

January 21, 2016

EDI Project No: 15Y0146

Assessment and Abandoned Mines Branch (AAM) K-149
Department of Energy, Mines and Resources, Yukon Government
Room 2C Royal Center, 4114-4th Avenue
PO 2703, Whitehorse, YT, Y1A 2C6

Attention: Erik Pit, Type II Project Manager

**RE: Mount Nansen Water Resources Investigations – Monthly Report: December 2015
FINAL**

Trip dates:	December 14-15, 2015
EDI field staff:	Dawn Hansen, Joel MacFabe and Danny Skookum
Weather during trip:	Conditions for the three days included air temperatures from -24 to -15°C, with clear skies to light snow and calm to light wind conditions.

The following monthly report includes a summary of site conditions and data collected during EDI's December 2015 trip to Mount Nansen as part of the 2015/16 Water Resources Investigations. The December 2015 trip represents the second monitoring event of the winter season. See 0 for a summary of data included in this report.

Table 1. Summary of information provided in this monthly report.

Report Section	Description
Site Conditions	<ul style="list-style-type: none"> • Summary of weather and general site conditions
Meteorology	<ul style="list-style-type: none"> • Statement on station status and identification of any data gaps or QA/QC issues • Snow depth sensor QA/QC
Hydrology	<ul style="list-style-type: none"> • Discussion of noteworthy hydrology observations for this month • Statement of QA/QC for the data collected this month
Water Quality	<ul style="list-style-type: none"> • Summary of noteworthy water quality observations for this month • Statement on QA/QC sample results for this month
Program Recommendations	<ul style="list-style-type: none"> • Program recommendations for meteorological, hydrology and water quality programs
Additional Trip Information	<ul style="list-style-type: none"> • Project Safety Concerns • Wildlife sightings • Budget and schedule considerations



Report Section	Description
List of Attachments	<ul style="list-style-type: none"> • Maps of stations and sites • Site and station photos • Data Tables – hydrology and water quality • Water quality lab result reports

SITE CONDITIONS

The December 2015 site trip represented winter conditions at the Mount Nansen site. Air temperatures were cold, ranging from -24 to -15°C. Weather conditions ranged from clear skies to light snow, with calm to light winds. Ice cover was present across all watercourses and waterbodies, with ice thickness ranging from 1 cm to 70 cm. Water levels were lower than during the October and November 2015 trips. Stations and sites along Pony Creek, Back Creek and Dome Creek remain frozen to bed.

METEOROLOGY

Meteorological data was collected at the ATM-ROAD station throughout the month of December 2015. EDI conducted a preliminary QA/QC review of the December 2015 data. All sensors appear to be functioning as expected, with the possible exception of the longwave radiation sensor. This sensor produced anomalous readings from December 6 to 29, 2015 then returned to what appear to be normal readings. The condition of the sensor will be checked visually by EDI staff during the January 2016 field visit (as this sensor sits outside the meteorological station compound). There was snow on site during the December investigation, which corresponded with a snow sensor measurement of 27.1 cm on December 15, 2015 (Table 2). This indicates that to date, the snow sensor appears to be slightly underestimating snow depth, however there is likely enough spatial variability of the snow distribution and ground surface elevation in the vicinity of the meteorological station that would account for the differences. Meteorological data for the winter season (October 15, 2015 to March 31, 2016) will be summarized and reported on in the March 2016 monthly report, which will include the seasonal analysis.

Table 2. Comparison of snow depth measured at the site with the snow sensor measurement.

Measurement Date/Time	Manual Snow Depth Measurement near Station (cm)	Meteorological Station Snow Sensor Measurement (cm)	Snow Sensor Quality ¹	Difference (cm)
October 13, 2015 1:00 pm	0.0	0.6	181 (Good)	0.6
November 16, 2015 2:20 pm	20.0	18.2	185 (Good)	1.8
December 15, 2015 6:05 pm	29.1	27.1	182 (Good)	2.0

Note:

¹- Quality numbers provide an indication of surface density in snow monitoring applications. Values will increase during snowfall events consisting of low-density snow. Quality Numbers: 0 = Not able to read distance; 152-210 = Good Measurement Quality Numbers; 210-300= Reduced Echo Signal Strength; 300-600 = High measurement uncertainty



HYDROLOGY

Discharge measurements were collected at all stations with suitable conditions during the December 2015 trip. Water levels were lower throughout the Mount Nansen Site than during the November 2015 trip. Hydrology stations at H-PC-DSP, H-BC, H-DC-B, H-DC-R and H-DC-D1b were frozen to substrate. Continuous water level records are available for five stations for the period up to December 14, 2015: H-VC-U, H-VC-DBC, H-VC-UMN, H-VC-R and H-VC-R+290. Data could not be downloaded from the continuous water level logger at H-DC-M WP because of a damaged direct-read cable attached to the logger. This cable will be replaced and the data will be downloaded from the logger during the next field visit if possible. All collected data will remain stored within the internal memory of the loggers therefore there will be no data gaps resulting from this issue.

See attached data tables for a summary of surface water conditions and hydrometric monitoring tasks completed at each station for December 2015 (Attachment 3). Quality control and quality assurance was conducted for all hydrometric data. Noteworthy observations are included below.

Noteworthy Observations

- The barologger installed along Victoria Creek at ATM-VC5 appears to be malfunctioning. From a preliminary review of the logger, the digital timestamps began drifting after the October 2015 field visit. An additional barologger will be installed at this location during the January 2016 field visit and the condition of the existing barologger will be assessed. Any gaps that exist in the barologger record will be filled using the barometer data from the Mount Nansen meteorological station.
- Discharge measurements were collected with an ADV at all Victoria Creek stations, H-VC-U, H-VC-DBC, H-VC-UMN, H-VC-R and H-VC-R+290 with discharge values ranging from 0.082 to 0.100 m³/s. These values were lower than the flows observed in November 2015 which ranged from 0.148 to 0.176 m³/s.
 - A preliminary review of the discharge values from the Victoria Creek stations in December 2015 show that the measured discharge at H-VC-DBC (0.100 m³/s) is greater than at the downstream station at H-VC-UMN (0.090 m³/s). Similarly, the discharge at H-VC-UMN is greater than the discharge downstream at H-VC-R (0.096 m³/s). Typically, discharge increases in the downstream direction as the contributing watershed area increases, therefore this decreasing winter flow pattern may indicate that the Victoria Creek reaches are losing surface flow to groundwater. Similar discharge patterns have been previously noted along Victoria Creek in July 2014, May 2015, June 2015, July 2015 and November 2015. A more detailed review of the local hydrology along Victoria Creek will be completed at the end of the winter season when additional low flow data is available.



- Placer mining construction works upstream of the H-PC-DSP site have stopped. No water was flowing over or through the embankment of the settling pond. The Pony Creek hydrometric site was frozen to bed. Multiple pieces of heavy equipment remain on site. Trenches in the ice around some equipment were excavated prior to the site visit.
- Instantaneous volumetric discharge measurements were collected at H-DC-DX+105 and H-DC-M WP with discharges of 0.001 and 0.003 m³/s, respectively. At H-DC-M WP all water was flowing through the weir; however the stilling well was encased in frozen sediment and ice. Concerns remain that the sedimentation is producing channel instability, rating curve shifts and continuous stage data errors for this station. Additional excavation may be required in the spring of 2016.
- Overflow ice conditions were present along Dome Creek in the vicinity of H-DC-R, H-DC-B and upstream of H-DC-M WP. The H-DC-B and H-DC-R stations were frozen to bed, no measurements could be collected.

WATER QUALITY

Water quality samples and data were collected at the regularly scheduled sites during the December 2015 trip. A total of 13 normally scheduled sites were visited, with 9 sites sampled. As noted above in the 'Site Conditions' section, the WQ-CH-P-13-01, WQ-DC-B, and WQ-DC-R sites had frozen to substrate for the winter since the November 2015 visit. The regular monthly drinking water sample was collected from the pumphouse well (WQ-PW). All samples were submitted for analysis through ALS Laboratories.

See the attached data tables for a summary of conditions at each site and a record of where samples were collected during each trip (Attachment 3). In-situ and laboratory results summary tables are also attached. Parameters that exceeded the Canadian Council of Ministers of the Environment Freshwater Aquatic Life (CCME-AL) guidelines and/or the Mount Nansen Effluent Quality Standards (EQS) criteria are highlighted. The lab certificates of analysis are also attached in Attachment 4. Many results reflect typical conditions for this time of year at Mount Nansen where water levels have decreased and watercourses are covered in ice. Noteworthy observations and comments on sample QA/QC are included in the subsections below.

Noteworthy Observations

- The WQ-CH-P-13-01, WQ-DC-B and WQ-DC-R had all frozen to substrate since the last trip. The WQ-DC-R and WQ-DC-B had thick ice and overflow conditions, with no flowing water. This is typical for the winter season, with these sites remaining frozen through the winter, aside from the WQ-DC-B site that can occasionally flow when ice dredging occurs in the diversion channel.
- The four Victoria Creek samples did not exceed any guidelines or standard criteria during the December 2015 trip – this is similar to the November and October 2015 results.



- The total zinc concentration in the December 2015 WQ-SEEP sample was above the CCME-AL guideline with a concentration of 0.112 mg/L. This is a small increase from the November 2015 sample result of 0.103 mg/L. It is likely concentrations will continue to increase as water levels decrease and ions become more concentrated in the water column through the winter. This site also commonly exceeds the guidelines and/or standards for ammonia, arsenic, cadmium, iron, and manganese.
- The WQ-DC-U site downstream of the WQ-DC-B and WQ-SEEP stations exceeded the guidelines and/or standards for ammonia, arsenic, iron, manganese and zinc (which is common in the winter months).

QA/QC Samples

Travel Blank Sample – The travel blank had all parameters below detection limits, except for total chromium. Parameters above detection limits suggest that contamination from transportation and/or storage may have occurred; however, total chromium concentrations for all other samples appear to be within their normal range, thus there are no concerns for sample contamination. The lab is currently investigating potential reasons for the chromium concentration above the detection limit - it may be related to the sample being dated (similar to what occurs occasionally with the ammonia concentrations in some travel blank samples).

