



SUMMIT ENVIRONMENTAL CONSULTANTS
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Date Received: 27-MAY-13
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Client Phone: 867-456-2711

Certificate of Analysis

Lab Work Order #: L1307027
Project P.O. #: NOT SUBMITTED
Job Reference: 2013-2333.300.323
C of C Numbers: 1
Legal Site Desc:

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ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID	L1307027-1 Groundwater 22-MAY-13 12:00 L2	L1307027-2 Surface Water 22-MAY-13 12:00 TAILINGS SAND (HUMIDITY CELL)	L1307027-4 Surface Water 22-MAY-13 12:00 TRENCH ABOVE MILL ROAD 01	L1307027-5 Surface Water 23-MAY-13 12:00 TRENCH ABOVE MILL ROAD 02	L1307027-6 Surface Water 23-MAY-13 12:00 DES-03	
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	296	1320	27.2	24.1	743
	Hardness (as CaCO3) (mg/L)	170	896	14.0	14.7	422
	pH (pH)	7.57	8.47	6.93	5.82	5.84
Anions and Nutrients	Acidity (as CaCO3) (mg/L)	5.0	4.8	4.3	11.3	10.1
	Alkalinity, Total (as CaCO3) (mg/L)	37.2	18.2	10.5	7.6	8.6
	Chloride (Cl) (mg/L)	<0.50	<5.0 ^{DLA}	<0.50	<0.50	<0.50
	Fluoride (F) (mg/L)	0.188	<0.20 ^{DLA}	0.020	<0.020	<0.020
	Nitrate (as N) (mg/L)	0.0563	<0.050 ^{DLA}	0.0217	0.0191	0.874
	Nitrite (as N) (mg/L)	<0.0010	<0.010 ^{DLA}	<0.0010	<0.0010	<0.0010
	Sulfate (SO4) (mg/L)	133	844	1.91	<0.50	402
Total Metals	Aluminum (Al)-Total (mg/L)	0.302	<0.0050	1.97	0.774	0.477
	Antimony (Sb)-Total (mg/L)	0.00340	0.0465	0.00110	0.00055	<0.00050
	Arsenic (As)-Total (mg/L)	0.0316	0.00117	0.0206	0.00444	0.00307
	Barium (Ba)-Total (mg/L)	<0.020	0.020	0.041	0.045	0.064
	Beryllium (Be)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Boron (B)-Total (mg/L)	<0.10	<0.10	<0.10	<0.10	<0.10
	Cadmium (Cd)-Total (mg/L)	0.00128	0.000408	0.000074	0.000143	0.00912
	Calcium (Ca)-Total (mg/L)	47.0	302	4.94	4.40	103
	Chromium (Cr)-Total (mg/L)	<0.0010	0.0015	0.0019	<0.0010	<0.0010
	Cobalt (Co)-Total (mg/L)	<0.00030	0.00635	0.00119	0.00032	0.00063
	Copper (Cu)-Total (mg/L)	0.0073	0.0024	0.0057	0.0058	0.0039
	Iron (Fe)-Total (mg/L)	0.675	<0.030	2.99	0.501	0.874
	Lead (Pb)-Total (mg/L)	0.0178	<0.00050	0.00229	0.00132	0.00064
	Lithium (Li)-Total (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Magnesium (Mg)-Total (mg/L)	11.5	24.4	1.47	0.90	37.2
	Manganese (Mn)-Total (mg/L)	0.0646	0.0187	0.129	0.0426	0.968
	Mercury (Hg)-Total (mg/L)	<0.000010	<0.000010	0.000015	0.000026	<0.000010
	Molybdenum (Mo)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Nickel (Ni)-Total (mg/L)	<0.0010	0.0019	0.0015	0.0018	0.0052
	Potassium (K)-Total (mg/L)	<2.0	2.9	<2.0	<2.0	2.3
	Selenium (Se)-Total (mg/L)	<0.00010	0.00011	<0.00010	<0.00010	<0.00010
	Silver (Ag)-Total (mg/L)	0.000277	<0.000020	0.000075	0.000060	0.000023
	Sodium (Na)-Total (mg/L)	<2.0	<2.0	<2.0	<2.0	3.0
	Thallium (Tl)-Total (mg/L)	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Tin (Sn)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	
Titanium (Ti)-Total (mg/L)	<0.010	0.011	0.082	0.012	0.023	
Uranium (U)-Total (mg/L)	0.00022	0.00040	<0.00020	<0.00020	<0.00020	

