Memorandum

Date:	May 29, 2017
To:	Andrew Crook, Sabina Gold and Silver Corporation
From:	Tyler Gale, P. Geo., ERM; Korina Houghton, ERM
Cc:	Deborah Muggli, ERM; Merle Keefe, Sabina; Matthew Pickard, Sabina
Subject:	**Sub-permafrost Groundwater Sampling Conducted at the Umwelt Westbay System in April 2017**

1. INTRODUCTION

This memorandum documents methods and results of sampling and monitoring conducted at the Umwelt Westbay system (the Westbay system) in April 2017. The work was conducted by ERM Consultants Canada Inc. (ERM) for Sabina Gold & Silver Corporation (Sabina).

The Westbay system was installed in the spring of 2013. Installation methods and results, as well as background information on Westbay system components and the hydrogeologic context are documented in Rescan (2014a).

Sampling and monitoring has previously been conducted at the Westbay system in 2013, 2014, and 2015. Methods and results are documented in Rescan (2014a), Rescan (2014b), and Rescan (2015).

2. METHODS AND DESCRIPTION OF WORK CONDUCTED

Monitoring and sampling were conducted between April 19th and 27th, 2017. The tasks conducted included:

- measuring water pressures at each measuring port (referred to as a pressure profile);
- collecting a sample and processing a field/equipment blank for water quality analysis; and
- collecting 18 litres of water for Sabina's use in metallurgical tests.

The MOSDAX sampler system (as described in Rescan 2014a) was used to operate the Westbay system.

2.1 Pressure Profile

A pressure profile was completed April 19, 2017. Absolute pressure in each measuring port was measured using the pressure transducer housed in the sampler probe. Atmospheric pressure was measured before starting pressure measurements and upon completion of all the measurements.

The pressure measurements may be used to calculate equivalent potentiometric elevations and evaluate Westbay packer seal integrity. These analyses have not been conducted.

2.2 Water Quality Sampling

A sample was collected from Westbay Zone 3 (Table 1) for water quality analysis.

Table 1. Westbay Zone 3 Location

Northing	7,270,320 m N
Easting	430,041 m E
Elevation	Top: -328.4 m bottom: -332.0 m
Depth (vertical, below collar)	Top: 622.1 m bottom: 625.6 m

Horizontal coordinates referenced to NAD83 UTM Zone 10N, elevations referenced to CGVD28

A fluid purge was conducted prior to collecting a sample from Zone 3. The purge was conducted by directing water from Zone 3 into the Westbay casing through the sampler probe connected to the measuring port. The fluid level inside the Westbay casing was lowered (inertial pumping system) such that the pressure inside the casing was around 15 m H_2O lower than the natural pressure in Zone 3. The sampler probe was kept stationary connected to zone 3 for 64 hours (April 19 to 22, 2017), allowing water to flow from the zone into the casing under the introduced hydraulic gradient. The fluid level was measured and pumped down after 16 and 40 hours. An estimated 25 litres was purged, which is equivalent to approximately one zone volume.

The water quality sample was collected through the measuring port at Zone 3 using the MOSDAX sampler probe and laboratory-cleaned stainless steel containers. Four containers were connected in series below the sampler probe, providing for collection of one litre of fluid in a single run down inside the casing to Zone 3 and back to surface. The air inside the containers was vacuumed out using a hand vacuum pump prior to each run. Bottles were filled by iteratively opening and closing the sampler probe valve, while sustaining zone pressure no more than 100 psi below the natural zone pressure. A coil tube flow restrictor was used, providing operator control on the differential pressure introduced while filling bottles.

A set of quality control routines were conducted as part of the sampling procedure to confirm the representativeness of each litre of fluid collected from Zone 3. Surface testing during bottle evacuation was documented to demonstrate system seal integrity. The water pressure inside the Westbay casing was documented before and after the bottles were filled on each run to demonstrate proper connection between the face seal and measuring port. The evolution of pressure with time while filling bottles was observed by the operator, providing an additional indicator of proper connection to the measuring port.

Water was transferred into sample bottles upon recovery of the full stainless steel containers at surface. Containers were wiped dry upon recovery from the casing. Water was directed into the sample bottles from the interconnect valve at the lower end of the string of containers until the

pressure in the containers was completely evacuated. The lower interconnect valve was sprayed with deionized water and rinsed with sample water before filling bottles. Containers were then disconnected and the remaining water was decanted into the sample bottles from the neck of each container.

Sample water was stored in bottles with materials and preservatives as directed by the environmental laboratory (ALS Environmental, Burnaby BC). Samples were shipped to the laboratory in coolers chilled with ice packs. Analyses performed by the laboratory are listed in Table 2.

Table 2. Preservation and Laboratory Methods for Water Quality Analyses

Parameter	Preservation [A]	Analysis Method	Analysis Reference
Physical Tests			
Conductivity	No field preservation	Electrode	APHA Method 2510
Hardness (as $CaCO_3$)		Calculated [Ca] + [Mg]	-
pH		pH electrode	APHA Method 4500-H
Total Suspended Solids		Gravimetric	APHA 2540 D
Total Dissolved Solids		Gravimetric	APHA 2540 C
Turbidity		Nephelometric	APHA 2130
Anions and Nutrients			
Acidity (as $CaCO_3$)	No field preservation	Potentiometric titration	APHA 2310
Alkalinity, Total (as $CaCO_3$)		Potentiometric titration	APHA 2320
Ammonia, Total (as N)	Acidified with sulfuric acid to pH < 2	Fluorescence	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC
Bromide (Br)	No field preservation	Ion Chromatography	EPA 300.1
Chloride (Cl)			
Fluoride (F)			
Nitrate (as N)			
Nitrite (as N)			
Orthophosphate-Dissolved (as P)	No field preservation	Colorometric	APHA 4500-P
Phosphorus (P)-Total			
Sulfate (SO_4)		Ion Chromatography	EPA 300.1
Organic / Inorganic Carbon			
Total Organic Carbon	Acidified with sulfuric acid to pH < 2	Combustion	APHA 5310B

(continued)

Table 2. Preservation and Laboratory Methods for Water Quality Analyses (continued)

Parameter	Preservation [A]	Analysis Method	Analysis Reference
Total Metals			
Aluminum (Al)-Total Antimony (Sb)-Total Arsenic (As)-Total Barium (Ba)-Total Beryllium (Be)-Total Bismuth (Bi)-Total Boron (B)-Total Cadmium (Cd)-Total Calcium (Ca)-Total Cesium (Cs)-Total Chromium (Cr)-Total Cobalt (Co)-Total Copper (Cu)-Total Gallium (Ga)-Total Iron (Fe)-Total Lead (Pb)-Total Lithium (Li)-Total Magnesium (Mg)-Total Manganese (Mn)-Total	Acidified with nitric acid to pH < 2	High resolution - inductively coupled plasma mass spectroscopy, and inductively coupled plasma - optical emission spectrophotometry	EPA 200.8 and EPA SW-846 3005A/6010B
Mercury (Hg)-Total	Acidified with hydrochloric acid to pH < 2	Cold vapour atomic absorption spectrometry	EPA 1631E
Molybdenum (Mo)-Total Nickel (Ni)-Total Phosphorus (P)-Total Potassium (K)-Total Rhenium (Re)-Total Rubidium (Rb)-Total Selenium (Se)-Total Silicon (Si)-Total Silver (Ag)-Total Sodium (Na)-Total Strontium (Sr)-Total Tellurium (Te)-Total	Acidified with nitric acid to pH < 2	High resolution - inductively coupled plasma mass spectroscopy, and inductively coupled plasma - optical emission spectrophotometry	EPA 200.8 and EPA SW-846 3005A/6010B

(continued)

Table 2. Preservation and Laboratory Methods for Water Quality Analyses (continued)

Parameter	Preservation [A]	Analysis Method	Analysis Reference
Total Metals *(cont'd)*			
Thallium (Tl)-Total Thorium (Th)-Total Tin (Sn)-Total Titanium (Ti)-Total Tungsten (W)-Total Uranium (U)-Total Vanadium (V)-Total Yttrium (Y)-Total Zinc (Zn)-Total Zirconium (Zr)-Total			
Dissolved Metals			
Aluminum (Al)-Dissolved Antimony (Sb)-Dissolved Arsenic (As)-Dissolved Barium (Ba)-Dissolved Beryllium (Be)-Dissolved Bismuth (Bi)-Dissolved Boron (B)-Dissolved Cadmium (Cd)-Dissolved Calcium (Ca)-Dissolved Cesium (Cs)-Dissolved Chromium (Cr)-Dissolved Cobalt (Co)-Dissolved Copper (Cu)-Dissolved Gallium (Ga)-Dissolved Iron (Fe)-Dissolved Lead (Pb)-Dissolved Lithium (Li)-Dissolved Magnesium (Mg)-Dissolved Manganese (Mn)-Dissolved	Field filtered, acidified with nitric acid to pH < 2	High resolution - inductively coupled plasma mass spectroscopy, and inductively coupled plasma - optical emission spectrophotometry	EPA 200.8 and EPA SW-846 3005A/6010B
Mercury (Hg)-Dissolved	Field filtered, acidified with hydrochloric acid to pH < 2	Cold vapour atomic absorption spectrometry	EPA 1631E