Field Blank Sample – all parameters were below detection limits.

Replicate Sample(s) – The average relative percent difference (RPD) of the replicate sample set for WQ-DC-DX+105-r was 2%, indicating that sample analysis was adequately precise (RPD<20%). The average RPD for total metals in the replicate sample set was 3% and the average RPD for dissolved metals was 1%. All individual parameters had RPD less than 20% or below detection limits.

PROGRAM RECOMMENDATIONS

- During each winter trip, collect photographs and snow depths adjacent to the meteorological station compound to confirm snow sensor data.
- Monitor sediment deposition in the H-DC-M WP station weir pond and recommend excavation as required. Also monitor ice build-up at the H-DC-M WP station and WQ-DC-U site.
- Continue to monitor water quality at the WQ-SEEP – zinc concentrations have been increasing along with other parameters and it is likely they will continue to do so through the winter. LC50 samples will be collected again in February 2016.
- Conduct concurrent ADV and salt tracer discharge measurement tests at select Victoria Creek stations from January to March 2016, where possible, to continue to validate the salt tracer method.
- Revisit sites/stations that have frozen to substrate in March 2016 (depending on spring weather conditions). It is common for many areas to remain frozen to substrate through April and May. This likely applies to WQ-DC-DX, H/WQ-DC-D1b, WQ-PC-U, WQ-PC-D, H-PC-DSP,



H/WQ-BC, H/WQ-DC-R, H/WQ-DC-B and WQ-CH-P-13-01; as well as the other seeps that have been dry most or all of the 2015 open water season – WQ-ADIT-SEEP, WQ-LW-SEEP-01, WQ-MS-S-08.

- Visually inspect the condition of the longwave radiation sensor at the meteorological sensor on the January 2016 trip – look for any unusual frost/snow build-up and take photos if necessary.

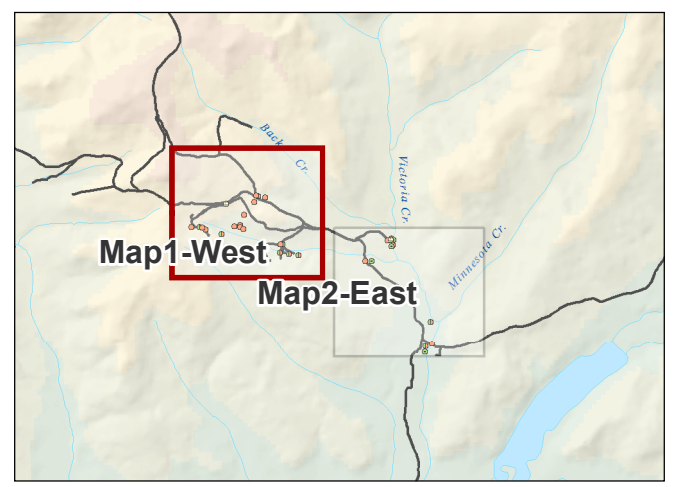
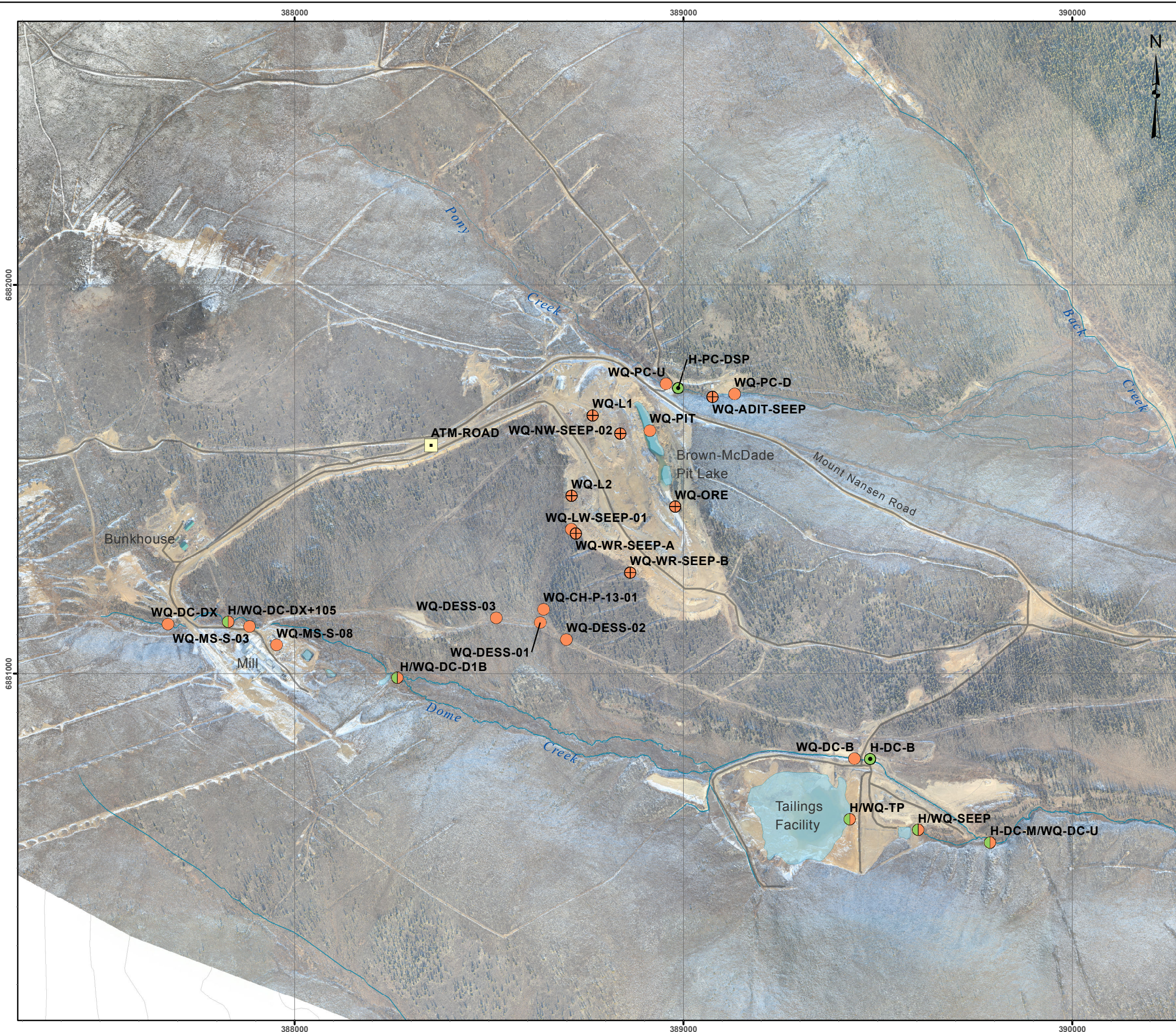
ADDITIONAL TRIP INFORMATION

Any changes to project scope (i.e. additional sites sampled):	<p>None. All sampling and monitoring was conducted within scope. The trip took two days versus the typical three days, as the number of sites/stations is reduced in the winter.</p> <p>The next trip is scheduled for January 12/13, 2015, and will be the third winter season trip.</p> <p>As discussed below a replacement direct read cable will need to be purchased for the H-DC-M WP station (estimated cost: \$100). There is remaining budget in the contingency fund for the project which could cover this cost.</p>
Any alterations to sample schedule/budget:	None.
Additional Comments:	<p>The direct read cable for the logger at the H-DC-M WP station appears to be broken, as data could not be downloaded at this station during the November 2015 or December 2015 trip. A replacement direct read cable has since been purchased and will be installed as soon as possible.</p> <p>The barologger installed at ATM-VC5 may be malfunctioning. Data downloaded during the November and December trips indicate that the timestamps on the logger are drifting. A new barologger will be installed at the station in January 2016 and the condition of the existing barologger will be assessed.</p>
Wildlife Sightings:	None.
Site concerns (safety):	None.

LIST OF ATTACHMENTS

The following information is attached to this monthly report:

1. Maps of Hydrometric Stations and Water Quality Sites
2. Site and Station Photos from the trip
3. Data Tables
 - a. Hydrology – Site Conditions and Tasks Completed & Summary Table of Discharge Measurements.
 - b. Water Quality – Site Conditions and Samples Collected & Summary Table of In Situ Parameters and Lab Results
4. Copies of Lab Certificate of Analysis (COA) & Yukon Environmental Health Services Bacteriological Results (November 2015).



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)
- + Temporary Water Quality Site (label e.g. WQ-MS-S-03)
- Unpaved Road/Access

Mount Nansen Site (West): Hydrometric Stations and Water Quality Sites

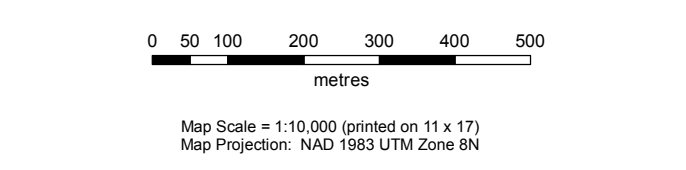
Notes:

