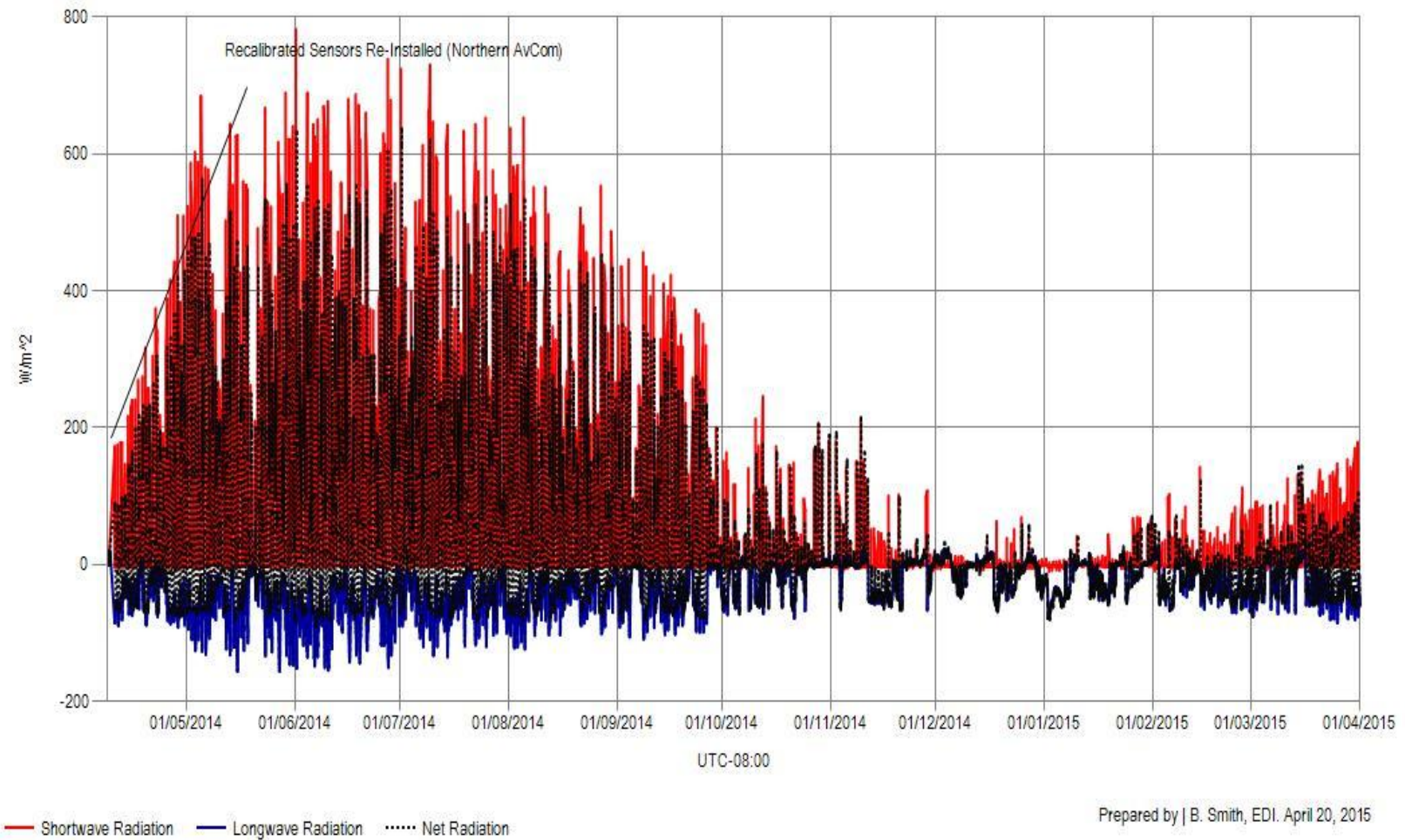


Figure F-7. Mount Nansen mean hourly net shortwave, longwave and total radiation, April 1, 2014 to March 31, 2015.