(continued)

Table 2. Preservation and Laboratory Methods for Water Quality Analyses (completed)

Parameter	Preservation [A]	Analysis Method	Analysis Reference
Dissolved Metals *(cont'd)*			
Molybdenum (Mo)-Dissolved Nickel (Ni)-Dissolved Phosphorus (P)-Dissolved Potassium (K)-Dissolved Rhenium (Re)-Dissolved Rubidium (Rb)-Dissolved Selenium (Se)-Dissolved Silicon (Si)-Dissolved Silver (Ag)-Dissolved Sodium (Na)-Dissolved Strontium (Sr)-Dissolved Tellurium (Te)-Dissolved Thallium (Tl)-Dissolved Thorium (Th)-Dissolved Tin (Sn)-Dissolved Titanium (Ti)-Dissolved Tungsten (W)-Dissolved Uranium (U)-Dissolved Vanadium (V)-Dissolved Yttrium (Y)-Dissolved Zinc (Zn)-Dissolved Zirconium (Zr)-Dissolved	Field filtered, acidified with nitric acid to pH < 2	High resolution - inductively coupled plasma mass spectroscopy, and inductively coupled plasma - optical emission spectrophotometry	EPA 200.8 and EPA SW-846 3005A/6010B
Glycols			
Diethylene Glycol Ethylene Glycol 1,2-Propylene Glycol Triethylene Glycol	Preservation with sodium bisulfate	gas chromatography with flame ionization detection	SW-846, METHOD 8015B, EPA
Organic Parameters			
Ethane, Dissolved Ethene, Dissolved Methane, Dissolved	No head space, preservation with sodium bisulfate	gas chromatography with flame ionization detection	EPA REGION 1, NATATTEN.WPD REV. 1
Ra-226	Acidified with nitric acid to pH < 2	Radon Emanation	EPA 903.1

[A] *All samples were chilled with ice*

APHA. 2012. Standard Methods for the Examination of Water and Wastewater (22nd Ed.). American Public Works Association, American Water Works Association, Water Environment Federation.

EPA. 2012. Selected Analytical Methods for Environmental Remediation and Recovery (SAM) 2012. U.S. Environmental Protection Agency, Washington, D.C., EPA/600/R-12/555, 2012.

An equipment/field blank sample was processed and submitted for water quality analysis alongside the sample from Zone 3. Deionized water was decanted into four Westbay containers. The containers were connected to the sampler probe, and lowered inside the Westbay casing until they were submerged in the fluid inside the casing. The motor was then operated to deploy and retract the landing arm and shoe, then the probe and containers were reeled back to surface. The water was decanted into sample bottles from the necks of the stainless steel containers. This procedure was repeated until a full set of sample bottles was filled (approximately three litres).

2.3 Sample for Metallurgical Tests

Water was collected for metallurgical testing following collection of the water quality sample. Water collection methods were identical to those used for the water quality sample (Section 2.2): water was collected from zone 3 using the sampler probe and stainless steel containers, and the same quality control procedures were conducted for each run. A total of approximately 18 litres of water from zone 3 was collected between April 23rd and 27th. The water was transferred into two 15 L plastic water containers and provided to Sabina personnel in Goose Camp. The water was not chemically preserved.

3. RESULTS

3.1 Pressure Profile

Pressures measured in each zone are included in Table 3. Atmospheric pressure was 14.1 psi immediately before and after conducting the pressure profile. The fluid level inside the Westbay casing was 30.5 m below the collar.

Table 3. Water Pressures Measured in Westbay Zones

Zone	Counter Depth (m)	Pressure in Casing (psia)	Zone Pressure (psia)
QA1	701.7	1012.25	1000.06
1	697.3	1005.37	993.25
QA2	677.5	975.75	963.35
2	671	966.11	956.70
QA3	652.8	938.73	928.48
3	648.2	931.82	922.23
QA4	631.5	906.73	899.92
4	626.7	899.78	893.35
QA5	540.4	770.64	767.75
5	536.1	763.74	762.10
QA6	458.4	647.68	651.85
QA7	383.9	536.15	549.80
QA8	283.6	386.61	406.95
QA9	183.7	238.03	265.36
QA10	86.4	95.30	125.70

pisa = absolute pressure (psi)
Fluid level inside casing: 30.5 m on counter

3.2 Groundwater Quality

The laboratory analysis report is attached in Appendix A. Water quality for the sample collected from Westbay Zone 3 is presented in Table 4.

Table 4. April 2017 Westbay Zone 3 Sample Concentrations

Parameter	Units	Detection Limit	Concentration
Physical Tests			
Conductivity	uS/cm	2.0	103,000
Hardness (as $CaCO_3$)	mg/L	8.6	47,300
pH	pH	0.10	6.59
Total Suspended Solids	mg/L	3.0	119
Total Dissolved Solids	mg/L	80	78,900
Turbidity	NTU	0.10	43.1
Anions and Nutrients			
Acidity (as $CaCO_3$)	mg/L	1.0	29.5
Alkalinity, Total (as $CaCO_3$)	mg/L	1.0	36.1
Ammonia, Total (as N)	mg/L	0.0050	<0.0050
Bromide (Br)	mg/L	10	469
Chloride (Cl)	mg/L	50	49,700
Fluoride (F)	mg/L	2.0	<2.0
Nitrate (as N)	mg/L	0.50	<0.50
Nitrite (as N)	mg/L	0.10	<0.10
Orthophosphate-Dissolved (as P)	mg/L	0.0010	0.0017
Phosphorus (P)-Total	mg/L	0.020	0.081
Sulfate (SO_4)	mg/L	30	<30
Total Organic Carbon	mg/L	10	319
Total Metals			
Aluminum (Al)	mg/L	0.15	<0.15
Antimony (Sb)	mg/L	0.0015	<0.0015
Arsenic (As)	mg/L	0.0025	<0.0025
Barium (Ba)	mg/L	0.0050	8.28
Beryllium (Be)	mg/L	0.00025	<0.00025
Bismuth (Bi)	mg/L	0.0025	<0.0025
Boron (B)	mg/L	0.50	4.71
Cadmium (Cd)	mg/L	0.00025	0.00025
Calcium (Ca)	mg/L	1.0	18,100
Cesium (Cs)	mg/L	0.00025	0.0222
Chromium (Cr)	mg/L	0.025	<0.025

(continued)

Table 4. April 2017 Westbay Zone 3 Sample Concentrations (continued)

Parameter	Units	Detection Limit	Concentration
Total Metals *(cont'd)*			
Cobalt (Co)	mg/L	0.0025	<0.0025
Copper (Cu)	mg/L	0.025	<0.025
Gallium (Ga)	mg/L	0.0025	<0.0025
Iron (Fe)	mg/L	0.60	5.36
Lead (Pb)	mg/L	0.0025	<0.0025
Lithium (Li)	mg/L	0.020	8.67
Magnesium (Mg)	mg/L	2.0	1030
Manganese (Mn)	mg/L	0.010	4.31
Mercury (Hg)	mg/L	0.0000050	<0.0000050
Molybdenum (Mo)	mg/L	0.0025	0.0632
Nickel (Ni)	mg/L	0.010	<0.010
Phosphorus (P)	mg/L	6.0	<6.0
Potassium (K)	mg/L	40	377
Rhenium (Re)	mg/L	0.00025	<0.00025
Rubidium (Rb)	mg/L	0.0010	0.544
Selenium (Se)	mg/L	0.010	<0.010
Silicon (Si)	mg/L	2.0	<2.0
Silver (Ag)	mg/L	0.00025	0.00079
Sodium (Na)	mg/L	40	7,170
Strontium (Sr)	mg/L	0.010	269
Tellurium (Te)	mg/L	0.00050	<0.00050
Thallium (Tl)	mg/L	0.00025	<0.00025
Thorium (Th)	mg/L	0.00025	<0.00025
Tin (Sn)	mg/L	0.010	<0.010
Titanium (Ti)	mg/L	0.010	<0.010
Tungsten (W)	mg/L	0.000010	0.00139
Uranium (U)	mg/L	0.00010	<0.00010
Vanadium (V)	mg/L	0.0025	<0.0025
Yttrium (Y)	mg/L	0.00025	0.00209
Zinc (Zn)	mg/L	0.15	0.55
Zirconium (Zr)	mg/L	0.0025	<0.0025
Dissolved Metals			
Aluminum (Al)	mg/L	0.050	<0.050
Antimony (Sb)	mg/L	0.00050	0.00061
Arsenic (As)	mg/L	0.0025	<0.0025

(continued)

Table 4. April 2017 Westbay Zone 3 Sample Concentrations (continued)