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

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

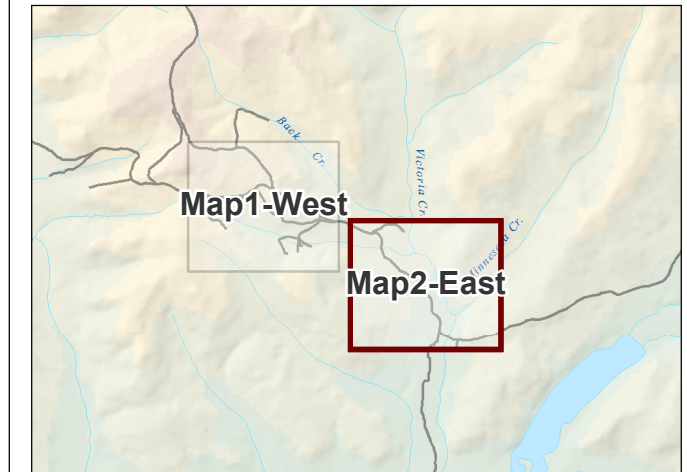
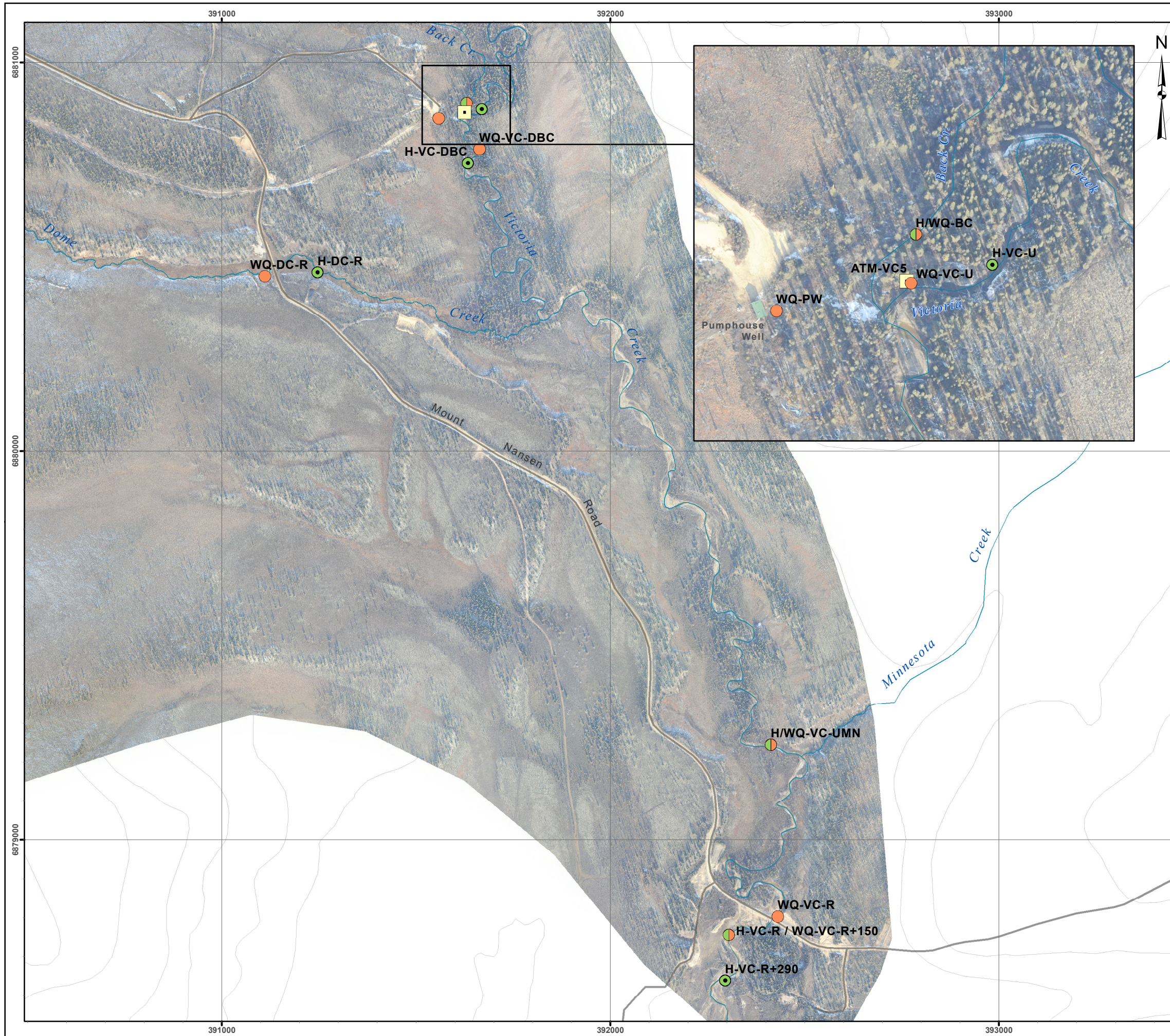
Imagery provided by Yukon Government - Energy, Mines and Resources - Abandoned Mines Branch.

Project data displayed is site specific. Data collected by EDI Environmental Dynamics Inc. (2015) was obtained using Garmin GPS technology.



Drawn: MP	Checked: MM/SD	Date: 21/09/2015	MAP 1
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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)
- Temporary Water Quality Site (label e.g. WQ-MS-S-03)
- Unpaved Road/Access

Mount Nansen Site (East): Hydrometric Stations and Water Quality Sites

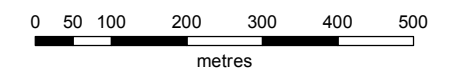
Notes:

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

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. (2015) was obtained using Garmin GPS technology.



Map Scale = 1:10,000 (printed on 11 x 17)
Map Projection: NAD 1983 UTM Zone 8N

Drawn: MP	Checked: MM/SD	Date: 21/09/2015	MAP 2
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Photo 1. H/WQ-DC-DX+105 – looking upstream.



Photo 2. H/WQ-DC-B – looking upstream. Site frozen to bed.



Photo 3. H/WQ-DC-B – looking downstream. Site frozen to bed.



Photo 4. H-DC-M WP – upstream of station. Looking at overflow ice between H-SEEP and weir pond.



Photo 5. WQ-DC-U looking downstream.



Photo 6. H-DC-R – looking upstream. Site frozen to bed. Overflow ice conditions at site.



Photo 7. H-DC-R – overview. Site frozen to bed. Overflow ice at site.



Photo 8. WQ-DC-R - looking upstream. Site frozen to bed. Overflow ice at site.



Photo 9. WQ-CH-P-13-01 – looking upstream. Site frozen to bed.



Photo 10. H/WQ-SEEP– pipe moved to collect sample.



Photo 11. H/WQ-TP – overview sample site.



Photo 12. H/WQ-BC – looking upstream. Site remains dry.



Photo 13. WQ-VC-U – looking downstream.



Photo 14. H-VC-U – looking upstream.



Photo 15. WQ-VC-DBC – looking upstream.



Photo 16. WQ-VC-DBC – looking upstream.



Photo 17. H/WQ-VC-UMN – looking upstream.



Photo 18. H-VC-UMN – looking downstream.



Photo 19. WQ-VC-R+150 – looking upstream at sampling location near H-VC-R+290.



Photo 20. H-VC-R – looking downstream.



Photo 21. H-VC-R+290 – looking downstream.



Photo 22. H/WQ-PW – overview.



Photo 23. Met station snow depth.

Measurement ID	Hydrometric Identifier (HID)	Measurement Date	Measurement Time	Discharge Measurement Method	Discharge (m ³ /s)	Discharge Data Flag	Surveyed Water Elevation (m)	Survey Data Flag	Comments
403	ATM-VC5	15/12/2015		N		X			Logger downloaded at 14:32. Ice observed on the logger and in the bottom of the PVC case due to broken cap. Removed ice from the logger and repaired PVC case. Timestamp dates on logger are offset from known download time. Will investigate time stamps next trip and assess whether logger needs to be repaired.
409	H-DC-DX+105	15/12/2015	10:35	V	0.001				Open leads in some sections, but it is mostly ice covered. Volumetric discharge measurement was completed.
405	H-DC-B	15/12/2015	09:10	N		X		N	Multiple holes augured and chipped through ice along typical measurement reach in channel. Channel frozed to bed below 0.6 to 0.7 m of ice. Denison Environmental Services reported that flow is backing up at the corner upstream of the bridge.
407	H-SEEP	14/12/2015	17:45	V	0.003				Volumetric discharge measurement collected from outlet pipe. Site appears normal. Seepage pond pumphouse at 17:51 flow was 133.698 Litres/minute (0.002 m3/s).
406	H-DC-M WP	14/12/2015	17:15	V	0.003			N	Weir pond covered with ice. All water flows through V-notch weir. Thin layer of ice was cleared to access flow at V-notch. Unable to download data from logger due to suspected problem with direct read cable. Logger continues to log. Overflow ice is building up and moving downstream.
404	H-DC-R	14/12/2015	15:25	N		X		N	Overflow ice conditions upstream and downstream of the road crossing. Channel is unconfined with substantial overflow present at the hydrology measurement area. Ice thickness varies from 0.4 to 0.7 m. No flow observed downstream of the road. Frozen seep on right downstream bank along valley wall. No measurements collected.
398	H-VC-U	15/12/2015	15:50	ADV-MID	0.084	B		N	Channel covered with ice with variable thickness. ADV cross section completed.
408	H-PW	15/12/2015	15:05	V	0.003				Site appears normal. No substantial ice build up. Volumetric discharge measurement collected.
399	H-VC-DBC	15/12/2015	14:26	ADV-MID	0.100	B		N	Ice covers entire channel. Channel conditions typical for this time of year. ADV cross section completed.
400	H-VC-UMN	15/12/2015	12:41	ADV-MID	0.090	B		N	Ice covers entire channel with varying thickness. Ice was sufficiently thick to walk across approximately 50 m downstream of stilling well; upstream of the stilling well the ice was too thin to walk across. ADV cross section completed.
401	H-VC-R	14/12/2015	15:27	ADV-MID	0.096	B		N	ADV cross section completed. Water depth to substrate ratio large resulting in higher than normal measurement uncertainty.
402	H-VC-R+290	14/12/2015	14:11	ADV-MID	0.082	B		N	Conducted ADV measurement downstream of the stilling well. Large section of ice cover removed to reduce backwater effect for measurement. All flow contained in a single channel along the left downstream bank, right bank side of channel frozen to bed.