* 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	L1307027-1 Groundwater 22-MAY-13 12:00 L2	L1307027-2 Surface Water 22-MAY-13 12:00 TAILINGS SAND (HUMIDITY CELL)	L1307027-4 Surface Water 22-MAY-13 12:00 TRENCH ABOVE MILL ROAD 01	L1307027-5 Surface Water 23-MAY-13 12:00 TRENCH ABOVE MILL ROAD 02	L1307027-6 Surface Water 23-MAY-13 12:00 DES-03
Grouping	Analyte					
WATER						
Total Metals	Vanadium (V)-Total (mg/L)	0.0011	<0.0010	0.0072	0.0011	0.0017
	Zinc (Zn)-Total (mg/L)	0.0639	0.0082	0.0129	0.0124	3.42
Dissolved Metals	Dissolved Metals Filtration Location	LAB	FIELD	LAB	LAB	LAB
	Aluminum (Al)-Dissolved (mg/L)	0.0434	<0.0050	0.252	0.560	0.130
	Antimony (Sb)-Dissolved (mg/L)	0.00140	0.0491	<0.00050	<0.00050	<0.00050
	Arsenic (As)-Dissolved (mg/L)	0.0211	0.00111	0.00336	0.00267	0.00126
	Barium (Ba)-Dissolved (mg/L)	<0.020	0.021	<0.020	0.043	0.058
	Beryllium (Be)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Boron (B)-Dissolved (mg/L)	<0.10	<0.10	<0.10	<0.10	<0.10
	Cadmium (Cd)-Dissolved (mg/L)	0.000626	0.000379	0.000020	0.000138	0.00921
	Calcium (Ca)-Dissolved (mg/L)	48.5	317	4.08	4.44	107
	Chromium (Cr)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Cobalt (Co)-Dissolved (mg/L)	<0.00030	0.00614	<0.00030	<0.00030	0.00052
	Copper (Cu)-Dissolved (mg/L)	0.0025	<0.0010	0.0025	0.0055	0.0017
	Iron (Fe)-Dissolved (mg/L)	0.059	<0.030	0.219	0.297	0.236
	Lead (Pb)-Dissolved (mg/L)	0.00216	<0.00050	<0.00050	0.00061	0.00078
	Lithium (Li)-Dissolved (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Magnesium (Mg)-Dissolved (mg/L)	11.8	25.7	0.92	0.88	37.8
	Manganese (Mn)-Dissolved (mg/L)	0.0150	0.0169	0.00724	0.0356	0.995
	Mercury (Hg)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	0.000020	<0.000010
	Molybdenum (Mo)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Nickel (Ni)-Dissolved (mg/L)	<0.0010	0.0016	<0.0010	0.0018	0.0051
	Potassium (K)-Dissolved (mg/L)	<2.0	3.0	<2.0	<2.0	2.3
	Selenium (Se)-Dissolved (mg/L)	<0.00010	0.00011	<0.00010	<0.00010	<0.00010
	Silver (Ag)-Dissolved (mg/L)	0.000033	<0.000020	<0.000020	0.000030	<0.000020
	Sodium (Na)-Dissolved (mg/L)	<2.0	<2.0	<2.0	<2.0	3.1
	Thallium (Tl)-Dissolved (mg/L)	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
	Tin (Sn)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Titanium (Ti)-Dissolved (mg/L)	<0.010	0.011	<0.010	<0.010	<0.010
	Uranium (U)-Dissolved (mg/L)	0.00021	0.00041	<0.00020	<0.00020	<0.00020
	Vanadium (V)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zinc (Zn)-Dissolved (mg/L)	0.0331	0.0070	<0.0050	0.0121	3.51