Parameter	Units	Detection Limit	Concentration
Dissolved Metals *(cont'd)*			
Barium (Ba)	mg/L	0.0050	8.31
Beryllium (Be)	mg/L	0.00025	<0.00025
Bismuth (Bi)	mg/L	0.0025	<0.0025
Boron (B)	mg/L	0.25	4.79
Cadmium (Cd)	mg/L	0.00025	<0.00025
Calcium (Ca)	mg/L	1.0	17,300
Cesium (Cs)	mg/L	0.00025	0.0223
Chromium (Cr)	mg/L	0.025	<0.025
Cobalt (Co)	mg/L	0.0025	<0.0025
Copper (Cu)	mg/L	0.010	<0.010
Gallium (Ga)	mg/L	0.0025	<0.0025
Iron (Fe)	mg/L	0.60	4.69
Lead (Pb)	mg/L	0.0025	<0.0025
Lithium (Li)	mg/L	0.010	8.61
Magnesium (Mg)	mg/L	2.0	984
Manganese (Mn)	mg/L	0.010	4.32
Mercury (Hg)	mg/L	0.0000050	<0.0000050
Molybdenum (Mo)	mg/L	0.0025	0.0586
Nickel (Ni)	mg/L	0.010	<0.010
Phosphorus (P)	mg/L	6.0	<6.0
Potassium (K)	mg/L	40	358
Rhenium (Re)	mg/L	0.00025	<0.00025
Rubidium (Rb)	mg/L	0.0010	0.539
Selenium (Se)	mg/L	0.010	<0.010
Silicon (Si)	mg/L	1.0	<1.0
Silver (Ag)	mg/L	0.00025	<0.00025
Sodium (Na)	mg/L	40	7,090
Strontium (Sr)	mg/L	0.0025	372
Tellurium (Te)	mg/L	0.00050	<0.00050
Thallium (Tl)	mg/L	0.00010	<0.00010
Thorium (Th)	mg/L	0.00025	<0.00025
Tin (Sn)	mg/L	0.010	<0.010
Titanium (Ti)	mg/L	0.010	<0.010
Tungsten (W)	mg/L	0.00050	0.00136
Uranium (U)	mg/L	0.00010	<0.00010

(continued)

Table 4. April 2017 Westbay Zone 3 Sample Concentrations (completed)

Parameter	Units	Detection Limit	Concentration
Dissolved Metals *(cont'd)*			
Vanadium (V)	mg/L	0.0025	<0.0025
Yttrium (Y)	mg/L	0.00025	0.00159
Zinc (Zn)	mg/L	0.050	0.064
Zirconium (Zr)	mg/L	0.0025	<0.0025
Glycols			
Diethylene Glycol	mg/L	5.0	<5.0
Ethylene Glycol	mg/L	5.0	<5.0
1,2-Propylene Glycol	mg/L	25	435
Triethylene Glycol	mg/L	5.0	<5.0
Organic Parameters			
Ethane, Dissolved	ug/L	5.0	499
Ethene, Dissolved	ug/L	5.0	<5.0
Methane, Dissolved	ug/L	5.0	6,670
Ra-226	Bq/L	0.25	61

"<" indicates the concentration is below the detection limit.

The concentrations of major ions (chloride, calcium, sodium) are within the expected ranges for the groundwater at the depth of Zone 3, suggesting the rebounding drilling fluid proportion observed in the 2014 and 2015 samples was removed by the three day purge.

The charge balance error calculated for the Zone 3 sample is - 3.3 %. This value is within the ± 5% target, and indicates acceptable laboratory accuracy.

Parameters with detections in the blank sample are identified in Appendix A (Table A-1). These detections are expected, and attributable to contact with the stainless steel sample bottles and trace sample contamination with fluid from inside the casing, which occurs when the sample is decanted from the Westbay containers into the sample bottles. The fluid inside the Westbay casing consists of a mix of 3:1 Goose Lake Water:propylene glycol anti freeze solution, and drilling fluid.

Propylene glycol was detected in the Zone 3 sample, and the concentration is consistent with previous sampling in 2013, 2014, and 2015. There are three identified sources:

- trace cross-contamination of the sample with fluid from inside the Westbay casing, corresponding with the detection in the blank sample;
- a few milliliters of fluid from inside the casing retained in front of the face seal and inside the probe above the valve when connecting to the zone immediately before collecting a sample; and

- residual casing fluid in the zone, which was allowed to enter during packer inflation during installation in June 2013.

The Zone 3 sample is estimated to contain as much as 0.5% fluid from inside the Westbay casing, as supported by analysis and discussion documented in Rescan (2014a).

4. SUMMARY

Sampling and monitoring was conducted at the Umwelt Westbay system in April 2017.

A pressure profile was conducted on April 19th. The pressure measurements are included in this memorandum.

Approximately one zone volume of water was purged from Westbay Zone 3 (626 to 622 m below surface) prior to collection of samples. The water quality results suggest the purge adequately removed drilling fluid that was observed to be slowly mixing into the zone during previous sampling in 2014 and 2015.

A sample was collected from Westbay Zone 3 for water quality analysis, along with an equipment/field blank. Quality control data indicate the sample is representative for Zone 3. The water quality data are consistent with previous estimates for sub-permafrost groundwater quality at the corresponding depth.

Eighteen liters of water was collected from Westbay Zone 3 for Sabina's use in metallurgical testing. Quality control data indicate the sample is representative for Zone 3.

REFERENCES

Rescan. 2014a. *Back River Project: 2013 Sub-permafrost Groundwater Quality Baseline Report*. Prepared for Sabina Gold & Silver Corp. by Rescan Environmental Services Ltd., an ERM company

Rescan. 2014b. *Back River Project: 2014 Sub-permafrost Groundwater Quality Baseline Report*. Prepared for Sabina Gold & Silver Corp. by Rescan Environmental Services Ltd., an ERM company

Rescan. 2015. *Back River Project: 2015 Sub-permafrost Groundwater Quality Baseline Report.* Prepared for Sabina Gold & Silver Corp. by Rescan Environmental Services Ltd., an ERM company.

— Appendix A —

Laboratory Analysis Report

Appendix A. Blank Analysis

Parameter	Units	Concentration in Blank	Zone 3 Sample Detection Limits
Physical Tests			
Conductivity	uS/cm	***13.6***	2.0
Hardness (as $CaCO_3$)	mg/L	4.18	8.6
pH	pH	6.02	NA
Total Suspended Solids	mg/L	<3.0	3.0
Total Dissolved Solids	mg/L	<10	80
Turbidity	NTU	0.33	0.10
Anions and Nutrients			
Acidity (as $CaCO_3$)	mg/L	2.4	NA
Alkalinity, Total (as $CaCO_3$)	mg/L	***1.2***	1.0
Ammonia, Total (as N)	mg/L	***0.508***	0.0050
Bromide (Br)	mg/L	<0.050	10
Chloride (Cl)	mg/L	0.75	50
Fluoride (F)	mg/L	<0.020	2.0
Nitrate (as N)	mg/L	<0.0050	0.50
Nitrite (as N)	mg/L	<0.0010	0.10
Orthophosphate-Dissolved (as P)	mg/L	***0.171***	0.0010
Phosphorus (P)-Total	mg/L	***0.083***	0.020
Sulfate (SO_4)	mg/L	<0.30	30
Total Organic Carbon	mg/L	7.16	10
Total Metals			
Aluminum (Al)-Total	mg/L	0.0092	0.15
Antimony (Sb)-Total	mg/L	0.000109	0.0015
Arsenic (As)-Total	mg/L	0.000055	0.0025
Barium (Ba)-Total	mg/L	0.00099	0.0050
Beryllium (Be)-Total	mg/L	<0.0000050	0.00025
Bismuth (Bi)-Total	mg/L	<0.000050	0.0025
Boron (B)-Total	mg/L	<0.010	0.50
Cadmium (Cd)-Total	mg/L	0.0000706	0.00025
Calcium (Ca)-Total	mg/L	0.800	1.0
Cesium (Cs)-Total	mg/L	<0.0000050	0.00025
Chromium (Cr)-Total	mg/L	0.00097	0.025
Cobalt (Co)-Total	mg/L	0.000054	0.0025
Copper (Cu)-Total	mg/L	0.00648	0.025
Gallium (Ga)-Total	mg/L	<0.000050	0.0025
Iron (Fe)-Total	mg/L	<0.030	0.60
Lead (Pb)-Total	mg/L	<0.000050	0.0025
Lithium (Li)-Total	mg/L	0.00067	0.020
Magnesium (Mg)-Total	mg/L	<0.10	2.0
Manganese (Mn)-Total	mg/L	0.00088	0.010
Mercury (Hg)-Total	mg/L	<0.0000050	0.0000050
Molybdenum (Mo)-Total	mg/L	0.000150	0.0025
Nickel (Ni)-Total	mg/L	0.00119	0.010
Phosphorus (P)-Total	mg/L	<0.30	6.0
Potassium (K)-Total	mg/L	<2.0	40
Rhenium (Re)-Total	mg/L	<0.0000050	0.00025
Rubidium (Rb)-Total	mg/L	0.000085	0.0010
Selenium (Se)-Total	mg/L	<0.00020	0.010
Silicon (Si)-Total	mg/L	<0.10	2.0