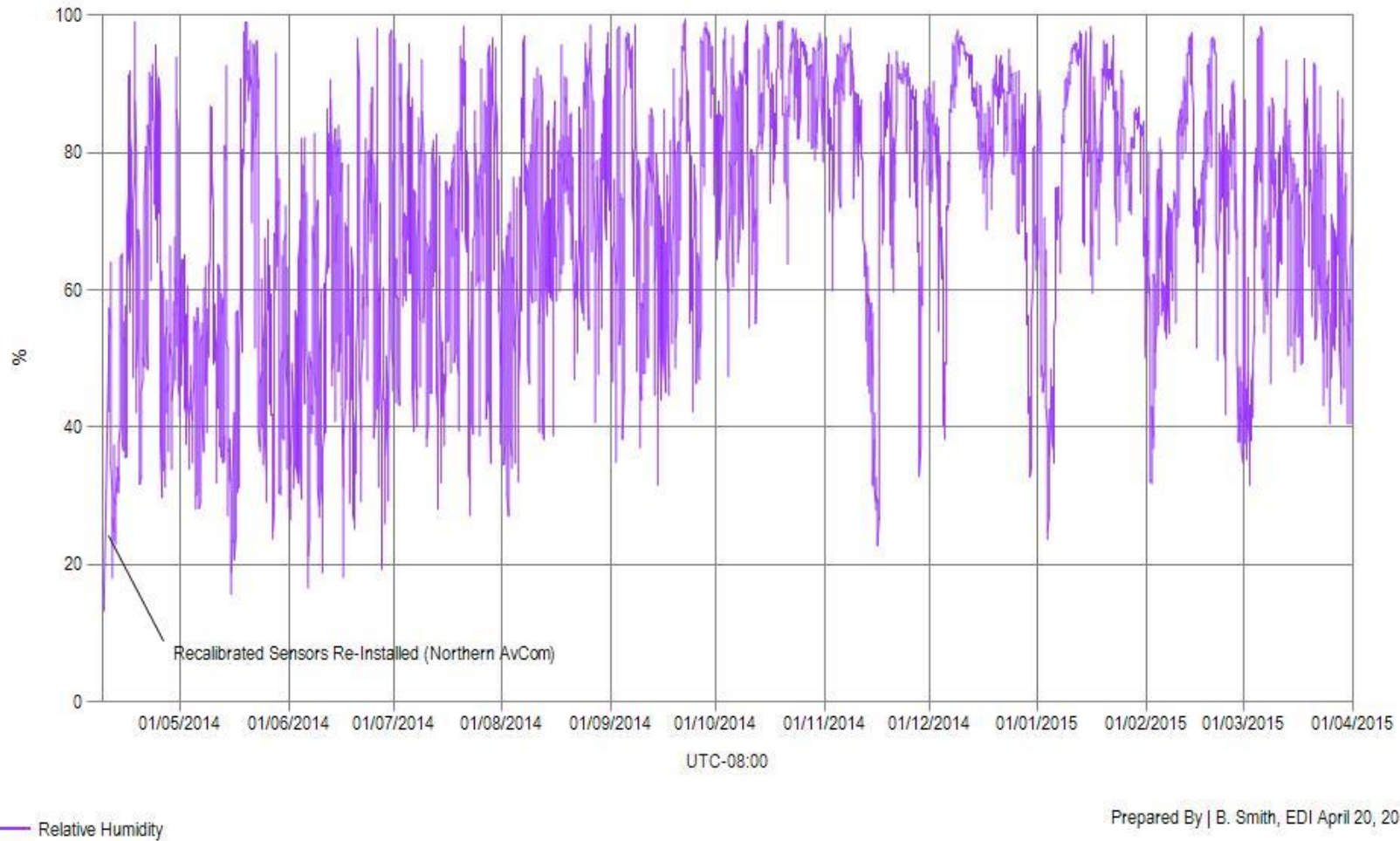


Figure F-8. Mount Nansen mean hourly relative humidity, April 1, 2014 to March 31, 2015.

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