Appendix V6-2A

Analytical Results of the Umwelt Westbay Groundwater Sampling Program

Sabina
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Date Received: 03-JUN-13
Report Date: 20-JUN-13 16:51 (MT)
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Client Phone: 604-689-9460

Certificate of Analysis

Lab Work Order #: L1310386

Project P.O. #: NOT SUBMITTED
Job Reference: 0194096-0012
C of C Numbers: 10-295953
Legal Site Desc:

Amber Springer
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ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1310386-1 Water 01-JUN-13 10:00 IWB-1-2013	L1310386-2 Water 01-JUN-13 10:00 ZONE1-1-2013	L1310386-3 Water 01-JUN-13 10:00 ZONE5-1-2013	L1310386-4 Water 02-JUN-13 10:00 ZONE4-1-2013	L1310386-5 Water ALS TRAVEL BLANK
WATER						
Physical Tests	Conductivity (uS/cm)	22300	173000	180000	154000	2.2
	Hardness (as CaCO3) (mg/L)	25400	142000	150000	146000	
	pH (pH)	6.98	7.71	7.88	7.67	7.31
	Total Suspended Solids (mg/L)	490	245	253	572	<3.0
	Total Dissolved Solids (mg/L)	57500	187000	201000	188000	<10
	Turbidity (NTU)	118	138	10.6	396	<0.10
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	20.3	36.0	43.0	31.1	<2.0
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<2.0	<2.0	<2.0	<2.0	<2.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<2.0	<2.0	<2.0	<2.0	<2.0
	Alkalinity, Total (as CaCO3) (mg/L)	20.3	36.0	43.0	31.1	<2.0
	Ammonia, Total (as N) (mg/L)	0.851	3.84	4.43	3.77	0.0081 RRV
	Bromide (Br) (mg/L)	315	1580	1660	1500	<0.050
	Chloride (Cl) (mg/L)	23800	114000	120000	109000	<0.50
	Fluoride (F) (mg/L)	0.067	0.43	0.46	0.41	<0.020
	Nitrate (as N) (mg/L)	<0.50 DLM	<0.50 DLM	<0.50 DLM	<0.50 DLM	<0.0050
	Nitrite (as N) (mg/L)	<0.10 DLM	<0.10 DLM	<0.10 DLM	<0.10 DLM	<0.0010
	Total Kjeldahl Nitrogen (mg/L)	<25 DLM	<25 DLM	<25 DLM	<25 DLM	0.138 RRV
	Orthophosphate-Dissolved (as P) (mg/L)	0.877	0.045	0.047	0.057	<0.0010
	Phosphorus (P)-Total (mg/L)	68.7	1.40	0.416	2.32	<0.0020
	Sulfate (SO4) (mg/L)	<50 DLM	<50 DLM	<50 DLM	<50 DLM	<0.50
Total Metals	Aluminum (Al)-Total (mg/L)	1.41	4.13	<1.5 DLA	<0.60 DLA	<0.0030
	Antimony (Sb)-Total (mg/L)	<0.010 DLA	0.016	<0.025 DLA	<0.010 DLA	<0.000050
	Arsenic (As)-Total (mg/L)	<0.0060 DLA	0.0209	<0.015 DLA	<0.0060 DLA	<0.000030
	Barium (Ba)-Total (mg/L)	0.442	2.91	2.80	2.76	<0.000050
	Beryllium (Be)-Total (mg/L)	<0.040 DLA	<0.040 DLA	<0.10 DLA	<0.040 DLA	<0.00020
	Bismuth (Bi)-Total (mg/L)	<0.10 DLA	<0.10 DLA	<0.25 DLA	<0.10 DLA	<0.00050
	Boron (B)-Total (mg/L)	3.0	15.0	13.2	11.6	<0.0050
	Cadmium (Cd)-Total (mg/L)	<0.0020 DLA	<0.0020 DLA	<0.0050 DLA	<0.0020 DLA	<0.000010
	Calcium (Ca)-Total (mg/L)	8770	59000	55500	51100	<0.020
	Chromium (Cr)-Total (mg/L)	0.070	0.062	<0.050 DLA	<0.020 DLA	<0.00010
	Cobalt (Co)-Total (mg/L)	<0.020 DLA	<0.020 DLA	<0.050 DLA	<0.020 DLA	<0.00010
	Copper (Cu)-Total (mg/L)	<0.10 DLA	<0.10 DLA	<0.25 DLA	<0.10 DLA	<0.00050
	Iron (Fe)-Total (mg/L)	5.00	15.8	2.7	<1.0 DLA	<0.010
	Lead (Pb)-Total (mg/L)	0.017	0.019	<0.025 DLA	<0.010 DLA	<0.000050
	Lithium (Li)-Total (mg/L)	8.28	46.7	45.3	38.7	<0.0050
	Magnesium (Mg)-Total (mg/L)	29.5	48.3	70.0	70.0	<0.0050
	Manganese (Mn)-Total (mg/L)	0.093	0.395	0.475	0.346	<0.000050