Discharge Measurement Method Legend

Measurement Method ID	Measurement Method	Measurement Description
ADV-MID	Mid Section Method - Acoustic Doppler Velocimeter	Cross-sectional velocity using an ADV, mid-section method.
SS	Brine Salt Slug Tracer	Salt dilution gauging using a brine salt slug.
V	Volumetric	Volumetric measurement obtained by filling a graduated container at a culvert, pipe outlet or weir.
W	Weir	Measurement obtained by a rated structure (v-notch weir).
N	None	No measurement could be obtained.
SD	Dry Salt Slug Tracer	Salt dilution gauging using a dry salt slug.
HWM	High Water Mark - Indirect Method	Indirect method using high water mark in the slope-area calculation for estimating high discharges.
ADCP	Acoustic Doppler Current Profiler	Cross-sectional velocity using an ADCP, mid-section method.
SC	Constant Rate Salt Tracer	Salt dilution gauging using the constant rate method.
CM-MID	Mid Section Method - Current Meter	Cross-sectional velocity using a velocimeter (Swoffer or Pygmy AA)

Hydrometric Stations

Hydrometric ID	Hydrometric Stations
ATM-VC5	Atmospheric Barologger (5) at Victoria Creek
H-BC	Back Creek
H-DC-B	Diversion Channel at Bridge
H-DC-D1B	Dome Creek at D1b
H-DC-DX	Dome Creek at DX
H-DC-DX+105	Dome Creek at DX+105
H-DC-M-WP	Middle Dome Creek at Weir Pond
H-DC-R	Dome Creek at Road
H-PC-DSP	Pony Creek Downstream of Pit
H-SEEP	Seepage Pond Outflow
H-TP	Tailings Pond
H-VC-DBC	Victoria Creek Downstream of Back Creek
H-VC-R	Victoria Creek at Road
H-VC-U	Upper Victoria Creek
H-VC-UMN	Victoria Creek Upstream of Minnesota Creek

Discharge Data Flag Legend

Discharge Data Flag	Discharge Data Flag Description
E	Estimated value
B	Backwater effects (ice related)
F	Instrument malfunction
M	Manual measurement
A	Automated measurement (logged)
ML	Missing length data
MD	Missing depth data
MW	Missing width data
O	Outside of measurement reporting range
P	Potential Place Mining Interference with Flow
S	Suspect data
X	Poor channel conditions for discharge measurement
MI	Missing Data
SH-L	Data logger Shift
SH-SG	Staff Gauge Shift
UR	Under review

Survey Data Flag Legend

Survey Flag	Survey Flag Description
S	Suspect data
MI	Missing data
UR	Under review
F	Instrument Malfunction
O	Outside measurement Accuracy (+/-0.003 m)
N	No survey conducted

Water Quality Site	Sample Collected? (Y/N)	Measurement Date	Comments
WQ-BC	N	15-Dec-15	Sample hole in ice from previous trip still open and site remains dry. Approx 4cm fresh snow in hole.
WQ-CH-P-13-01	N	15-Dec-15	Site is frozen to bed. No sign of water in immediate area to indicate that flow is redirected.
WQ-DC-B	N	15-Dec-15	Augured hole in usual sample location and site was frozen to bed, augured additional holes downstream and channel remains frozen to bed. Cannot hear water or detect water seepage anywhere at the site - considered dry/ frozen for this trip.
WQ-DC-DX+105	N	15-Dec-15	Channel has open leads upstream of typical sample site.
WQ-DC-R	N	14-Dec-15	Chipped down 70 cm and did not find water. Lots of overflow in area. Could not hear water. Overflow has not yet covered the road but it is also present on the downstream side of the crossing.
WQ-DC-U	Y	14-Dec-15	Overflow ice starting to form upstream of weir pond (coming from seepage discharge and diversion channel, no overflow at weir pond or downstream at WQ site.
WQ-PW	Y	15-Dec-15	Conditions normal for time of year. Ice around pipe outlet.
WQ-SEEP	Y	14-Dec-15	Regular samples collected - conditions appear normal. Some ice build up around culvert and pipe outlet.
WQ-TP	Y	14-Dec-15	The tailings pond has 100% snow and ice cover.
WQ-VC-DBC	Y	15-Dec-15	No open leads in area but visibly thinner ice just up and downstream of water quality site.
WQ-VC-R	N	14-Dec-15	Frozen to bed - thick overflow ice. Samples now collected from winter location at WQ-VC-R+150.
WQ-VC-R+150	Y	14-Dec-15	Ice thickness 10-20cm thick. WQ collected at winter sampling location. Over flow conditions observed upstream of culvert at WQ-VC-R.
WQ-VC-U	Y	15-Dec-15	No open leads up or downstream but thinner ice observed both up and downstream. Site conditions seem normal for this time of year.
WQ-VC-UMN	Y	15-Dec-15	Ice has variable thickness from 1-8cm across channel.
QA/QC Samples			
Replicate 1	Y	15-Dec-15	Replicate collected at WQ-DC-DX+105 (sample ID WQ-DC-DX+105-r).
Field Blank	Y	14-Dec-15	Sample bottles filled with deionized water supplied by ALS; samples were filtered and preserved as instructed. Collected at WQ-VC-R+150.
Travel Blank	Y	14-Dec-15	Samples provided by lab and were transported to and from site.



ENVIRONMENTAL DYNAMICS INC.
ATTN: Meghan Marjanovic
2195 - 2nd Ave
Whitehorse YT Y1A 3T8

Date Received: 16-DEC-15
Report Date: 31-DEC-15 11:01 (MT)
Version: FINAL

Client Phone: 867-393-4882

Certificate of Analysis

Lab Work Order #: L1715452
Project P.O. #: NOT SUBMITTED
Job Reference: MOUNT NANSEN 15-Y-0146
C of C Numbers: 1, 2
Legal Site Desc:

Can Dang
Senior Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group A Campbell Brothers Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	Description	Sampled Date	Sampled Time	Client ID	L1715452-1	L1715452-2	L1715452-3	L1715452-4	L1715452-5
					Water	Water	Water	Water	Water
		14-DEC-15	14-DEC-15	14-DEC-15	14-DEC-15	14-DEC-15	14-DEC-15	14-DEC-15	15-DEC-15
		14:25	17:40	18:15	13:55	10:30			
		FIELD BLANK	WQ-SEEP	WQ-TP	WQ-VC-R+150	WQ-DC-DX+105-R			
Grouping	Analyte								
WATER									
Physical Tests	Conductivity (uS/cm)	<2.0	1630	1880	250	1180			
	Hardness (as CaCO3) (mg/L)	<0.50	898	1120	125	693			
	pH (pH)	6.02	7.25	7.82	7.71	7.42			
	Total Suspended Solids (mg/L)	<3.0	37.0	<3.0	<3.0	<3.0			
	Total Dissolved Solids (mg/L)	<1.0	1250	1560	134	818			
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	1.0	251	155	93.1	265			
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0			
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0			
	Alkalinity, Total (as CaCO3) (mg/L)	1.0	251	155	93.1	265			
	Ammonia, Total (as N) (mg/L)	<0.0050	4.61	0.469	<0.0050	0.0165			
	Chloride (Cl) (mg/L)	<0.50	<2.5 ^{DLA}	<2.5 ^{DLA}	<0.50	<1.0 ^{DLA}			
	Fluoride (F) (mg/L)	<0.020	<0.10 ^{DLA}	0.23	0.046	0.168 ^{DLA}			
	Nitrate (as N) (mg/L)	<0.0050	0.867	0.196	0.176	<0.010 ^{DLA}			
	Nitrite (as N) (mg/L)	<0.0010	0.0124	<0.0050 ^{DLA}	<0.0010	<0.0020 ^{DLA}			
	Sulfate (SO4) (mg/L)	<0.30	710	1020	30.6	410			
	Anion Sum (meq/L)	<0.10	19.8	24.3	2.51	13.8			
	Cation Sum (meq/L)	<0.10	20.8	24.0	2.65	14.2			
	Cation - Anion Balance (%)	-90.9	2.4	-0.7	2.6	1.3			
	Cyanides	Cyanide, Weak Acid Diss (mg/L)	<0.0050	0.0152	<0.0050	<0.0050	<0.0050		
Cyanide, Total (mg/L)		<0.0050	0.0669	<0.0050	<0.0050	<0.0050			
Cyanate (mg/L)		<0.20	1.08	0.97	<0.20	<0.20			
Thiocyanate (SCN) (mg/L)		<0.50	4.35	<0.50	<0.50	<0.50			
Total Metals	Aluminum (Al)-Total (mg/L)	<0.0030	0.0170	0.0225	0.0149	0.0038			
	Antimony (Sb)-Total (mg/L)	<0.00010	0.00054	0.0438	0.00036	0.0105			
	Arsenic (As)-Total (mg/L)	<0.00010	0.0682	0.146	0.00125	0.0419			
	Barium (Ba)-Total (mg/L)	<0.000050	0.0618	0.0216	0.0741	0.0121			
	Beryllium (Be)-Total (mg/L)	<0.000020	<0.000020	<0.000040 ^{DLA}	<0.000020	<0.000020			
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.00010 ^{DLA}	<0.000050	<0.000050			
	Boron (B)-Total (mg/L)	<0.010	0.059	0.110	<0.010	<0.010			
	Cadmium (Cd)-Total (mg/L)	<0.0000050	0.000648	0.00199	0.0000154	0.00202			
	Calcium (Ca)-Total (mg/L)	<0.050	259	346	32.2	183			
	Chromium (Cr)-Total (mg/L)	<0.00010	0.00065	<0.00020 ^{DLA}	0.00013	0.00010			
	Cobalt (Co)-Total (mg/L)	<0.00010	0.00933	0.00083	<0.00010	0.00087			
	Copper (Cu)-Total (mg/L)	<0.00050	0.00390	0.0381	0.00103	<0.00050			
	Iron (Fe)-Total (mg/L)	<0.010	15.4	0.265	0.029	0.378			
	Lead (Pb)-Total (mg/L)	<0.000050	0.000065	0.00896	<0.000050	<0.000050			
	Lithium (Li)-Total (mg/L)	<0.0010	<0.0010	0.0120	<0.0010	0.0091			

