



SUMMIT ENVIRONMENTAL CONSULTANTS  
INC.

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Date Received: 17-MAY-13  
Report Date: 29-MAY-13 18:40 (MT)  
Version: FINAL

Client Phone: 867-456-2711

## Certificate of Analysis

**Lab Work Order #:** L1303465  
**Project P.O. #:** JOB# VM00605.TAR 3.230  
**Job Reference:** 2013-2333.300.323  
**C of C Numbers:** 1  
**Legal Site Desc:**

Dean Watt  
Account Manager

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## ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	Description	Sampled Date	Sampled Time	Client ID	L1303465-1	L1303465-2	L1303465-3	L1303465-4
					Surface Water	Surface Water	Surface Water	Surface Water
		16-MAY-13	12:00		16-MAY-13	16-MAY-13	16-MAY-13	16-MAY-13
					12:00	12:00	12:00	12:00
					ORE RAMP	WASTE ROCK PILE 01	LOWER PLATFORM	UPPER PLATFORM
Grouping	Analyte							
<b>WATER</b>								
<b>Physical Tests</b>	Conductivity (uS/cm)	327	2090	217	1220			
	Hardness (as CaCO3) (mg/L)	157	1450	107	766			
	pH (pH)	7.58	7.88	7.79	8.17			
<b>Anions and Nutrients</b>	Acidity (as CaCO3) (mg/L)	3.0	5.2	2.5	2.4			
	Alkalinity, Total (as CaCO3) (mg/L)	30.2	94.6	27.1	155			
	Chloride (Cl) (mg/L)	<0.50	<10 <sup>DLA</sup>	<0.50	<5.0 <sup>DLA</sup>			
	Fluoride (F) (mg/L)	0.074	<0.40 <sup>DLA</sup>	0.041	<0.20 <sup>DLA</sup>			
	Nitrate (as N) (mg/L)	0.0118	9.85	<0.0050	0.053			
	Nitrite (as N) (mg/L)	<0.0010	<0.020 <sup>DLA</sup>	<0.0010	0.012			
	Sulfate (SO4) (mg/L)	127	1290	74.8	573			
<b>Total Metals</b>	Aluminum (Al)-Total (mg/L)	0.874	0.0876	4.28	0.137			
	Antimony (Sb)-Total (mg/L)	0.00757	0.00247	0.0665	0.0190			
	Arsenic (As)-Total (mg/L)	0.0738	0.00616	0.782	0.0683			
	Barium (Ba)-Total (mg/L)	0.078	<0.020	0.125	0.034			
	Beryllium (Be)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010			
	Boron (B)-Total (mg/L)	<0.10	<0.10	<0.10	<0.10			
	Cadmium (Cd)-Total (mg/L)	0.00314	0.0268	0.0120	0.00507			
	Calcium (Ca)-Total (mg/L)	55.1	308	32.4	177			
	Chromium (Cr)-Total (mg/L)	0.0012	<0.0010	0.0064	<0.0010			
	Cobalt (Co)-Total (mg/L)	0.00093	<0.00030	0.00422	0.00058			
	Copper (Cu)-Total (mg/L)	0.0107	0.0168	0.0856	0.0203			
	Iron (Fe)-Total (mg/L)	2.16	0.194	12.3	0.355			
	Lead (Pb)-Total (mg/L)	0.0472	0.00672	0.600	0.0187			
	Lithium (Li)-Total (mg/L)	<0.0050	<0.0050	<0.0050	0.0105			
	Magnesium (Mg)-Total (mg/L)	6.59	176	9.92	87.4			
	Manganese (Mn)-Total (mg/L)	0.355	0.258	0.834	0.640			
	Mercury (Hg)-Total (mg/L)	<0.000010	<0.000010	0.000046	<0.000010			
	Molybdenum (Mo)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010			
	Nickel (Ni)-Total (mg/L)	0.0013	0.0024	0.0056	0.0012			
	Potassium (K)-Total (mg/L)	2.6	2.4	3.3	4.4			
	Selenium (Se)-Total (mg/L)	0.00012	0.00106	0.00020	0.00134			
	Silver (Ag)-Total (mg/L)	0.000492	0.000126	0.00712	0.000361			
	Sodium (Na)-Total (mg/L)	<2.0	5.1	<2.0	3.4			
	Thallium (Tl)-Total (mg/L)	<0.00020	<0.00020	<0.00034 <sup>DLM</sup>	<0.00020			
	Tin (Sn)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050			
	Titanium (Ti)-Total (mg/L)	0.025	0.013	0.181	0.016			
Uranium (U)-Total (mg/L)	<0.00020	0.00155	0.00064	0.00310				