* 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	L1307027-1, -4, -5, -6
Duplicate	Arsenic (As)-Dissolved	DLA	L1307027-1, -4, -5, -6
Duplicate	Beryllium (Be)-Dissolved	DLA	L1307027-1, -4, -5, -6
Duplicate	Cobalt (Co)-Dissolved	DLA	L1307027-1, -4, -5, -6
Duplicate	Lead (Pb)-Dissolved	DLA	L1307027-1, -4, -5, -6
Duplicate	Silver (Ag)-Dissolved	DLA	L1307027-1, -4, -5, -6
Duplicate	Thallium (Tl)-Dissolved	DLA	L1307027-1, -4, -5, -6
Duplicate	Tin (Sn)-Dissolved	DLA	L1307027-1, -4, -5, -6
Duplicate	Vanadium (V)-Dissolved	DLA	L1307027-1, -4, -5, -6
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L1307027-2
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L1307027-2
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L1307027-2
Matrix Spike	Sulfate (SO4)	MS-B	L1307027-1, -2, -4, -5, -6
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L1307027-1, -4, -5, -6
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L1307027-1, -4, -5, -6
Matrix Spike	Molybdenum (Mo)-Dissolved	MS-B	L1307027-1, -4, -5, -6

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLA	Detection Limit Adjusted For required dilution
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**
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.			
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.			
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.			
ANIONS-CL-IC-WR	Water	Chloride by Ion Chromatography	EPA 300.1
This analysis is carried out using procedures adapted from EPA Method 300.1, "Determination of Inorganic Anions by Ion Chromatography", Revision 1.0, April 1999 and from "Determination of Inorganic Anions in Environmental Waters Using a Hydroxide-Selective Column", Application Note 154 v.19, Dionex 2003.			
ANIONS-F-IC-WR	Water	Fluoride by Ion Chromatography	EPA 300.1
This analysis is carried out using procedures adapted from EPA Method 300.1, "Determination of Inorganic Anions by Ion Chromatography", Revision 1.0, April 1999 and from "Determination of Inorganic Anions in Environmental Waters Using a Hydroxide-Selective Column", Application Note 154 v.19, Dionex 2003.			
ANIONS-NO2-IC-WR	Water	Nitrite Nitrogen by Ion Chromatography	EPA 300.1
This analysis is carried out using procedures adapted from EPA Method 300.1, "Determination of Inorganic Anions by Ion Chromatography", Revision 1.0, April 1999 and from "Determination of Inorganic Anions in Environmental Waters Using a Hydroxide-Selective Column", Application Note 154 v.19, Dionex 2003. Nitrate is detected by UV absorbance.			
ANIONS-NO3-IC-WR	Water	Nitrate Nitrogen by Ion Chromatography	EPA 300.1
This analysis is carried out using procedures adapted from EPA Method 300.1, "Determination of Inorganic Anions by Ion Chromatography", Revision 1.0, April 1999 and from "Determination of Inorganic Anions in Environmental Waters Using a Hydroxide-Selective Column", Application Note 154 v.19, Dionex 2003. Nitrate is detected by UV absorbance.			
ANIONS-SO4-IC-WR	Water	Sulphate by Ion Chromatography	EPA 300.1
This analysis is carried out using procedures adapted from EPA Method 300.1, "Determination of Inorganic Anions by Ion Chromatography", Revision 1.0, April 1999 and from "Determination of Inorganic Anions in Environmental Waters Using a Hydroxide-Selective Column", Application Note 154 v.19, Dionex 2003.			
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.			

Reference Information

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-DIS-LOW-CVAFS-VA Water Dissolved Mercury in Water by CVAFS(Low) EPA SW-846 3005A & EPA 245.7

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 filtration (EPA Method 3005A) and 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).

HG-TOT-LOW-CVAFS-VA Water Total Mercury in Water by CVAFS(Low) EPA 245.7

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).

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030 B&E / EPA SW-846 6020A

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 hotblock, or filtration (APHA 3030B&E). Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).

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-CCMS-VA Water Total Metals in Water by CRC ICPMS APHA 3030 B&E / EPA SW-846 6020A

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 hotblock, or filtration (APHA 3030B&E). Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).

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).

PH-MAN-WR Water pH by Meter APHA 4500-H (B)

"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."

** 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
WR	ALS ENVIRONMENTAL - WHITEHORSE, YUKON, CANADA
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

Reference Information

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.