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L1715452-6 Water 15-DEC-15 10:05 WQ-DC-DX+105	L1715452-7 Water 15-DEC-15 13:50 WQ-VC-DBC	L1715452-8 Water 15-DEC-15 14:20 WQ-VC-U	L1715452-9 Water 14-DEC-15 14:25 TRAVEL BLANK	L1715452-10 Water 14-DEC-15 16:55 WQ-DC-V
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	1180	230	229	<2.0	1610
	Hardness (as CaCO3) (mg/L)	699	118	117	<0.50	898
	pH (pH)	7.41	7.66	7.65	5.58	7.70
	Total Suspended Solids (mg/L)	<3.0	<3.0	<3.0	<3.0	22.0
	Total Dissolved Solids (mg/L)	821	121	121	<1.0	1210
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	263	91.0	93.0	<1.0	252
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	263	91.0	93.0	<1.0	252
	Ammonia, Total (as N) (mg/L)	0.0167	<0.0050	<0.0050	<0.0050	3.93
	Chloride (Cl) (mg/L)	<1.0 ^{DLA}	<0.50	<0.50	<0.50	<2.5 ^{DLA}
	Fluoride (F) (mg/L)	0.171	0.045	0.043	<0.020	<0.10 ^{DLA}
	Nitrate (as N) (mg/L)	<0.010 ^{DLA}	0.186	0.187	<0.0050	0.482
	Nitrite (as N) (mg/L)	<0.0020 ^{DLA}	<0.0010	<0.0010	<0.0010	0.0102
	Sulfate (SO4) (mg/L)	412	21.1	20.9	<0.30	689
	Anion Sum (meq/L)	13.8	2.27	2.31	<0.10	19.4
	Cation Sum (meq/L)	14.3	2.48	2.47	<0.10	20.1
	Cation - Anion Balance (%)	1.8	4.4	3.4	0.0	1.8
	Cyanides	Cyanide, Weak Acid Diss (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050
Cyanide, Total (mg/L)		<0.0050	<0.0050	<0.0050	<0.0050	0.0404
Cyanate (mg/L)		<0.20	<0.20	<0.20	<0.20	<0.20
Thiocyanate (SCN) (mg/L)		<0.50	<0.50	<0.50	<0.50	2.54
Total Metals	Aluminum (Al)-Total (mg/L)	0.0038	0.0095	0.0109	<0.0030	0.0974
	Antimony (Sb)-Total (mg/L)	0.0102	0.00011	<0.00010	<0.00010	0.00038
	Arsenic (As)-Total (mg/L)	0.0412	0.00029	0.00027	<0.00010	0.0484
	Barium (Ba)-Total (mg/L)	0.0114	0.0807	0.0784	<0.000050	0.0737
	Beryllium (Be)-Total (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Total (mg/L)	<0.000050	0.000056	<0.000050	<0.000050	<0.000050
	Boron (B)-Total (mg/L)	<0.010	<0.010	<0.010	<0.010	0.050
	Cadmium (Cd)-Total (mg/L)	0.00210	0.0000220	0.0000206	<0.000050	0.000224
	Calcium (Ca)-Total (mg/L)	179	30.8	29.6	<0.050	249
	Chromium (Cr)-Total (mg/L)	<0.00010	0.00014	0.00013	0.00012 ^{RRV}	0.00062
	Cobalt (Co)-Total (mg/L)	0.00086	<0.00010	<0.00010	<0.00010	0.00693
	Copper (Cu)-Total (mg/L)	<0.00050	0.00098	0.00092	<0.00050	0.00186
	Iron (Fe)-Total (mg/L)	0.381	0.021	0.020	<0.010	6.91
	Lead (Pb)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	0.000158
	Lithium (Li)-Total (mg/L)	0.0092	<0.0010	<0.0010	<0.0010	<0.0010

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID Description Sampled Date Sampled Time Client ID	L1715452-11			
		Water			
		15-DEC-15			
		12:35			
		WQ-VC-UMN			
Grouping	Analyte				
WATER					
Physical Tests	Conductivity (uS/cm)	255			
	Hardness (as CaCO3) (mg/L)	127			
	pH (pH)	7.87			
	Total Suspended Solids (mg/L)	<3.0			
	Total Dissolved Solids (mg/L)	137			
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	96.2			
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0			
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0			
	Alkalinity, Total (as CaCO3) (mg/L)	96.2			
	Ammonia, Total (as N) (mg/L)	<0.0050			
	Chloride (Cl) (mg/L)	<0.50			
	Fluoride (F) (mg/L)	0.046			
	Nitrate (as N) (mg/L)	0.173			
	Nitrite (as N) (mg/L)	<0.0010			
	Sulfate (SO4) (mg/L)	30.5			
	Anion Sum (meq/L)	2.57			
	Cation Sum (meq/L)	2.68			
	Cation - Anion Balance (%)	2.1			
	Cyanides	Cyanide, Weak Acid Diss (mg/L)	<0.0050		
Cyanide, Total (mg/L)		<0.0050			
Cyanate (mg/L)		<0.20			
Thiocyanate (SCN) (mg/L)		<0.50			
Total Metals	Aluminum (Al)-Total (mg/L)	0.0204			
	Antimony (Sb)-Total (mg/L)	0.00027			
	Arsenic (As)-Total (mg/L)	0.00138			
	Barium (Ba)-Total (mg/L)	0.0752			
	Beryllium (Be)-Total (mg/L)	<0.000020			
	Bismuth (Bi)-Total (mg/L)	<0.000050			
	Boron (B)-Total (mg/L)	<0.010			
	Cadmium (Cd)-Total (mg/L)	0.0000174			
	Calcium (Ca)-Total (mg/L)	32.8			
	Chromium (Cr)-Total (mg/L)	0.00011			
	Cobalt (Co)-Total (mg/L)	<0.00010			
	Copper (Cu)-Total (mg/L)	0.00102			
	Iron (Fe)-Total (mg/L)	0.041			
	Lead (Pb)-Total (mg/L)	0.000067			
	Lithium (Li)-Total (mg/L)	<0.0010			

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID	L1715452-1	L1715452-2	L1715452-3	L1715452-4	L1715452-5
		Description	Water	Water	Water	Water	Water
		Sampled Date	14-DEC-15	14-DEC-15	14-DEC-15	14-DEC-15	15-DEC-15
		Sampled Time	14:25	17:40	18:15	13:55	10:30
		Client ID	FIELD BLANK	WQ-SEEP	WQ-TP	WQ-VC-R+150	WQ-DC-DX+105-R
Grouping	Analyte						
WATER							
Total Metals	Magnesium (Mg)-Total (mg/L)	<0.10	56.6	65.1	10.6	61.8	
	Manganese (Mn)-Total (mg/L)	<0.00010	6.87	0.890	0.0263	1.36	
	Mercury (Hg)-Total (mg/L)	<0.0000050	0.0000054	0.0000104	<0.0000050	<0.0000050	
	Molybdenum (Mo)-Total (mg/L)	<0.000050	0.00103	0.00179	0.000404	0.000405	
	Nickel (Ni)-Total (mg/L)	<0.00050	0.00429	0.0021	<0.00050	0.00185	
	Phosphorus (P)-Total (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050	
	Potassium (K)-Total (mg/L)	<0.10	6.56	22.5	0.82	3.65	
	Selenium (Se)-Total (mg/L)	<0.000050	0.000274	<0.00010 ^{DLA}	<0.000050	<0.000050	
	Silicon (Si)-Total (mg/L)	<0.050	7.49	4.18	6.08	6.58	
	Silver (Ag)-Total (mg/L)	<0.000010	0.000034	0.000191	<0.000010	<0.000010	
	Sodium (Na)-Total (mg/L)	<0.050	31.7	21.3	2.85	4.71	
	Strontium (Sr)-Total (mg/L)	<0.00020	0.785	0.933	0.314	0.449	
	Sulfur (S)-Total (mg/L)	<0.50	238	340	10.4	144	
	Thallium (Tl)-Total (mg/L)	<0.000010	0.000010	0.000245 ^{DLA}	<0.000010	0.000095	
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010 ^{DLM}	<0.00020 ^{DLA}	<0.00010	<0.00010	
	Titanium (Ti)-Total (mg/L)	<0.00030	<0.00021 ^{DLA}	<0.00060 ^{DLA}	<0.00030	<0.00030	
	Uranium (U)-Total (mg/L)	<0.000010	0.00193	0.00164 ^{DLA}	0.000706	0.00446	
	Vanadium (V)-Total (mg/L)	<0.00050	0.00239	<0.0010 ^{DLA}	<0.00050	<0.00050	
	Zinc (Zn)-Total (mg/L)	<0.0030	0.112	0.217 ^{DLA}	<0.0030	0.820	
	Zirconium (Zr)-Total (mg/L)	<0.00030	0.00067	<0.00060 ^{DLA}	<0.00030	<0.00030	
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD	
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD	
	Aluminum (Al)-Dissolved (mg/L)	<0.0010	0.0113	0.0045	0.0055	<0.0010	
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	0.00051	0.0416	0.00033	0.0102	
	Arsenic (As)-Dissolved (mg/L)	<0.00010	0.0453	0.107	0.00115	0.0195	
	Barium (Ba)-Dissolved (mg/L)	<0.000050	0.0589	0.0204 ^{DLA}	0.0738	0.0113	
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000040 ^{DLA}	<0.000020	<0.000020	
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.00010 ^{DLA}	<0.000050	<0.000050	
	Boron (B)-Dissolved (mg/L)	<0.010	0.054	0.101	<0.010	<0.010	
	Cadmium (Cd)-Dissolved (mg/L)	<0.0000050	0.000488	0.00178	0.0000097	0.000793	
	Calcium (Ca)-Dissolved (mg/L)	<0.050	265	344 ^{DLA}	32.7	179	
	Chromium (Cr)-Dissolved (mg/L)	<0.00010	0.00047	<0.00020 ^{DLA}	<0.00010	<0.00010	
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	0.00928	0.00076	<0.00010	0.00083	
	Copper (Cu)-Dissolved (mg/L)	<0.00020	0.00234	0.0336	0.00093	<0.00020	
	Iron (Fe)-Dissolved (mg/L)	<0.010	13.7	0.048	0.013	0.232	
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	0.00167	<0.000050	<0.000050	
	Lithium (Li)-Dissolved (mg/L)	<0.0010	<0.0010	0.0107	<0.0010	0.0091	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID	L1715452-6	L1715452-7	L1715452-8	L1715452-9	L1715452-10
		Description	Water	Water	Water	Water	Water
		Sampled Date	15-DEC-15	15-DEC-15	15-DEC-15	14-DEC-15	14-DEC-15
		Sampled Time	10:05	13:50	14:20	14:25	16:55
		Client ID	WQ-DC-DX+105	WQ-VC-DBC	WQ-VC-U	TRAVEL BLANK	WQ-DC-V
Grouping	Analyte						
WATER							
Total Metals	Magnesium (Mg)-Total (mg/L)		60.1	9.97	9.60	<0.10	63.4
	Manganese (Mn)-Total (mg/L)		1.30	0.0698	0.0678	<0.00010	5.94
	Mercury (Hg)-Total (mg/L)		<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Total (mg/L)		0.000397	0.000461	0.000402	<0.000050	0.000885
	Nickel (Ni)-Total (mg/L)		0.00171	<0.00050	<0.00050	<0.00050	0.00296
	Phosphorus (P)-Total (mg/L)		<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Total (mg/L)		3.56	0.69	0.66	<0.10	6.14
	Selenium (Se)-Total (mg/L)		<0.000050	<0.000050	<0.000050	<0.000050	0.000181
	Silicon (Si)-Total (mg/L)		6.37	6.04	5.85	<0.050	7.29
	Silver (Ag)-Total (mg/L)		<0.000010	<0.000010	<0.000010	<0.000010	0.000020
	Sodium (Na)-Total (mg/L)		4.52	2.57	2.52	<0.050	29.5
	Strontium (Sr)-Total (mg/L)		0.436	0.335	0.323	<0.00020	0.794
	Sulfur (S)-Total (mg/L)		140	7.49	7.20	<0.50	232
	Thallium (Tl)-Total (mg/L)		0.000094	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Total (mg/L)		<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Total (mg/L)		<0.00030	<0.00030	<0.00030	<0.00030	0.00545
	Uranium (U)-Total (mg/L)		0.00440	0.000743	0.000721	<0.000010	0.00157
	Vanadium (V)-Total (mg/L)		<0.00050	<0.00050	<0.00050	<0.00050	0.00166
	Zinc (Zn)-Total (mg/L)		0.780	<0.0030	<0.0030	<0.0030	0.0430
	Zirconium (Zr)-Total (mg/L)		<0.00030	<0.00030	<0.00030	<0.00030	0.00036
Dissolved Metals	Dissolved Mercury Filtration Location		FIELD	FIELD	FIELD		FIELD
	Dissolved Metals Filtration Location		FIELD	FIELD	FIELD		FIELD
	Aluminum (Al)-Dissolved (mg/L)		<0.0010	0.0058	0.0060		0.0084
	Antimony (Sb)-Dissolved (mg/L)		0.0102	<0.00010	<0.00010		0.00034
	Arsenic (As)-Dissolved (mg/L)		0.0194	0.00024	0.00022		0.0362
	Barium (Ba)-Dissolved (mg/L)		0.0115	0.0796	0.0796		0.0697
	Beryllium (Be)-Dissolved (mg/L)		<0.000020	<0.000020	<0.000020		<0.000020
	Bismuth (Bi)-Dissolved (mg/L)		<0.000050	<0.000050	<0.000050		<0.000050
	Boron (B)-Dissolved (mg/L)		<0.010	<0.010	<0.010		0.045
	Cadmium (Cd)-Dissolved (mg/L)		0.000781	0.0000223	0.0000199		0.000158
	Calcium (Ca)-Dissolved (mg/L)		181	30.9	30.7		255
	Chromium (Cr)-Dissolved (mg/L)		<0.00010	<0.00010	<0.00010		0.00031
	Cobalt (Co)-Dissolved (mg/L)		0.00083	<0.00010	<0.00010		0.00653
	Copper (Cu)-Dissolved (mg/L)		<0.00020	0.00083	0.00088		0.00117
	Iron (Fe)-Dissolved (mg/L)		0.230	<0.010	0.011		5.11
	Lead (Pb)-Dissolved (mg/L)		<0.000050	<0.000050	<0.000050		<0.000050
	Lithium (Li)-Dissolved (mg/L)		0.0091	<0.0010	<0.0010		<0.0010