\* 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	L1303465-1	L1303465-2	L1303465-3	L1303465-4
					Surface Water	Surface Water	Surface Water	Surface Water
		16-MAY-13	12:00		16-MAY-13	16-MAY-13	16-MAY-13	16-MAY-13
					ORE RAMP	WASTE ROCK PILE 01	LOWER PLATFORM	UPPER PLATFORM
Grouping	Analyte							
<b>WATER</b>								
<b>Total Metals</b>	Vanadium (V)-Total (mg/L)	0.0029	<0.0020	0.0178	<0.0010			
	Zinc (Zn)-Total (mg/L)	0.151	2.51	0.886	0.724			
<b>Dissolved Metals</b>	Dissolved Metals Filtration Location	LAB	LAB	LAB	LAB			
	Aluminum (Al)-Dissolved (mg/L)	0.0063	<0.0050	0.0982	0.0098			
	Antimony (Sb)-Dissolved (mg/L)	0.00284	0.00180	0.0117	0.0167			
	Arsenic (As)-Dissolved (mg/L)	0.00937	0.00153	0.0345	0.0465			
	Barium (Ba)-Dissolved (mg/L)	0.059	<0.020	0.021	0.031			
	Beryllium (Be)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010			
	Boron (B)-Dissolved (mg/L)	<0.10	<0.10	<0.10	<0.10			
	Cadmium (Cd)-Dissolved (mg/L)	0.00104	0.0253	0.00241	0.00448			
	Calcium (Ca)-Dissolved (mg/L)	52.8	299	29.5	169			
	Chromium (Cr)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010			
	Cobalt (Co)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	0.00051			
	Copper (Cu)-Dissolved (mg/L)	0.0018	0.0096	0.0165	0.0137			
	Iron (Fe)-Dissolved (mg/L)	<0.030	<0.030	0.126	<0.030			
	Lead (Pb)-Dissolved (mg/L)	<0.00050	<0.00050	0.00501	0.00070			
	Lithium (Li)-Dissolved (mg/L)	<0.0050	<0.0050	<0.0050	0.0097			
	Magnesium (Mg)-Dissolved (mg/L)	6.01	171	8.09	83.7			
	Manganese (Mn)-Dissolved (mg/L)	0.0167	0.226	0.137	0.615			
	Mercury (Hg)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010			
	Molybdenum (Mo)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010			
	Nickel (Ni)-Dissolved (mg/L)	<0.0010	0.0023	0.0010	0.0011			
	Potassium (K)-Dissolved (mg/L)	2.3	2.2	2.0	4.1			
	Selenium (Se)-Dissolved (mg/L)	<0.00010	0.00096	<0.00010	0.00129			
	Silver (Ag)-Dissolved (mg/L)	<0.000020	<0.000020	0.000046	<0.000020			
	Sodium (Na)-Dissolved (mg/L)	<2.0	4.8	<2.0	3.2			
	Thallium (Tl)-Dissolved (mg/L)	<0.00020	<0.00020	<0.00020	<0.00020			
	Tin (Sn)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050			
	Titanium (Ti)-Dissolved (mg/L)	<0.010	0.011	<0.010	<0.010			
	Uranium (U)-Dissolved (mg/L)	<0.00020	0.00145	0.00021	0.00282			
	Vanadium (V)-Dissolved (mg/L)	<0.0010	<0.0020	<0.0010	<0.0010			
	Zinc (Zn)-Dissolved (mg/L)	0.0515	2.41	0.173	0.646			

\* 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)
Method Blank	Aluminum (Al)-Dissolved	MB-LOR	L1303465-1, -2, -3, -4
Matrix Spike	Sulfate (SO4)	MS-B	L1303465-1, -2, -3, -4
Matrix Spike	Sulfate (SO4)	MS-B	L1303465-1, -2, -3, -4
Matrix Spike	Fluoride (F)	MS-B	L1303465-1, -2, -3, -4
Matrix Spike	Sulfate (SO4)	MS-B	L1303465-1, -2, -3, -4
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L1303465-1, -2, -3, -4
Matrix Spike	Calcium (Ca)-Total	MS-B	L1303465-1, -2, -3, -4
Matrix Spike	Magnesium (Mg)-Total	MS-B	L1303465-1, -2, -3, -4
Matrix Spike	Antimony (Sb)-Dissolved	MS-B	L1303465-1, -2, -3, -4
Matrix Spike	Arsenic (As)-Dissolved	MS-B	L1303465-1, -2, -3, -4
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L1303465-1, -2, -3, -4

### Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLA	Detection Limit Adjusted For required dilution
DLM	Detection Limit Adjusted For Sample Matrix Effects
MB-LOR	Method Blank exceeds ALS DQO. LORs adjusted for samples with positive hits below 5 times blank level.
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**
<b>ACY-PCT-VA</b>	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.			
<b>ACY-PCT-VA</b>	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.			
<b>ALK-COL-VA</b>	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.			
<b>ANIONS-CL-IC-WR</b>	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.			
<b>ANIONS-F-IC-WR</b>	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.			
<b>ANIONS-NO2-IC-WR</b>	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.			
<b>ANIONS-NO3-IC-WR</b>	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.			
<b>ANIONS-SO4-IC-WR</b>	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.			
<b>EC-PCT-VA</b>	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.			
<b>HARDNESS-CALC-VA</b>	Water	Hardness	APHA 2340B
Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents.			

## Reference Information

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 (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 (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-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.

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\*\* 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:*

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

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**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.*