Appendix A. Blank Analysis

Parameter	Units	Concentration in Blank	Zone 3 Sample Detection Limits
Silver (Ag)-Total	mg/L	0.0000099	0.00025
Sodium (Na)-Total	mg/L	<2.0	40
Strontium (Sr)-Total	mg/L	***0.0127***	0.010
Tellurium (Te)-Total	mg/L	<0.000010	0.00050
Thallium (Tl)-Total	mg/L	<0.0000050	0.00025
Thorium (Th)-Total	mg/L	<0.0000050	0.00025
Tin (Sn)-Total	mg/L	<0.00020	0.010
Titanium (Ti)-Total	mg/L	<0.00020	0.010
Tungsten (W)-Total	mg/L	0.000025	0.00050
Uranium (U)-Total	mg/L	0.0000039	0.00010
Vanadium (V)-Total	mg/L	0.000399	0.0025
Yttrium (Y)-Total	mg/L	<0.0000050	0.00025
Zinc (Zn)-Total	mg/L	0.0408	0.15
Zirconium (Zr)-Total	mg/L	<0.000050	0.0025
Dissolved Metals			
Aluminum (Al)-Dissolved	mg/L	<0.0010	0.050
Antimony (Sb)-Dissolved	mg/L	<0.000010	0.00050
Arsenic (As)-Dissolved	mg/L	<0.000050	0.0025
Barium (Ba)-Dissolved	mg/L	0.00156	0.0050
Beryllium (Be)-Dissolved	mg/L	<0.0000050	0.00025
Bismuth (Bi)-Dissolved	mg/L	<0.000050	0.0025
Boron (B)-Dissolved	mg/L	<0.0050	0.25
Cadmium (Cd)-Dissolved	mg/L	0.0000884	0.00025
Calcium (Ca)-Dissolved	mg/L	***1.67***	1.0
Cesium (Cs)-Dissolved	mg/L	<0.0000050	0.00025
Chromium (Cr)-Dissolved	mg/L	<0.00050	0.025
Cobalt (Co)-Dissolved	mg/L	<0.000050	0.0025
Copper (Cu)-Dissolved	mg/L	0.00210	0.010
Gallium (Ga)-Dissolved	mg/L	<0.000050	0.0025
Iron (Fe)-Dissolved	mg/L	<0.030	0.60
Lead (Pb)-Dissolved	mg/L	<0.000050	0.0025
Lithium (Li)-Dissolved	mg/L	0.00146	0.010
Magnesium (Mg)-Dissolved	mg/L	<0.10	2.0
Manganese (Mn)-Dissolved	mg/L	0.00064	0.010
Mercury (Hg)-Dissolved	mg/L	<0.0000050	0.0000050
Molybdenum (Mo)-Dissolved	mg/L	0.000056	0.0025
Nickel (Ni)-Dissolved	mg/L	0.00044	0.010
Phosphorus (P)-Dissolved	mg/L	<0.30	6.0
Potassium (K)-Dissolved	mg/L	<2.0	40
Rhenium (Re)-Dissolved	mg/L	<0.0000050	0.00025
Rubidium (Rb)-Dissolved	mg/L	0.000168	0.0010
Selenium (Se)-Dissolved	mg/L	<0.00020	0.010
Silicon (Si)-Dissolved	mg/L	<0.050	1.0
Silver (Ag)-Dissolved	mg/L	<0.0000050	0.00025
Sodium (Na)-Dissolved	mg/L	<2.0	40
Strontium (Sr)-Dissolved	mg/L	***0.0305***	0.0025
Tellurium (Te)-Dissolved	mg/L	<0.000010	0.00050
Thallium (Tl)-Dissolved	mg/L	<0.0000020	0.00010
Thorium (Th)-Dissolved	mg/L	<0.0000050	0.00025

Appendix A. Blank Analysis

Parameter	Units	Concentration in Blank	Zone 3 Sample Detection Limits
Tin (Sn)-Dissolved	mg/L	0.00034	0.010
Titanium (Ti)-Dissolved	mg/L	<0.00020	0.010
Tungsten (W)-Dissolved	mg/L	<0.000010	0.00050
Uranium (U)-Dissolved	mg/L	0.0000029	0.00010
Vanadium (V)-Dissolved	mg/L	0.000081	0.0025
Yttrium (Y)-Dissolved	mg/L	<0.0000050	0.00025
Zinc (Zn)-Dissolved	mg/L	0.0471	0.050
Zirconium (Zr)-Dissolved	mg/L	<0.000050	0.0025
Glycols			
Diethylene Glycol	mg/L	<5.0	5.0
Ethylene Glycol	mg/L	<5.0	5.0
1,2-Propylene Glycol	mg/L	***49.7***	25
Triethylene Glycol	mg/L	<5.0	5.0
Organic Parameters			
Ethane, Dissolved	ug/L	<5.0	5.0
Ethene, Dissolved	ug/L	<5.0	5.0
Methane, Dissolved	ug/L	<5.0	5.0
Ra-226	Bq/L	0.027	0.25

ERM Consultants Canada Ltd.
ATTN: Tyler Gale
1500-1111 West Hastings Street
Vancouver BC V6E 2J3

Date Received: 27-APR-17
Report Date: 25-MAY-17 15:50 (MT)
Version: FINAL

Client Phone: 604-689-9460

Certificate of Analysis

Lab Work Order #: L1918067

Project P.O. #: NOT SUBMITTED
Job Reference: 0333261-0012
C of C Numbers: 15-602698
Legal Site Desc:

Amber Springer, B.Sc
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1918067-1	L1918067-2			
	Description	water	water			
	Sampled Date	22-APR-17	22-APR-17			
	Sampled Time	12:00	15:00			
	Client ID	ZONE18-0417	ZONE3-0417			
Grouping	**Analyte**					
WATER						
Physical Tests	Conductivity (uS/cm)	13.6	103000			
	Hardness (as CaCO3) (mg/L)	4.18	47300			
	pH (pH)	6.02	6.59			
	Total Suspended Solids (mg/L)	<3.0	119			
	Total Dissolved Solids (mg/L)	<10	78900			
	Turbidity (NTU)	0.33	43.1			
Anions and Nutrients	Acidity (as CaCO3) (mg/L)	2.4	29.5			
	Alkalinity, Total (as CaCO3) (mg/L)	1.2	36.1			
	Ammonia, Total (as N) (mg/L)	0.508	<0.0050			
	Bromide (Br) (mg/L)	<0.050	469			
	Chloride (Cl) (mg/L)	0.75	49700			
	Fluoride (F) (mg/L)	<0.020	<2.0 DLDS			
	Nitrate (as N) (mg/L)	<0.0050	<0.50 DLDS			
	Nitrite (as N) (mg/L)	<0.0010	<0.10 DLDS			
	Orthophosphate-Dissolved (as P) (mg/L)	0.171 RRV	0.0017			
	Phosphorus (P)-Total (mg/L)	0.083	0.081			
	Sulfate (SO4) (mg/L)	<0.30	<30 DLDS			
Organic / Inorganic Carbon	Total Organic Carbon (mg/L)	7.16	319			
Total Metals	Aluminum (Al)-Total (mg/L)	0.0092	<0.15 DLA			
	Antimony (Sb)-Total (mg/L)	0.000109	<0.0015 DLA			
	Arsenic (As)-Total (mg/L)	0.000055	<0.0025 DLA			
	Barium (Ba)-Total (mg/L)	0.00099	8.28			
	Beryllium (Be)-Total (mg/L)	<0.0000050	<0.00025 DLA			
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.0025 DLA			
	Boron (B)-Total (mg/L)	<0.010	4.71			
	Cadmium (Cd)-Total (mg/L)	0.0000706	0.00025			
	Calcium (Ca)-Total (mg/L)	0.800	18100			
	Cesium (Cs)-Total (mg/L)	<0.0000050	0.0222			
	Chromium (Cr)-Total (mg/L)	0.00097	<0.025 DLA			
	Cobalt (Co)-Total (mg/L)	0.000054	<0.0025 DLA			
	Copper (Cu)-Total (mg/L)	0.00648	<0.025 DLA			
	Gallium (Ga)-Total (mg/L)	<0.000050	<0.0025 DLA			
	Iron (Fe)-Total (mg/L)	<0.030	5.36			
	Lead (Pb)-Total (mg/L)	<0.000050	<0.0025 DLA			
	Lithium (Li)-Total (mg/L)	0.00067	8.67			
	Magnesium (Mg)-Total (mg/L)	<0.10	1030			