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1310386-6				
	Description	Water				
	Sampled Date					
	Sampled Time					
	Client ID	ALS FIELD BLANK				
Grouping	**Analyte**					
WATER						
Physical Tests	Conductivity (uS/cm)	<2.0				
	Hardness (as CaCO3) (mg/L)					
	pH (pH)	6.86				
	Total Suspended Solids (mg/L)	<3.0				
	Total Dissolved Solids (mg/L)	<10				
	Turbidity (NTU)	<0.10				
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	<2.0				
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<2.0				
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<2.0				
	Alkalinity, Total (as CaCO3) (mg/L)	<2.0				
	Ammonia, Total (as N) (mg/L)	<0.0050				
	Bromide (Br) (mg/L)	<0.050				
	Chloride (Cl) (mg/L)	<0.50				
	Fluoride (F) (mg/L)	<0.020				
	Nitrate (as N) (mg/L)	<0.0050				
	Nitrite (as N) (mg/L)	<0.0010				
	Total Kjeldahl Nitrogen (mg/L)	<0.050				
	Orthophosphate-Dissolved (as P) (mg/L)	<0.0010				
	Phosphorus (P)-Total (mg/L)	<0.0020				
	Sulfate (SO4) (mg/L)	<0.50				
Total Metals	Aluminum (Al)-Total (mg/L)	<0.0030				
	Antimony (Sb)-Total (mg/L)	<0.000050				
	Arsenic (As)-Total (mg/L)	<0.000030				
	Barium (Ba)-Total (mg/L)	<0.000050				
	Beryllium (Be)-Total (mg/L)	<0.00020				
	Bismuth (Bi)-Total (mg/L)	<0.00050				
	Boron (B)-Total (mg/L)	<0.0050				
	Cadmium (Cd)-Total (mg/L)	<0.000010				
	Calcium (Ca)-Total (mg/L)	<0.020				
	Chromium (Cr)-Total (mg/L)	<0.00010				
	Cobalt (Co)-Total (mg/L)	<0.00010				
	Copper (Cu)-Total (mg/L)	<0.00050				
	Iron (Fe)-Total (mg/L)	<0.010				
	Lead (Pb)-Total (mg/L)	<0.000050				
	Lithium (Li)-Total (mg/L)	<0.0050				
	Magnesium (Mg)-Total (mg/L)	<0.0050				
	Manganese (Mn)-Total (mg/L)	<0.000050				