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID Description Sampled Date Sampled Time Client ID	L1715452-11			
		Water			
		15-DEC-15			
		12:35			
		WQ-VC-UMN			
Grouping	Analyte				
WATER					
Total Metals	Magnesium (Mg)-Total (mg/L)	10.6			
	Manganese (Mn)-Total (mg/L)	0.0566			
	Mercury (Hg)-Total (mg/L)	<0.0000050			
	Molybdenum (Mo)-Total (mg/L)	0.000390			
	Nickel (Ni)-Total (mg/L)	<0.00050			
	Phosphorus (P)-Total (mg/L)	<0.050			
	Potassium (K)-Total (mg/L)	0.76			
	Selenium (Se)-Total (mg/L)	<0.000050			
	Silicon (Si)-Total (mg/L)	6.08			
	Silver (Ag)-Total (mg/L)	<0.000010			
	Sodium (Na)-Total (mg/L)	2.95			
	Strontium (Sr)-Total (mg/L)	0.300			
	Sulfur (S)-Total (mg/L)	10.5			
	Thallium (Tl)-Total (mg/L)	<0.000010			
	Tin (Sn)-Total (mg/L)	<0.00010			
	Titanium (Ti)-Total (mg/L)	0.00047			
	Uranium (U)-Total (mg/L)	0.000692			
	Vanadium (V)-Total (mg/L)	<0.00050			
	Zinc (Zn)-Total (mg/L)	<0.0030			
	Zirconium (Zr)-Total (mg/L)	<0.00030			
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD			
	Dissolved Metals Filtration Location	FIELD			
	Aluminum (Al)-Dissolved (mg/L)	0.0051			
	Antimony (Sb)-Dissolved (mg/L)	0.00028			
	Arsenic (As)-Dissolved (mg/L)	0.00130			
	Barium (Ba)-Dissolved (mg/L)	0.0758			
	Beryllium (Be)-Dissolved (mg/L)	<0.000020			
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050			
	Boron (B)-Dissolved (mg/L)	<0.010			
	Cadmium (Cd)-Dissolved (mg/L)	0.0000196			
	Calcium (Ca)-Dissolved (mg/L)	33.2			
	Chromium (Cr)-Dissolved (mg/L)	<0.00010			
	Cobalt (Co)-Dissolved (mg/L)	<0.00010			
	Copper (Cu)-Dissolved (mg/L)	0.00094			
	Iron (Fe)-Dissolved (mg/L)	0.018			
	Lead (Pb)-Dissolved (mg/L)	<0.000050			
	Lithium (Li)-Dissolved (mg/L)	<0.0010			

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	Description	Sampled Date	Sampled Time	Client ID	L1715452-1	L1715452-2	L1715452-3	L1715452-4	L1715452-5
					Water	Water	Water	Water	Water
		14-DEC-15	14-DEC-15		14-DEC-15	14-DEC-15	14-DEC-15	14-DEC-15	15-DEC-15
		14:25	17:40		18:15	13:55	10:30		
		FIELD BLANK	WQ-SEEP		WQ-TP	WQ-VC-R+150	WQ-DC-DX+105-R		
Grouping	Analyte								
WATER									
Dissolved Metals	Magnesium (Mg)-Dissolved (mg/L)	<0.10	57.3	64.3	10.6	59.7			
	Manganese (Mn)-Dissolved (mg/L)	<0.00010	6.86	0.854	0.0245	1.28			
	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050			
	Molybdenum (Mo)-Dissolved (mg/L)	<0.000050	0.000963	0.00169	0.000377	0.000349			
	Nickel (Ni)-Dissolved (mg/L)	<0.00050	0.00414	0.0019	<0.00050	0.00163			
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050			
	Potassium (K)-Dissolved (mg/L)	<0.10	6.59	22.1	0.79	3.47			
	Selenium (Se)-Dissolved (mg/L)	<0.000050	0.000231	<0.00010 ^{DLA}	<0.000050	<0.000050			
	Silicon (Si)-Dissolved (mg/L)	<0.050	7.48	4.03	6.10	6.33			
	Silver (Ag)-Dissolved (mg/L)	<0.000010	0.000010	0.000053	<0.000010	<0.000010			
	Sodium (Na)-Dissolved (mg/L)	<0.050	31.9	20.6	2.86	4.50			
	Strontium (Sr)-Dissolved (mg/L)	<0.00020	0.777	0.899	0.306	0.425			
	Sulfur (S)-Dissolved (mg/L)	<0.50	231	328	10.4	137			
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	0.000238	<0.000010	0.000088			
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00020 ^{DLA}	<0.00010	<0.00010			
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	0.00095	<0.00060 ^{DLA}	<0.00030	<0.00030			
	Uranium (U)-Dissolved (mg/L)	<0.000010	0.00190	0.00153	0.000673	0.00420			
	Vanadium (V)-Dissolved (mg/L)	<0.00050	0.00156	<0.0010 ^{DLA}	<0.00050	<0.00050			
	Zinc (Zn)-Dissolved (mg/L)	<0.0010	0.109	0.205	0.0013	0.767			
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	0.00063	<0.00060 ^{DLA}	<0.00030	<0.00030			

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID	L1715452-6	L1715452-7	L1715452-8	L1715452-9	L1715452-10
		Description	Water	Water	Water	Water	Water
		Sampled Date	15-DEC-15	15-DEC-15	15-DEC-15	14-DEC-15	14-DEC-15
		Sampled Time	10:05	13:50	14:20	14:25	16:55
		Client ID	WQ-DC-DX+105	WQ-VC-DBC	WQ-VC-U	TRAVEL BLANK	WQ-DC-V
Grouping	Analyte						
WATER							
Dissolved Metals	Magnesium (Mg)-Dissolved (mg/L)		59.9	9.84	9.80		63.6
	Manganese (Mn)-Dissolved (mg/L)		1.28	0.0674	0.0663		5.79
	Mercury (Hg)-Dissolved (mg/L)		<0.0000050	<0.0000050	<0.0000050		<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)		0.000356	0.000396	0.000401		0.000815
	Nickel (Ni)-Dissolved (mg/L)		0.00159	<0.00050	<0.00050		0.00276
	Phosphorus (P)-Dissolved (mg/L)		<0.050	<0.050	<0.050		<0.050
	Potassium (K)-Dissolved (mg/L)		3.46	0.65	0.66		6.10
	Selenium (Se)-Dissolved (mg/L)		<0.000050	<0.000050	<0.000050		0.000180
	Silicon (Si)-Dissolved (mg/L)		6.35	6.01	6.02		7.21
	Silver (Ag)-Dissolved (mg/L)		<0.000010	<0.000010	<0.000010		<0.000010
	Sodium (Na)-Dissolved (mg/L)		4.56	2.55	2.58		28.7
	Strontium (Sr)-Dissolved (mg/L)		0.423	0.325	0.319		0.783
	Sulfur (S)-Dissolved (mg/L)		138	7.31	7.20		228
	Thallium (Tl)-Dissolved (mg/L)		0.000087	<0.000010	<0.000010		<0.000010
	Tin (Sn)-Dissolved (mg/L)		<0.00010	<0.00010	<0.00010		<0.00010
	Titanium (Ti)-Dissolved (mg/L)		<0.00030	<0.00030	<0.00030		<0.0012 ^{DLM}
	Uranium (U)-Dissolved (mg/L)		0.00420	0.000697	0.000680		0.00150
	Vanadium (V)-Dissolved (mg/L)		<0.00050	<0.00050	<0.00050		0.00089
	Zinc (Zn)-Dissolved (mg/L)		0.770	<0.0010	0.0016		0.0401
	Zirconium (Zr)-Dissolved (mg/L)		<0.00030	<0.00030	<0.00030		0.00038