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1918067-1	L1918067-2			
	Description	water	water			
	Sampled Date	22-APR-17	22-APR-17			
	Sampled Time	12:00	15:00			
	Client ID	ZONE18-0417	ZONE3-0417			
Grouping	**Analyte**					
WATER						
Total Metals	Manganese (Mn)-Total (mg/L)	0.00088	4.31			
	Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050			
	Molybdenum (Mo)-Total (mg/L)	0.000150	0.0632			
	Nickel (Ni)-Total (mg/L)	0.00119	<0.010 DLA			
	Phosphorus (P)-Total (mg/L)	<0.30	<6.0 DLHC			
	Potassium (K)-Total (mg/L)	<2.0	377			
	Rhenium (Re)-Total (mg/L)	<0.0000050	<0.00025 DLA			
	Rubidium (Rb)-Total (mg/L)	0.000085	0.544			
	Selenium (Se)-Total (mg/L)	<0.00020	<0.010 DLA			
	Silicon (Si)-Total (mg/L)	<0.10	<2.0 DLHC			
	Silver (Ag)-Total (mg/L)	0.0000099	0.00079			
	Sodium (Na)-Total (mg/L)	<2.0	7170			
	Strontium (Sr)-Total (mg/L)	0.0127	269			
	Tellurium (Te)-Total (mg/L)	<0.000010	<0.00050 DLA			
	Thallium (Tl)-Total (mg/L)	<0.0000050	<0.00025 DLA			
	Thorium (Th)-Total (mg/L)	<0.0000050	<0.00025 DLA			
	Tin (Sn)-Total (mg/L)	<0.00020	<0.010 DLA			
	Titanium (Ti)-Total (mg/L)	<0.00020	<0.010 DLA			
	Tungsten (W)-Total (mg/L)	0.000025	0.00139			
	Uranium (U)-Total (mg/L)	0.0000039	<0.00010 DLA			
	Vanadium (V)-Total (mg/L)	0.000399	<0.0025 DLA			
	Yttrium (Y)-Total (mg/L)	<0.0000050	0.00209			
	Zinc (Zn)-Total (mg/L)	0.0408	0.55			
	Zirconium (Zr)-Total (mg/L)	<0.000050	<0.0025 DLA			
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD			
	Dissolved Metals Filtration Location	FIELD	FIELD			
	Aluminum (Al)-Dissolved (mg/L)	<0.0010	<0.050 DLA			
	Antimony (Sb)-Dissolved (mg/L)	<0.000010	0.00061			
	Arsenic (As)-Dissolved (mg/L)	<0.000050	<0.0025 DLA			
	Barium (Ba)-Dissolved (mg/L)	0.00156 DTC	8.31			
	Beryllium (Be)-Dissolved (mg/L)	<0.0000050	<0.00025 DLA			
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.0025 DLA			
	Boron (B)-Dissolved (mg/L)	<0.0050	4.79			
	Cadmium (Cd)-Dissolved (mg/L)	0.0000884 DTC	<0.00025 DLA			
	Calcium (Ca)-Dissolved (mg/L)	1.67 DTC	17300			
	Cesium (Cs)-Dissolved (mg/L)	<0.0000050	0.0223			
	Chromium (Cr)-Dissolved (mg/L)	<0.00050	<0.025 DLA			

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1918067-1	L1918067-2			
	Description	water	water			
	Sampled Date	22-APR-17	22-APR-17			
	Sampled Time	12:00	15:00			
	Client ID	ZONE18-0417	ZONE3-0417			
Grouping	**Analyte**					
WATER						
Dissolved Metals	Cobalt (Co)-Dissolved (mg/L)	<0.000050	<0.0025 DLA			
	Copper (Cu)-Dissolved (mg/L)	0.00210	<0.010 DLA			
	Gallium (Ga)-Dissolved (mg/L)	<0.000050	<0.0025 DLA			
	Iron (Fe)-Dissolved (mg/L)	<0.030	4.69			
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.0025 DLA			
	Lithium (Li)-Dissolved (mg/L)	0.00146	8.61			
	Magnesium (Mg)-Dissolved (mg/L)	<0.10	984			
	Manganese (Mn)-Dissolved (mg/L)	0.00064	4.32			
	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050			
	Molybdenum (Mo)-Dissolved (mg/L)	0.000056	0.0586			
	Nickel (Ni)-Dissolved (mg/L)	0.00044	<0.010 DLA			
	Phosphorus (P)-Dissolved (mg/L)	<0.30	<6.0 DLHC			
	Potassium (K)-Dissolved (mg/L)	<2.0	358			
	Rhenium (Re)-Dissolved (mg/L)	<0.0000050	<0.00025 DLA			
	Rubidium (Rb)-Dissolved (mg/L)	0.000168 DTC	0.539			
	Selenium (Se)-Dissolved (mg/L)	<0.00020	<0.010 DLA			
	Silicon (Si)-Dissolved (mg/L)	<0.050	<1.0 DLHC			
	Silver (Ag)-Dissolved (mg/L)	<0.0000050	<0.00025 DLA			
	Sodium (Na)-Dissolved (mg/L)	<2.0	7090			
	Strontium (Sr)-Dissolved (mg/L)	0.0305 DTC	372 DTC			
	Tellurium (Te)-Dissolved (mg/L)	<0.000010	<0.00050 DLA			
	Thallium (Tl)-Dissolved (mg/L)	<0.0000020	<0.00010 DLA			
	Thorium (Th)-Dissolved (mg/L)	<0.0000050	<0.00025 DLA			
	Tin (Sn)-Dissolved (mg/L)	0.00034	<0.010 DLA			
	Titanium (Ti)-Dissolved (mg/L)	<0.00020	<0.010 DLA			
	Tungsten (W)-Dissolved (mg/L)	<0.000010	0.00136			
	Uranium (U)-Dissolved (mg/L)	0.0000029	<0.00010 DLA			
	Vanadium (V)-Dissolved (mg/L)	0.000081	<0.0025 DLA			
	Yttrium (Y)-Dissolved (mg/L)	<0.0000050	0.00159			
	Zinc (Zn)-Dissolved (mg/L)	0.0471	0.064			
	Zirconium (Zr)-Dissolved (mg/L)	<0.000050	<0.0025 DLA			
Glycols	Diethylene Glycol (mg/L)	<5.0	<5.0			
	Ethylene Glycol (mg/L)	<5.0	<5.0			
	1,2-Propylene Glycol (mg/L)	49.7	435			
	Triethylene Glycol (mg/L)	<5.0	<5.0			
Organic Parameters	Ethane, Dissolved (ug/L)	<5.0	499			
	Ethene, Dissolved (ug/L)	<5.0	<5.0			

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1918067-1	L1918067-2			
	Description	water	water			
	Sampled Date	22-APR-17	22-APR-17			
	Sampled Time	12:00	15:00			
	Client ID	ZONE18-0417	ZONE3-0417			
Grouping	**Analyte**					
WATER						
Organic Parameters	Methane, Dissolved (ug/L)	<5.0	6670			
Radiological Parameters	Ra-226 (Bq/L)	0.027	61 DLRC			

* 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	Total Organic Carbon	MS-B	L1918067-1
Matrix Spike	Total Organic Carbon	MS-B	L1918067-1
Matrix Spike	Total Organic Carbon	MS-B	L1918067-2
Matrix Spike	Total Organic Carbon	MS-B	L1918067-2
Matrix Spike	Total Organic Carbon	MS-B	L1918067-2
Matrix Spike	Phosphorus (P)-Total	MS-B	L1918067-1

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLA	Detection Limit adjusted for required dilution
DLDS	Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity.
DLHC	Detection Limit Raised: Dilution required due to high concentration of test analyte(s).
DLRC	Detection Limit Raised for RadioChemistry test due to sample matrix (e.g. high TDS) or instrument detector conditions.
DTC	Dissolved concentration exceeds total. Results were confirmed by re-analysis.
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**
ACY-PCT-VA	Water	Acidity by Automatic Titration	APHA 2310 "Acidity"

This analysis is carried out using procedures adapted from APHA Method 2310 "Acidity". Acidity is determined by potentiometric titration to a specified endpoint.

Samples of industrial wastes, acid mine drainage, or other solutions that contain appreciable amounts of hydrolyzable metal ions such as aluminum, iron, and manganese may require hot peroxide treatment to ensure oxidation and hydrolysis of reduced forms of polyvalent cations. Acidity results may be highly variable if this procedure is not followed. Results in this report for 'Acidity (as CaCO3)' have not been peroxide treated.

ACY-PCT-VA	Water	Acidity by Automatic Titration	APHA 2310 Acidity

This analysis is carried out using procedures adapted from APHA Method 2310 "Acidity". Acidity is determined by potentiometric titration to a specified endpoint.

Samples of industrial wastes, acid mine drainage, or other solutions that contain appreciable amounts of hydrolyzable metal ions such as aluminum, iron, and manganese may require hot peroxide treatment to ensure oxidation and hydrolysis of reduced forms of polyvalent cations. Acidity results may be highly variable if this procedure is not followed. Results in this report for 'Acidity (as CaCO3)' have not been peroxide treated.

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.

BR-L-IC-N-VA	Water	Bromide in Water by IC (Low Level)	EPA 300.1 (mod)

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

CARBONS-TOC-VA	Water	Total organic carbon by combustion	APHA 5310B TOTAL ORGANIC CARBON (TOC)

This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)".

CL-IC-N-VA	Water	Chloride in Water by IC	EPA 300.1 (mod)

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

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.

EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510

Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.

F-IC-N-VA	Water	Fluoride in Water by IC	EPA 300.1 (mod)

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

GLY-WAT-FID-VA	Water	Glycols in Water by GCFID	SW-846, METHOD 8015B, EPA

This analysis is carried out using procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846, Method 8015B, published by the United States Environmental Protection Agency (EPA). The procedure involves treatment of the sample with a strong base (NaOH) and benzoyl

Reference Information

chloride to form the corresponding benzoate esters. The benzoate esters are then extracted with iso-octane and the extract is analyzed by capillary column gas chromatography with flame ionization detection (FID).