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1310386-1 Water 01-JUN-13 10:00 IWB-1-2013	L1310386-2 Water 01-JUN-13 10:00 ZONE1-1-2013	L1310386-3 Water 01-JUN-13 10:00 ZONE5-1-2013	L1310386-4 Water 02-JUN-13 10:00 ZONE4-1-2013	L1310386-5 Water ALS TRAVEL BLANK
WATER						
Total Metals	Mercury (Hg)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)-Total (mg/L)	0.076	0.351	0.365	0.323	<0.000050
	Nickel (Ni)-Total (mg/L)	0.069	0.068	DLA <0.050	DLA <0.020	<0.00010
	Phosphorus (P)-Total (mg/L)	50.7	DLA <30	DLA <30	DLA <30	<0.30
	Potassium (K)-Total (mg/L)	2890	2540	2260	2240	<0.050
	Selenium (Se)-Total (mg/L)	DLA <0.020	0.047	DLA <0.050	DLA <0.020	<0.00010
	Silicon (Si)-Total (mg/L)	2.1	DLA <5.0	DLA <5.0	DLA <5.0	<0.050
	Silver (Ag)-Total (mg/L)	DLA <0.0020	0.0027	DLA <0.0050	DLA <0.0020	<0.000010
	Sodium (Na)-Total (mg/L)	267	1070	1210	1160	<0.010
	Strontium (Sr)-Total (mg/L)	166	896	899	823	<0.00020
	Thallium (Tl)-Total (mg/L)	DLA <0.010	DLA <0.010	DLA <0.025	DLA <0.010	<0.000050
	Tin (Sn)-Total (mg/L)	DLA <0.020	DLA <0.020	DLA <0.050	DLA <0.020	<0.00010
	Titanium (Ti)-Total (mg/L)	DLA <0.20	DLA <1.0	DLA <1.0	DLA <1.0	<0.010
	Uranium (U)-Total (mg/L)	DLA <0.0020	DLA <0.0020	DLA <0.0050	DLA <0.0020	<0.000010
	Vanadium (V)-Total (mg/L)	<0.20	DLA <0.20	DLA <0.50	DLA <0.20	<0.0010
	Zinc (Zn)-Total (mg/L)	2.61	DLA <0.60	DLA <1.5	DLA <0.60	<0.0030
Dissolved Metals	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	
	Aluminum (Al)-Dissolved (mg/L)	DLA <0.20	DLA <0.20	DLA <0.50	5.28	
	Antimony (Sb)-Dissolved (mg/L)	DLA <0.010	DLA <0.010	DLA <0.025	DLA <0.010	
	Arsenic (As)-Dissolved (mg/L)	DLA <0.0060	0.0102	DLA <0.015	DLA <0.0060	
	Barium (Ba)-Dissolved (mg/L)	0.445	2.93	3.02	3.12	
	Beryllium (Be)-Dissolved (mg/L)	DLA <0.040	DLA <0.040	DLA <0.10	DLA <0.040	
	Bismuth (Bi)-Dissolved (mg/L)	DLA <0.10	DLA <0.10	DLA <0.25	DLA <0.10	
	Boron (B)-Dissolved (mg/L)	3.0	14.9	13.9	13.2	
	Cadmium (Cd)-Dissolved (mg/L)	DLA <0.0020	DLA <0.0020	DLA <0.0050	DLA <0.0020	
	Calcium (Ca)-Dissolved (mg/L)	10100	56900	59900	58200	
	Chromium (Cr)-Dissolved (mg/L)	DLA <0.020	DLA <0.020	DLA <0.050	0.053	
	Cobalt (Co)-Dissolved (mg/L)	DLA <0.020	DLA <0.020	DLA <0.050	DLA <0.020	
	Copper (Cu)-Dissolved (mg/L)	0.058	0.056	DLA <0.10	0.070	
	Iron (Fe)-Dissolved (mg/L)	DLA <0.20	DLA <1.0	DLA <1.0	28.8	
	Lead (Pb)-Dissolved (mg/L)	DLA <0.010	DLA <0.010	DLA <0.025	0.029	
	Lithium (Li)-Dissolved (mg/L)	8.62	48.0	46.4	44.2	
	Magnesium (Mg)-Dissolved (mg/L)	29.4	45.1	73.8	78.9	
	Manganese (Mn)-Dissolved (mg/L)	0.378	0.287	0.448	0.563	
	Mercury (Hg)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	
	Molybdenum (Mo)-Dissolved (mg/L)	0.0669	0.338	0.392	0.387	
	Nickel (Ni)-Dissolved (mg/L)	0.026	0.055	DLA <0.050	0.032	

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1310386-6				
	Description	Water				
	Sampled Date					
	Sampled Time					
	Client ID	ALS FIELD BLANK				
Grouping	**Analyte**					
WATER						
Total Metals	Mercury (Hg)-Total (mg/L)	<0.000010				
	Molybdenum (Mo)-Total (mg/L)	<0.000050				
	Nickel (Ni)-Total (mg/L)	<0.00010				
	Phosphorus (P)-Total (mg/L)	<0.30				
	Potassium (K)-Total (mg/L)	<0.050				
	Selenium (Se)-Total (mg/L)	<0.00010				
	Silicon (Si)-Total (mg/L)	<0.050				
	Silver (Ag)-Total (mg/L)	<0.000010				
	Sodium (Na)-Total (mg/L)	<0.010				
	Strontium (Sr)-Total (mg/L)	<0.00020				
	Thallium (Tl)-Total (mg/L)	<0.000050				
	Tin (Sn)-Total (mg/L)	<0.00010				
	Titanium (Ti)-Total (mg/L)	<0.010				
	Uranium (U)-Total (mg/L)	<0.000010				
	Vanadium (V)-Total (mg/L)	<0.0010				
	Zinc (Zn)-Total (mg/L)	<0.0030				
Dissolved Metals	Dissolved Metals Filtration Location					
	Aluminum (Al)-Dissolved (mg/L)					
	Antimony (Sb)-Dissolved (mg/L)					
	Arsenic (As)-Dissolved (mg/L)					
	Barium (Ba)-Dissolved (mg/L)					
	Beryllium (Be)-Dissolved (mg/L)					
	Bismuth (Bi)-Dissolved (mg/L)					
	Boron (B)-Dissolved (mg/L)					
	Cadmium (Cd)-Dissolved (mg/L)					
	Calcium (Ca)-Dissolved (mg/L)					
	Chromium (Cr)-Dissolved (mg/L)					
	Cobalt (Co)-Dissolved (mg/L)					
	Copper (Cu)-Dissolved (mg/L)					
	Iron (Fe)-Dissolved (mg/L)					
	Lead (Pb)-Dissolved (mg/L)					
	Lithium (Li)-Dissolved (mg/L)					
	Magnesium (Mg)-Dissolved (mg/L)					
	Manganese (Mn)-Dissolved (mg/L)					
	Mercury (Hg)-Dissolved (mg/L)					
	Molybdenum (Mo)-Dissolved (mg/L)					
	Nickel (Ni)-Dissolved (mg/L)					