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID	L1715452-11				
		Description	Water				
		Sampled Date	15-DEC-15				
		Sampled Time	12:35				
		Client ID	WQ-VC-UMN				
Grouping	Analyte						
WATER							
Dissolved Metals	Magnesium (Mg)-Dissolved (mg/L)		10.6				
	Manganese (Mn)-Dissolved (mg/L)		0.0523				
	Mercury (Hg)-Dissolved (mg/L)		<0.000050				
	Molybdenum (Mo)-Dissolved (mg/L)		0.000382				
	Nickel (Ni)-Dissolved (mg/L)		<0.00050				
	Phosphorus (P)-Dissolved (mg/L)		<0.050				
	Potassium (K)-Dissolved (mg/L)		0.74				
	Selenium (Se)-Dissolved (mg/L)		<0.000050				
	Silicon (Si)-Dissolved (mg/L)		6.09				
	Silver (Ag)-Dissolved (mg/L)		<0.000010				
	Sodium (Na)-Dissolved (mg/L)		2.95				
	Strontium (Sr)-Dissolved (mg/L)		0.322				
	Sulfur (S)-Dissolved (mg/L)		10.3				
	Thallium (Tl)-Dissolved (mg/L)		<0.000010				
	Tin (Sn)-Dissolved (mg/L)		<0.00010				
	Titanium (Ti)-Dissolved (mg/L)		<0.00030				
	Uranium (U)-Dissolved (mg/L)		0.000713				
	Vanadium (V)-Dissolved (mg/L)		<0.00050				
	Zinc (Zn)-Dissolved (mg/L)		0.0019				
	Zirconium (Zr)-Dissolved (mg/L)		<0.00030				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Duplicate	Antimony (Sb)-Dissolved	DLA	L1715452-1, -10, -11, -2, -3, -4, -5, -6, -7, -8
Duplicate	Bismuth (Bi)-Dissolved	DLA	L1715452-1, -10, -11, -2, -3, -4, -5, -6, -7, -8
Duplicate	Chromium (Cr)-Dissolved	DLA	L1715452-1, -10, -11, -2, -3, -4, -5, -6, -7, -8
Duplicate	Selenium (Se)-Dissolved	DLA	L1715452-1, -10, -11, -2, -3, -4, -5, -6, -7, -8
Duplicate	Silver (Ag)-Dissolved	DLA	L1715452-1, -10, -11, -2, -3, -4, -5, -6, -7, -8
Duplicate	Thallium (Tl)-Dissolved	DLA	L1715452-1, -10, -11, -2, -3, -4, -5, -6, -7, -8
Duplicate	Tin (Sn)-Dissolved	DLA	L1715452-1, -10, -11, -2, -3, -4, -5, -6, -7, -8
Duplicate	Titanium (Ti)-Dissolved	DLA	L1715452-1, -10, -11, -2, -3, -4, -5, -6, -7, -8
Duplicate	Vanadium (V)-Dissolved	DLA	L1715452-1, -10, -11, -2, -3, -4, -5, -6, -7, -8
Duplicate	Zirconium (Zr)-Dissolved	DLA	L1715452-1, -10, -11, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Sulfur (S)-Dissolved	MS-B	L1715452-1, -10, -11, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Silicon (Si)-Dissolved	MS-B	L1715452-1, -10, -11, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L1715452-1, -10, -11, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L1715452-1, -10, -11, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1715452-1, -10, -11, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L1715452-1, -10, -11, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L1715452-1, -10, -11, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Silicon (Si)-Dissolved	MS-B	L1715452-1, -10, -11, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Sulfur (S)-Dissolved	MS-B	L1715452-1, -10, -11, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L1715452-1, -10, -11, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1715452-1, -10, -11, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L1715452-1, -10, -11, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L1715452-1, -10, -11, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1715452-1, -10, -11, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Uranium (U)-Dissolved	MS-B	L1715452-1, -10, -11, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L1715452-1, -10, -11, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L1715452-1, -10, -11, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1715452-1, -10, -11, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Uranium (U)-Dissolved	MS-B	L1715452-1, -10, -11, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Zinc (Zn)-Dissolved	MS-B	L1715452-1, -10, -11, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Aluminum (Al)-Total	MS-B	L1715452-1, -10, -11, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Cadmium (Cd)-Total	MS-B	L1715452-1, -10, -11, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Copper (Cu)-Total	MS-B	L1715452-1, -10, -11, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Manganese (Mn)-Total	MS-B	L1715452-1, -10, -11, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Sodium (Na)-Total	MS-B	L1715452-1, -10, -11, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Strontium (Sr)-Total	MS-B	L1715452-1, -10, -11, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Zinc (Zn)-Total	MS-B	L1715452-1, -10, -11, -2, -3, -4, -5, -6, -7, -8, -9

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLA	Detection Limit adjusted for required dilution
DLM	Detection Limit Adjusted due to sample matrix effects.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.
RRV	Reported Result Verified By Repeat Analysis

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
BE-D-L-CCMS-VA	Water	Diss. Be (low) in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			

Reference Information

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

BE-T-L-CCMS-VA Water Total Be (Low) in Water by CRC ICPMS EPA 200.2/6020A (mod)
 Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

CL-IC-N-WR Water Chloride in Water by IC EPA 300.1 (mod)
 Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

CN-CNO-WT Water Cyanate APHA 4500-CN-L
 This analysis is carried out using procedures adapted from APHA method 4500-CN "Cyanide". Cyanate is determined by the Cyanate hydrolysis method using an ammonia selective electrode

CN-SCN-VA Water Thiocyanate by Colour APHA 4500-CN CYANIDE
 This analysis is carried out using procedures adapted from APHA Method 4500-CN- M "Thiocyanate" Thiocyanate is determined by the ferric nitrate colourimetric method.

CN-T-CFA-VA Water Total Cyanide in water by CFA ISO 14403:2002
 This analysis is carried out using procedures adapted from ISO Method 14403:2002 "Determination of Total Cyanide using Flow Analysis (FIA and CFA)". Total or strong acid dissociable (SAD) cyanide is determined by in-line UV digestion along with sample distillation and final determination by colourimetric analysis. Method Limitation: This method is susceptible to interference from thiocyanate (SCN). If SCN is present in the sample, there could be a positive interference with this method, but it would be less than 1% and could be as low as zero.

CN-WAD-CFA-VA Water Weak Acid Diss. Cyanide in water by CFA APHA 4500-CN CYANIDE
 This analysis is carried out using procedures adapted from APHA Method 4500-CN I. "Weak Acid Dissociable Cyanide". Weak Acid Dissociable (WAD) cyanide is determined by in-line sample distillation with final determination by colourimetric analysis.

EC-PCT-VA Water Conductivity (Automated) APHA 2510 Auto. Conduc.
 This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

F-IC-N-WR Water Fluoride in Water by IC EPA 300.1 (mod)
 Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

HARDNESS-CALC-VA Water Hardness APHA 2340B
 Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO₃ equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HG-D-CVAA-VA Water Diss. Mercury in Water by CVAAS or CVAFS APHA 3030B/EPA 1631E (mod)
 Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

HG-T-CVAA-VA Water Total Mercury in Water by CVAAS or CVAFS EPA 1631E (mod)
 Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

IONBALANCE-VA Water Ion Balance Calculation APHA 1030E
 Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:

$$\text{Ion Balance (\%)} = \frac{[\text{Cation Sum} - \text{Anion Sum}]}{[\text{Cation Sum} + \text{Anion Sum}]}$$

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)
 Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-DIS-LOW-ICP-VA Water Dissolved Metals in Water by ICPOES EPA 3005A/6010B
 This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves filtration (EPA Method 3005A) and analysis by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)

Reference Information

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-TOT-LOW-ICP-VA Water Total Metals in Water by ICPOES EPA 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

NH3-F-VA Water Ammonia in Water by Fluorescence APHA 4500 NH3-NITROGEN (AMMONIA)

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Weston et al.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Weston et al.

NO2-L-IC-N-WR Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-WR Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H "pH Value"

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

S-DIS-ICP-VA Water Dissolved Sulfur in Water by ICPOES EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven, or filtration (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

Method Limitation: This method will not give total sulfur results for all samples. Sulfide or other volatile forms of sulfur that may be present in submitted samples, is often lost during the sampling, preservation and analysis process. The data reported as total and/or dissolved sulfur represents all non-volatile forms of sulfur present in a particular sample.

S-TOT-ICP-VA Water Total Sulfur in Water by ICPOES EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven, or filtration (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

Method Limitation: This method will not give total sulfur results for all samples. Sulfide or other volatile forms of sulfur that may be present in submitted samples, is often lost during the sampling, preservation and analysis process. The data reported as total and/or dissolved sulfur represents all non-volatile forms of sulfur present in a particular sample.

SO4-IC-N-WR Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA Water TDS (Calculated) APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".