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.

MET-D-L-HRMS-VA Water Diss. Metals in Water by HR-ICPMS EPA 200.8

Trace metals in water are analyzed by high resolution inductively coupled plasma mass spectrometry (HR-ICPMS) modified from US EPA Method 200.8, (Revision 5.5). The procedures may involve laboratory sample filtration modified from APHA Method 3030B.

MET-DIS-ICP-VA Water Dissolved 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 procedure involves filtration (EPA Method 3005A) and analysis by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

MET-T-L-HRMS-VA Water Total Metals in Water by HR-ICPMS EPA 200.8

Trace metals in water are analyzed by high resolution inductively coupled plasma mass spectrometry (HR-ICPMS) modified from US EPA Method 200.8, (Revision 5.5). The procedures may involve preliminary sample treatment by acid digestion modified from APHA Method 3030E.

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).

METHANE,C2-DIS-WT Water Methane, Ethane and Ethene EPA REGION 1, NATATTEN.WPD REV. 1

Water samples are collected in headspace vials containing sodium bisulfate preservative. A volume of water is withdrawn from the un-capped vial. After shaking & equilibration, the vial headspace is analyzed for target gases by GC/FID. The concentration of the gas in water is proportional to the partial pressure of the gas above the liquid & is calculated using Henry's Law.

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. Waston 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. Waston et al.

NO2-L-IC-N-VA 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-VA 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.

P-T-PRES-COL-VA Water Total P in Water by Colour APHA 4500-P Phosphorus

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorus is determined colourimetrically after persulphate digestion of the sample.
Samples with very high dissolved solids (i.e. seawaters, brackish waters) may produce a negative bias by this method. Alternate methods are available for these types of samples.

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

Reference Information

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

PO4-DO-COL-VA	Water	Diss. Orthophosphate in Water by Colour	APHA 4500-P Phosphorus

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Dissolved Orthophosphate is determined colourimetrically on a sample that has been lab or field filtered through a 0.45 micron membrane filter.
Samples with very high dissolved solids (i.e. seawaters, brackish waters) may produce a negative bias by this method. Alternate methods are available for these types of samples.

RA226-MMER-FC	Water	Ra226 by Alpha Scint, MDC=0.01 Bq/L	EPA 903.1
SO4-IC-N-VA	Water	Sulfate in Water by IC	EPA 300.1 (mod)

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

TDS-VA	Water	Total Dissolved Solids by Gravimetric	APHA 2540 C - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Dissolved Solids (TDS) are determined by filtering a sample through a glass fibre filter, TDS is determined by evaporating the filtrate to dryness at 180 degrees celsius.

TSS-VA	Water	Total Suspended Solids by Gravimetric	APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.
Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

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
WT	ALS ENVIRONMENTAL - WATERLOO, ONTARIO, CANADA
FC	ALS ENVIRONMENTAL - FORT COLLINS, COLORADO, USA
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

15-602698

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.

Thursday, May 18, 2017

Amber Springer
ALS Environmental
8081 Lougheed Hwy, Suite 100
Burnaby, BC V5A 1W9

Re: ALS Workorder: 1705141
Project Name:
Project Number: L1918067

Dear Ms. Springer:

Two water samples were received from ALS Environmental, on 5/5/2017. The samples were scheduled for the following analysis:

Radium-226

The results for these analyses are contained in the enclosed reports.

The data contained in the following report have been reviewed and approved by the personnel listed below. In addition, ALS certifies that the analyses reported herein are true, complete and correct within the limits of the methods employed.

Thank you for your confidence in ALS Environmental. Should you have any questions, please call.

Sincerely,

ALS Environmental
Shiloh J. Summy
Project Manager

ALS Environmental – Fort Collins is accredited by the following accreditation bodies for various testing scopes in accordance with requirements of each accreditation body. All testing is performed under the laboratory management system, which is maintained to meet these requirement and regulations. Please contact the laboratory or accreditation body for the current scope testing parameters.

ALS Environmental – Fort Collins	
Accreditation Body	License or Certification Number
AIHA	214884
Alaska (AK)	UST-086
Alaska (AK)	CO01099
Arizona (AZ)	AZ0742
California (CA)	06251CA
Colorado (CO)	CO01099
Connecticut (CT)	PH-0232
Florida (FL)	E87914
Idaho (ID)	CO01099
Kansas (KS)	E-10381
Kentucky (KY)	90137
L-A-B (DoD ELAP/ISO 170250)	L2257
Louisiana (LA)	05057
Maryland (MD)	285
Missouri (MO)	175
Nebraska(NE)	NE-OS-24-13
Nevada (NV)	CO000782008A
New York (NY)	12036
North Dakota (ND)	R-057
Oklahoma (OK)	1301
Pennsylvania (PA)	68-03116
Tennessee (TN)	2976
Texas (TX)	T104704241
Utah (UT)	CO01099
Washington (WA)	C1280

1705141

Radium-226:
The samples were prepared and analyzed according to the current revision of SOP 783.

Ra-226 activity is reported in the associated method blank above the minimum detectable concentration value. The method blank was transferred through the same tube as sample 1705141-2. The sample had Ra-226 activity at 61 Bq/L, resulting in contamination of the method blank. Results are submitted per project manager instruction.

All remaining acceptance criteria were met.

ALS -- Fort Collins

Sample Number(s) Cross-Reference Table

OrderNum: 1705141
Client Name: ALS Environmental
Client Project Name:
Client Project Number: L1918067
Client PO Number: L1918067

Client Sample Number	Lab Sample Number	COC Number	Matrix	Date Collected	Time Collected
L1918067-1	1705141-1		WATER	22-Apr-17	
L1918067-2	1705141-2		WATER	22-Apr-17	

ALS Environmental

1705141

Subcontract Request Form

Subcontract To:

ALS ENVIRONMENTAL - FORT COLLINS, COLORADO, USA
225 COMMERCE DRIVE
FORT COLLINS,CO 80524

NOTES: Please reference on final report and invoice: PO# *L1918067*
ALS requires QC data to be provided with your final results.

Please see enclosed 2 sample(s) in 2 Container(s)

SAMPLE NUMBER	ANALYTICAL REQUIRED	DATE SAMPLED / DUE DATE	Priority Flag
(1) **L1918067-1 ZONE18-0417**		**4/22/2017**	
	Ra226 by Alpha Scint, MDC=0.01 Bq/L (RA226-MMER-FC 1)	5/11/2017	
(2) **L1918067-2 ZONE3-0417**		**4/22/2017**	
	Ra226 by Alpha Scint, MDC=0.01 Bq/L (RA226-MMER-FC 1)	5/11/2017	

Subcontract Info Contact: Walter Lin (604) 253-4188
Analysis and reporting info contact: Amber Springer, B.Sc
8081 LOUGHEED HWY
SUITE 100
BURNABY,BC V5A 1W9
Phone: (604) 253-4188 Email: amber.springer@alsglobal.com

Please email confirmation of receipt to: amber.springer@alsglobal.com

Shipped By: Joshua N-S Date Shipped: 5/5/17
Received By: Moneer Shah Date Received: May 1/17
Verified By: _____ Date Verified: _____
Temperature: 10°C 8°C
Sample Integrity Issues: _____

ALS Environmental - Fort Collins

CONDITION OF SAMPLE UPON RECEIPT FORM

Client: ALS CA Workorder No: 1705141

Project Manager: S Initials: WS Date: 5/5/17

1. Does this project require any special handling in addition to standard ALS procedures?		YES	NO
2. Are custody seals on shipping containers intact?	NONE	YES	NO
3. Are Custody seals on sample containers intact?	NONE	YES	NO
4. Is there a COC (Chain-of-Custody) present or other representative documents?		YES	NO
5. Are the COC and bottle labels complete and legible?		YES	NO
6. Is the COC in agreement with samples received? (IDs, dates, times, no. of samples, no. of containers, matrix, requested analyses, etc.)		YES	NO
7. Were airbills / shipping documents present and/or removable?	DROP OFF	YES	NO
8. Are all aqueous samples requiring preservation preserved correctly? (excluding volatiles)	N/A	YES	NO
9. Are all aqueous non-preserved samples pH 4-9?	N/A	YES	NO
10. Is there sufficient sample for the requested analyses?		YES	NO
11. Were all samples placed in the proper containers for the requested analyses?		YES	NO
12. Are all samples within holding times for the requested analyses?		YES	NO
13. Were all sample containers received intact? (not broken or leaking, etc.)		YES	NO
14. Are all samples requiring no headspace (VOC, GRO, RSK/MEE, Rx CN/S, radon) headspace free? Size of bubble: ____ < green pea ____ > green pea	N/A	YES	NO
15. Do any water samples contain sediment? Amount Amount of sediment: ____ dusting ____ moderate ____ heavy	N/A	YES	NO
16. Were the samples shipped on ice?		YES	NO
17. Were cooler temperatures measured at 0.1-6.0°C? IR gun used*: #2 #4	RAD ONLY	YES	NO

Cooler #:	1							
Temperature (°C):	on ice							
No. of custody seals on cooler:	0							
DOT Survey/ Acceptance Information: External µR/hr reading:	10							
Background µR/hr reading:	10							

Were external µR/hr readings ≤ two times background and within DOT acceptance criteria? YES / NO / NA (If no, see Form 008.)

Additional Information: PROVIDE DETAILS BELOW FOR A NO RESPONSE TO ANY QUESTION ABOVE, EXCEPT #1 AND #16.

If applicable, was the client contacted? YES / NO / NA Contact: _____ Date/Time: _____

Project Manager Signature / Date: Shilah Summy

*IR Gun #2: Oakton, SN 29922500201-0066
*IR Gun #4: Oakton, SN 2372220101-0002

DEFINITIONS: On the Air Waybill 'We', 'Our', 'us' and 'FedEx' refer to Federal Express Corporation, its subsidiaries and branches and their respective employees, agents and independent contractors. 'You' and 'your' refer to the shipper, its employees, principals and agents. If your shipment originates outside the United States, your contract of carriage is with the Federal Express subsidiary, branch or independent contractor who originally accepts the shipment from you. 'Package' means any container or envelope that is accepted by us for delivery, including any such items tendered by you utilizing our automated systems, meters, manifests or waybills. 'Shipment' means all packages, which are tendered to and accepted by us on a single Air Waybill.

AGREEMENT TO TERMS. By giving us your shipment, you agree, regardless of whether you sign the front of this Air Waybill, for yourself and as agent for and on behalf of any other person having an interest in this shipment, to all terms on this NON-NEGOTIABLE Air Waybill. In any applicable tariff, and in our current Service Guide or Standard Conditions of Carriage, copies of which are available upon request. If there is a conflict between this Air Waybill and either the tariff, Service Guide or Standard Conditions then in effect, the tariff and the terms of any customer automation agreement between the shipper and Federal Express will control(the Service Guide or Standard Conditions have secondary priority). No one is authorized to alter or modify the terms of our agreement. This Air Waybill shall be binding on us when the shipment is accepted.

YOUR OBLIGATIONS: You warrant that each article in the shipment is properly described on this Air Waybill and is acceptable for transport by us, and that the shipment is properly marked, addressed (including postal codes) and packaged to ensure safe transportation with ordinary care in handling.

NOTE CONCERNING LIMITATIONS OF LIABILITY. Air Carriage Notice. If the carriage of your shipment by air involves an ultimate destination or stop in a country other than the country of departure, the Warsaw Convention, an international treaty relating to international carriage by air, may be applicable, which treaty would then govern and in most cases limit our liability for loss or delay of or damage to your shipment. In the U.S. the Warsaw Convention limits our liability to U.S. $9.07 per pound (U.S. $20.38 per kilogram). Unless you declare a higher value for carriage as described below. The interpretation of the Warsaw Convention liability limits may vary in other countries. There are no stopping places which are agreed at the time of tender of the shipment and we reserve the right to route shipments in any way we deem appropriate.

Road Transport Notice. Shipments transported partly or solely by road be it explicit agreement to do so or not-in, to, from a country which is party to the Convention on the Contract for the International Carriage of Goods by Road (the 'CMR') are subject to the terms and conditions of the CMR, notwithstanding any other provisions of this Agreement to the contrary. For these shipments transported solely by road, if a conflict arises between the provisions of the CMR and this Air Waybill the terms of the CMR shall prevail.

Limitation of Liability. If not governed by the Warsaw Convention or the CMR as described above, our maximum liability for loss, damage or delay is limited by this Air Waybill to U.S. $100 per shipment or U.S. $9.07 per pound (U.S. $20.38 per kilo) (or equivalent local currency), whichever is greater, unless you declare a higher value for carriage as described below. FedEx does not provide cargo liability or all-risk insurance, but you may pay an additional charge to each additional U.S. $100 (or equivalent local currency) of described value for carriage. If a higher value for carriage is declared and the additional charge is paid, FedEx maximum liability will be the lesser of the declared value for carriage or your actual damages.

LIABILITIES NOT ASSUMED. IN ANY EVENT, WE WON'T BE LIABLE FOR ANY DAMAGES WHETHER DIRECT , INCIDENTAL, SPECIAL OR CONSEQUENTIAL , IN EXCESS OF THE DECLARED VALUE FOR CARRIAGE (INCLUDING BUT NOT LIMITED TO LOSS OF INCOME OR PROFITS) WHETHER OR NOT WE HAD ANY KNOWLEDGE THAT SUCH DAMAGES MIGHT BE INCURRED, UNLESS SUCH DAMAGES WERE CAUSED BY OUR OWN WILLFUL MICONDUCT OR GROSS NEGLIGENCE.

We won't be liable for your actions or omissions, including but not limited to incorrect declaration of cargo, improper or insufficient packing, securing, marking or addressing of the shipment, or for the acts or omissions of the recipient or anyone else with an interest in the shipment. Also we won't be liable if you (or) the recipient violate any of the terms of our agreement. We won't be liable for loss of or damage to shipments of cash, currency or other prohibited items. We won't be liable for loss, damages or delay caused by events we cannot control, including but not limited to acts of God, perils of the air, weather conditions mechanical delays, acts of public enemies, war, strikes, civil commotions, or acts or omissions of public authorities (including customs and health officials) with actual or apparent authority.

NO WARRANTIES. We make no warranties, express or implied.

CLAIM FOR LOSS, DAMAGE FOR DELAY. ALL CLAIMS MUST BE NOTIFIED TO US WITHIN 15 DAYS AFTER DELIVERY OF THE SHIPMENT FAILING WHICH NO ACTION FOR DAMAGES MAY BE BROUGHT. All claims for loss, non-delivery or mis-delivery must be received by us within 90 days after the shipment is accepted by us. The right to damages against us shall be extinguished unless an action is brought within two years from the date of delivery of the shipment or from date on which the shipment should have been delivered. Within 30 days after notification to us (or) the claim, it must be documented by sending us all relevant information about it. We are not obligated to act on any claim until all transportation charges have been paid; the claim amount may not be deducted from those charges. If the recipient accepts the shipment without noting any damage on the delivery record, we will assume the shipment was delivered in good condition. In order for us to consider a claim for damages, the content(s), original shipping cartons, and packing must be available to us for inspection.

RIGHT TO INSPECT. Your shipment may, at our option or at the request of governmental authorities, be opened and inspected by us or such authorities or us at any time.

CUSTOMS CLEARANCE. It is your responsibility to provide proper customs documentation and confirmation, where required.

EXPORT CONTROL. You authorize Federal Express to act as forwarding agent for you for export control and customs purposes. You hereby certify that all statements and information contained in this air waybill relating to exportation are true and correct. Furthermore, you understand that civil and criminal penalties, including forfeiture and sale, may be imposed for making false or fraudulent statements or for the violation of any United States laws on exportation, including but not limited to, 13 USC Sec. 305; 22 USC Sec 401; 18 USC Sec. 1001; 50 USC app. 2410.

MANDATORY LAW. Insofar as any provision contained or referred to in this air Waybill may be contrary to any applicable international treaty, law government regulations, orders or requirements such provision shall remain in effect as a part of our agreement to the extent that it is not overridden. The invalidity or unenforceability of any provision shall not affect any other part of this Air Waybill. Unless otherwise indicated the Sender's address indicated on the face of this Waybill is the place of execution and the place of departure, and Recipient's address listed on the face of this Waybill is the place of destination. Unless otherwise indicated Federal Express Corporation, P.O. Box 727, Memphis, TN 38194 USA is the first carrier of this shipment.

After printing this label:
CONSIGNEE COPY - PLEASE PLACE IN FRONT OF POUCH
1. Fold the printed page along the horizontal line.
2. Place label in shipping pouch and affix it to your shipment.

ORIGIN ID:YBYA (604) 253-4188
HARJIT GILL
ALS ENVIRONMENTAL LAB GROUP
LOUGHEED HIGHWAY
BURNABY, BC V5A1W9
CANADA CA

SHIP DATE: 02MAY17
ACTWGT: 25.00 LB MAN
CAD: 0347419/CAFE3011

BILL SENDER

TO **SAMPLE RECEVING**
ALS ENVIRONMENTAL 17054
225 COMMERCE DRIVE
FORT COLLINS CO 80524 (US)
(970) 490-1511
DEPT: SUBLET
REF: SUBLETS

FedEx Express

J161216101002uv

540C1/8734/727F

TRK# 0430 **7012 5069 3113**

XH FTCA

10:30A
INTL PRIORITY

80524
DEN
CO-US

Client:	ALS Environmental	**Date:**	*18-May-17*
Project:	L1918067	**Work Order:**	1705141
Sample ID:	L1918067-1	**Lab ID:**	1705141-1
Legal Location:		**Matrix:**	WATER
Collection Date:	4/22/2017	**Percent Moisture:**	

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
Radium-226 by Radon Emanation - Method 903.1		**PAI 783**			Prep Date: **5/9/2017**	PrepBy: **HCJ**
Ra-226	**0.027 (+/- 0.010)**		**0.0062**	**BQ/l**	NA	5/17/2017 12:43
Carr: BARIUM	*93.4*		*40-110*	*%REC*	DL = NA	5/17/2017 12:43

Client:	ALS Environmental	**Date:**	*18-May-17*
Project:	L1918067	**Work Order:**	1705141
Sample ID:	L1918067-2	**Lab ID:**	1705141-2
Legal Location:		**Matrix:**	WATER
Collection Date:	4/22/2017	**Percent Moisture:**	

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
Radium-226 by Radon Emanation - Method 903.1		**PAI 783**			Prep Date: **5/9/2017**	PrepBy: **HCJ**
Ra-226	**61 (+/- 15)**	M3	**0.25**	**BQ/l**	NA	5/17/2017 12:43
Carr: BARIUM	*65.6*		*40-110*	*%REC*	DL = NA	5/17/2017 12:43

Client:	ALS Environmental	**Date:**	*18-May-17*
Project:	L1918067	**Work Order:**	1705141
Sample ID:	L1918067-2	**Lab ID:**	1705141-2
Legal Location:		**Matrix:**	WATER
Collection Date:	4/22/2017	**Percent Moisture:**	

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed

Explanation of Qualifiers

Radiochemistry:

U or ND - Result is less than the sample specific MDC.