TSS-MAN-WR Water Total Suspended Solids by Gravimetric APHA 2540 D



ENVIRONMENTAL DYNAMICS INC.
ATTN: Meghan Marjanovic
2195 - 2nd Ave
Whitehorse YT Y1A 3T8

Date Received: 16-DEC-15
Report Date: 30-DEC-15 10:56 (MT)
Version: FINAL

Client Phone: 867-393-4882

Certificate of Analysis

Lab Work Order #: L1715436
Project P.O. #: NOT SUBMITTED
Job Reference: MOUNT NANSEN 15-Y-0146
C of C Numbers: 1
Legal Site Desc:

Can Dang
Senior Account Manager

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ALS CANADA LTD Part of the ALS Group A Campbell Brothers Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID Description Sampled Date Sampled Time Client ID	L1715436-1			
		Water			
		15-DEC-15			
		15:00			
		WQ-PW			
Grouping	Analyte				
WATER					
Physical Tests	Colour, True (CU)	<5.0			
	Conductivity (uS/cm)	346			
	Hardness (as CaCO3) (mg/L)	184			
	pH (pH)	7.93			
	Total Dissolved Solids (mg/L)	192			
	Turbidity (NTU)	0.14			
Anions and Nutrients	Alkalinity, Total (as CaCO3) (mg/L)	159			
	Chloride (Cl) (mg/L)	<0.50			
	Fluoride (F) (mg/L)	0.092			
	Nitrate (as N) (mg/L)	0.135			
	Nitrite (as N) (mg/L)	<0.0010			
	Sulfate (SO4) (mg/L)	28.4			
	Anion Sum (meq/L)	3.79			
	Cation Sum (meq/L)	3.90			
	Cation - Anion Balance (%)	1.5			
Total Metals	Aluminum (Al)-Total (mg/L)	<0.010			
	Antimony (Sb)-Total (mg/L)	<0.00050			
	Arsenic (As)-Total (mg/L)	0.00040			
	Barium (Ba)-Total (mg/L)	0.081			
	Boron (B)-Total (mg/L)	<0.10			
	Cadmium (Cd)-Total (mg/L)	<0.00020			
	Calcium (Ca)-Total (mg/L)	42.8			
	Chromium (Cr)-Total (mg/L)	<0.0020			
	Copper (Cu)-Total (mg/L)	<0.0010			
	Iron (Fe)-Total (mg/L)	<0.030			
	Lead (Pb)-Total (mg/L)	0.00067			
	Magnesium (Mg)-Total (mg/L)	18.7			
	Manganese (Mn)-Total (mg/L)	<0.0020			
	Mercury (Hg)-Total (mg/L)	<0.00020			
	Potassium (K)-Total (mg/L)	0.89			
	Selenium (Se)-Total (mg/L)	<0.0010			
	Sodium (Na)-Total (mg/L)	4.7			
	Uranium (U)-Total (mg/L)	0.00169			
	Zinc (Zn)-Total (mg/L)	<0.050			

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Calcium (Ca)-Total	MS-B	L1715436-1
Matrix Spike	Zinc (Zn)-Total	MS-B	L1715436-1
Matrix Spike	Aluminum (Al)-Total	MS-B	L1715436-1
Matrix Spike	Cadmium (Cd)-Total	MS-B	L1715436-1
Matrix Spike	Copper (Cu)-Total	MS-B	L1715436-1
Matrix Spike	Manganese (Mn)-Total	MS-B	L1715436-1

Qualifiers for Individual Parameters Listed:

Qualifier	Description
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-COL-VA	Water	Alkalinity by Colourimetric (Automated)	EPA 310.2
This analysis is carried out using procedures adapted from EPA Method 310.2 "Alkalinity". Total Alkalinity is determined using the methyl orange colourimetric method.			
CL-IC-N-WR	Water	Chloride in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
COLOUR-TRUE-VA	Water	Colour (True) by Spectrometer	BCMOE Colour Single Wavelength
This analysis is carried out using procedures adapted from British Columbia Environmental Manual "Colour- Single Wavelength." Colour (True Colour) is determined by filtering a sample through a 0.45 micron membrane filter followed by analysis of the filtrate using the platinum-cobalt colourimetric method.			
Colour measurements can be highly pH dependent, and apply to the pH of the sample as received (at time of testing), without pH adjustment. Concurrent measurement of sample pH is recommended.			
EC-MAN-WR	Water	Conductivity by Meter	APHA 2510 (B)
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using an electrode.			
F-IC-N-WR	Water	Fluoride in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
HARDNESS-CALC-VA	Water	Hardness	APHA 2340B
Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.			
HG-TOT-CVAFS-VA	Water	Total Hg in Water by CVAFS LOR=50ppt	EPA 1631E (mod)
This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry or atomic absorption spectrophotometry (EPA Method 245.7).			
IONBALANCE-VA	Water	Ion Balance Calculation	APHA 1030E
Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.			
Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:			
Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum]			
MET-T-CCMS-VA	Water	Total Metals in Water by CRC ICPMS	EPA 200.2/6020A (mod)
Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.			
Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.			
MET-TOT-ICP-VA	Water	Total Metals in Water by ICPOES	EPA SW-846 3005A/6010B
This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).			

Reference Information

NO2-L-IC-N-WR	Water	Nitrite in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
NO3-L-IC-N-WR	Water	Nitrate in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
PH-MAN-WR	Water	pH by Meter	APHA 4500-H+
pH is determined by potentiometric measurement with a pH electrode, and is conducted at ambient laboratory temperature (normally 20 – 5°C). For high accuracy test results, pH should be measured in the field within the recommended 15 minute hold time.			
SO4-IC-N-WR	Water	Sulfate in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
TDS-CALC-VA	Water	TDS (Calculated)	APHA 1030E (20TH EDITION)
This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".			
TURBIDITY-VA	Water	Turbidity by Meter	APHA 2130 "Turbidity"
This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.			
TURBIDITY-VA	Water	Turbidity by Meter	APHA 2130 Turbidity
This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.			

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

1

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



BACTERIOLOGICAL ANALYSIS OF DRINKING WATER ANALYSE BACTÉRIOLOGIQUE DE L'EAU POTABLE

Health and Social Services
Santé et Affaires sociales
Environmental Health Services
Service d'hygiène du milieu

#2 Hospital Road, Whitehorse, Yukon Y1A 3H8
phone : (867) 667-8391 fax : (867) 667-8322
Toll free: 1-800-661-0408 ext.8391

2 Hospital Road, Whitehorse (Yukon) Y1A 3H8
Tel.: 867-667-8391 Téléc.: 867-667-8322
Sans frais au Yukon : 1-800-661-0408, poste 8391

Contact Information • Coordonnées de la personne ressource
Phone 867-393-4882
Téléphone

Contact Person Meghan Margenovic Fax
Personne ressource 2195 2nd Ave Whitehorse, YT Télécopieur
Mailing address Whitehorse, YT Postal code Y1A 3T8
Adresse postale EDI Environmental Dynamics Inc. Code postal

First Nation, Municipal or Business Name
Nom de la Première nation, de la municipalité ou de l'entreprise
Agent EDI Environmental Dynamics Inc. Fax
Télécopieur

Sampling Location • Lieu de la prise d'échantillon

Municipal Address Mt. Nansen Subdivision
Adresse municipale Quadrilatère Lotissement
Legal Description Lot Plan n°
Designation officielle Lot
Other Information (e.g., location, Business / Building Name)
Autres renseignements (ex.: emplacement, nom de l'édifice)

Sample Collection / Prélèvement de l'échantillon

Sample Collected By Dawn Hansen Date 15/12/15 Time 3:50
Échantillon prélevé par Pumphouse Date YYMMDD • AAAAMMUU Heure am pm

Sampling Site (e.g., kitchen tap) Pumphouse Previous Sample Number
Point d'échantillonnage (ex.: robinet de cuisine) Yes No Numéro de l'échantillon précédent
Is this a Resample from a Previous Test? Yes No
Est-ce un deuxième échantillon d'un test antérieur? Oui Non

Sample Supply / Source d'approvisionnement en eau

Public Supply Bulk Water Distributor Business Private Residence
Municipal - par canalisation Municipal - par camion Privé - entreprise Privé - résidence

Sample Source / Provenance de l'échantillon

Dug Well Driven Well Drilled Well Depth of Well
Puits creusé Puits tubulaire Puits foré à la sondeuse Profondeur du puits
 Water Holding Tank Other (explain) _____
Réservoir d'eau Autre (précisez)

Water Treatment / Traitement de l'eau

Is the Water Chlorinated? Yes No Free Available Chlorine _____ ppm
L'eau contient-elle du chlore? Oui Non Chlore libre disponible _____ mg/L
Other Treatment Systems (e.g., UV, softener, filter)
Autre dispositif de traitement (ex.: désinfection aux rayons UV, adoucisseur d'eau, filtre)

For Laboratory Use Only / À l'usage du laboratoire seulement

Receipt of Sample / Réception de l'échantillon		Details / Précisez	
Date	Time	Date	Time
YYMMDD • AAAAMMUU	Heure	YYMMDD • AAAAMMUU	Heure
<u>15-12-16</u>	<u>1:35 pm</u>	<u>15-12-16</u>	<u>5:30 C</u>
<input checked="" type="checkbox"/> Satisfactory / Satisfaisant	<input type="checkbox"/> Unsatisfactory / Non satisfaisant	<u>YYMMDD • AAAAMMUU</u>	<u>am pm</u>
<u>15-12-16</u>	<u>4:00 pm</u>	<u>YYMMDD • AAAAMMUU</u>	<u>88</u>
<u>15-12-17</u>	<u>4:10 pm</u>	<u>YYMMDD • AAAAMMUU</u>	<u>88</u>

Results (See Reverse Side for Interpretation) per 100 ml
Résultats (Voir au verso l'interprétation des résultats)

E. coli/E. coli

Present / Présence Absent / Absence

Comments / Commentaires

Report Authorized By B. Sturim Position WLT Date 15-12-17
Rapport autorisé par B. Sturim Poste WLT YYMMDD • AAAAMMUU
Distribution: White - Chain of Custody Yellow - Lab Copy
Blanc - Chaîne de possession Jaune - Laboratoire
Sample Number: 62255 Pink - Client Copy
Numéro de l'échantillon 62255 Rose - Client