Y1 - Chemical Yield is in control at 100-110%. Quantitative yield is assumed.

Y2 - Chemical Yield outside default limits.

W - DER is greater than Warning Limit of 1.42

* - Aliquot Basis is 'As Received' while the Report Basis is 'Dry Weight'.

- Aliquot Basis is 'Dry Weight' while the Report Basis is 'As Received'.

G - Sample density differs by more than 15% of LCS density.

D - DER is greater than Control Limit

M - Requested MDC not met.

LT - Result is less than requested MDC but greater than achieved MDC.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

L - LCS Recovery below lower control limit.

H - LCS Recovery above upper control limit.

P - LCS, Matrix Spike Recovery within control limits.

N - Matrix Spike Recovery outside control limits

NC - Not Calculated for duplicate results less than 5 times MDC

B - Analyte concentration greater than MDC.

B3 - Analyte concentration greater than MDC but less than Requested MDC.

Inorganics:

B - Result is less than the requested reporting limit but greater than the instrument method detection limit (MDL).

U or ND - Indicates that the compound was analyzed for but not detected.

E - The reported value is estimated because of the presence of interference. An explanatory note may be included in the narrative.

M - Duplicate injection precision was not met.

N - Spiked sample recovery not within control limits. A post spike is analyzed for all ICP analyses when the matrix spike and or spike duplicate fail and the native sample concentration is less than four times the spike added concentration.

Z - Spiked recovery not within control limits. An explanatory note may be included in the narrative.

* - Duplicate analysis (relative percent difference) not within control limits.

S - SAR value is estimated as one or more analytes used in the calculation were not detected above the detection limit.

Organics:

U or ND - Indicates that the compound was analyzed for but not detected.

B - Analyte is detected in the associated method blank as well as in the sample. It indicates probable blank contamination and warns the data user.

E - Analyte concentration exceeds the upper level of the calibration range.

J - Estimated value. The result is less than the reporting limit but greater than the instrument method detection limit (MDL).

A - A tentatively identified compound is a suspected aldol-condensation product.

X - The analyte was diluted below an accurate quantitation level.

* - The spike recovery is equal to or outside the control criteria used.

+ - The relative percent difference (RPD) equals or exceeds the control criteria.

G - A pattern resembling gasoline was detected in this sample.

D - A pattern resembling diesel was detected in this sample.

M - A pattern resembling motor oil was detected in this sample.

C - A pattern resembling crude oil was detected in this sample.

4 - A pattern resembling JP-4 was detected in this sample.

5 - A pattern resembling JP-5 was detected in this sample.

H - Indicates that the fuel pattern was in the heavier end of the retention time window for the analyte of interest.

L - Indicates that the fuel pattern was in the lighter end of the retention time window for the analyte of interest.

Z - This flag indicates that a significant fraction of the reported result did not resemble the patterns of any of the following petroleum hydrocarbon products:
- gasoline
- JP-8
- diesel
- mineral spirits
- motor oil
- Stoddard solvent
- bunker C

QC BATCH REPORT

Batch ID: **RE170509-1-1** Instrument ID **Alpha Scin** Method: **Radium-226 by Radon Emanation**

LCS Sample ID: **RE170509-1** Units: **BQ/l** Analysis Date: **5/17/2017 13:16**

Client ID: Run ID: **RE170509-1B** Prep Date: **5/9/2017** DF: **NA**

Analyte	Result	ReportLimit	SPK Val	SPK Ref Value	%REC	Control Limit	Decision Level	DER Ref	DER	DER Limit	Qual
Ra-226	1.61 (+/- 0.399)	0.00557	1.703		94.5	67-120					P
Carr: BARIUM	15500		15840		98.1	40-110					

LCSD Sample ID: **RE170509-1** Units: **BQ/l** Analysis Date: **5/17/2017 13:49**

Client ID: Run ID: **RE170509-1B** Prep Date: **5/9/2017** DF: **NA**

Analyte	Result	ReportLimit	SPK Val	SPK Ref Value	%REC	Control Limit	Decision Level	DER Ref	DER	DER Limit	Qual
Ra-226	1.85 (+/- 0.457)	0.00934	1.703		109	67-120		1.61	0.4	2.1	P
Carr: BARIUM	15400		15840		96.9	40-110		15500			

MB Sample ID: **RE170509-1** Units: **BQ/l** Analysis Date: **5/17/2017 13:16**

Client ID: Run ID: **RE170509-1B** Prep Date: **5/9/2017** DF: **NA**

Analyte	Result	ReportLimit	SPK Val	SPK Ref Value	%REC	Control Limit	Decision Level	DER Ref	DER	DER Limit	Qual
Ra-226	0.031 (+/- 0.012)	0.0079									B
Carr: BARIUM	15600		15840		98.3	40-110					

The following samples were analyzed in this batch: 1705141-1 1705141-2

ALS Environmental
www.alsglobal.com

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

L1918067-COFC

COC Number: 15 - 602698

Page 1 of 1

Report To	Contact and company name below will appear on the final report
Company:	ERM
Contact:	Tyler Gale
Phone:	604-689-9460
	Company address below will appear on the final report
Street:	15th Floor 1111 W. Hastings St.
City/Province:	Vancouver BC
Postal Code:	V6E 2J3
Invoice To	Same as Report To [x] YES [ ] NO
	Copy of Invoice with Report [ ] YES [x] NO
Company:	
Contact:	

Report Format / Distribution

Select Report Format: [x] PDF [x] EXCEL [ ] EDD (DIGITAL)
Quality Control (QC) Report with Report [x] YES [ ] NO
[ ] Compare Results to Criteria on Report - provide details below if box checked
Select Distribution: [x] EMAIL [ ] MAIL [ ] FAX
Email 1 or Fax: tyler.gale@erm.com
Email 2: piotr.rzepecki@erm.com
Email 3:

Invoice Distribution

Select Invoice Distribution: [x] EMAIL [ ] MAIL [ ] FAX
Email 1 or Fax:
Email 2: erm.canadapayables@erm.com

Project Information

ALS Account # / Quote #:
Job #: 0333261-0012
PO / AFE:
LSD:

Oil and Gas Required Fields (client use)

AFE/Cost Center: | PO#
Major/Minor Code: | Routing Code:
Requisitioner:
Location:

ALS Lab Work Order # (lab use only): L1918067

ALS Contact: Amber Springer | Sampler: Tyler Gale

Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply

Regular [R]: [x] Standard TAT if received by 3 pm - business days - no surcharges apply

PRIORITY (Business Days): 4 day [P4] [ ] | 3 day [P3] [ ] | 2 day [P2] [ ]

EMERGENCY: 1 Business day [E1] [ ] | Same Day, Weekend or Statutory holiday [E0] [ ]

Date and Time Required for all E&P TATs:

For tests that can not be performed according to the service level selected, you will be contacted.

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Routine tests	Total Metals + Hg	Dissolved Metals + Hg	Nutrients + TOC	Glycols	Methane + ethane + ethene	Ra-226	Number of Containers
					P	F/P	P	P	P	P	P	
	Zone 18-0416-7	22-Apr-17	12:00	Water								11
	Zone 3-0416-7	22-Apr-17	15:00	Water								11

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System? [ ] YES [ ] NO

Are samples for human drinking water use? [ ] YES [ ] NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

Metals by HRMS, minimize dilutions effects on detection limits, TDS ~80 g/L, Ca ~20 g/L, Cl ~50 g/L, Na ~10 g/L

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen [ ] | SIF Observations: Yes [ ] No [x]
Ice Packs [x] Ice Cubes [ ] | Custody seal intact: Yes [x] No [ ]
Cooling Initiated [ ]

INITIAL COOLER TEMPERATURES °C			FINAL COOLER TEMPERATURES °C		
10.3			10.10	10.8	8

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: Tyler Gale	Date:	Time: AM	Received by: AT	Date: 27-April-2017	Time: 9:20	Received by: JC	Date: MAY - 1 2017	Time: 12:40pm

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCTOBER 2015 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.