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1310386-1	L1310386-2	L1310386-3	L1310386-4	L1310386-5
	Description	Water	Water	Water	Water	Water
	Sampled Date	01-JUN-13	01-JUN-13	01-JUN-13	02-JUN-13	
	Sampled Time	10:00	10:00	10:00	10:00	
	Client ID	IWB-1-2013	ZONE1-1-2013	ZONE5-1-2013	ZONE4-1-2013	ALS TRAVEL BLANK
Grouping	**Analyte**					
WATER						
Dissolved Metals	Phosphorus (P)-Dissolved (mg/L)	<6.0 DLA	<30 DLA	<30 DLA	<30 DLA	
	Potassium (K)-Dissolved (mg/L)	3110	2420	2500	2510	
	Selenium (Se)-Dissolved (mg/L)	<0.020 DLA	0.031	<0.050 DLA	<0.020 DLA	
	Silicon (Si)-Dissolved (mg/L)	<1.0 DLA	<5.0 DLA	<5.0 DLA	<5.0 DLA	
	Silver (Ag)-Dissolved (mg/L)	<0.0020 DLA	<0.0020 DLA	<0.0050 DLA	0.0042	
	Sodium (Na)-Dissolved (mg/L)	279	1050	1270	1250	
	Strontium (Sr)-Dissolved (mg/L)	171	891	954	938	
	Thallium (Tl)-Dissolved (mg/L)	<0.010 DLA	<0.010 DLA	<0.025 DLA	<0.010 DLA	
	Tin (Sn)-Dissolved (mg/L)	<0.020 DLA	<0.020 DLA	<0.050 DLA	<0.020 DLA	
	Titanium (Ti)-Dissolved (mg/L)	<0.20 DLA	<1.0 DLA	<1.0 DLA	<1.0 DLA	
	Uranium (U)-Dissolved (mg/L)	<0.0020 DLA	<0.0020 DLA	<0.0050 DLA	<0.0020 DLA	
	Vanadium (V)-Dissolved (mg/L)	<0.20 DLA	<0.20 DLA	<0.50 DLA	<0.20 DLA	
	Zinc (Zn)-Dissolved (mg/L)	1.23	<0.20 DLA	<0.50 DLA	0.56	
Glycols	Diethylene Glycol (mg/L)	<50000 DLA	<500 DLA	<500 DLA	<1000 DLA	
	Ethylene Glycol (mg/L)	<50000 DLA	<500 DLA	<500 DLA	<1000 DLA	
	1,2-Propylene Glycol (mg/L)	632000	3840	2810	37700	

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1310386-6				
	Description	Water				
	Sampled Date					
	Sampled Time					
	Client ID	ALS FIELD BLANK				
Grouping	**Analyte**					
WATER						
Dissolved Metals	Phosphorus (P)-Dissolved (mg/L)					
	Potassium (K)-Dissolved (mg/L)					
	Selenium (Se)-Dissolved (mg/L)					
	Silicon (Si)-Dissolved (mg/L)					
	Silver (Ag)-Dissolved (mg/L)					
	Sodium (Na)-Dissolved (mg/L)					
	Strontium (Sr)-Dissolved (mg/L)					
	Thallium (Tl)-Dissolved (mg/L)					
	Tin (Sn)-Dissolved (mg/L)					
	Titanium (Ti)-Dissolved (mg/L)					
	Uranium (U)-Dissolved (mg/L)					
	Vanadium (V)-Dissolved (mg/L)					
	Zinc (Zn)-Dissolved (mg/L)					
Glycols	Diethylene Glycol (mg/L)					
	Ethylene Glycol (mg/L)					
	1,2-Propylene Glycol (mg/L)					

* 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	Iron (Fe)-Dissolved	DLA	L1310386-1, -2, -3, -4
Duplicate	Phosphorus (P)-Dissolved	DLA	L1310386-1, -2, -3, -4
Duplicate	Silicon (Si)-Dissolved	DLA	L1310386-1, -2, -3, -4
Duplicate	Titanium (Ti)-Dissolved	DLA	L1310386-1, -2, -3, -4
Duplicate	Sulfate (SO4)	DLM	L1310386-1, -2, -3, -4, -5, -6
Duplicate	Bromide (Br)	DLM	L1310386-1, -5, -6
Duplicate	Chloride (Cl)	DLM	L1310386-1, -5, -6
Duplicate	Bromide (Br)	DLM	L1310386-1, -2, -3, -4, -5, -6
Duplicate	Chloride (Cl)	DLM	L1310386-1, -2, -3, -4, -5, -6
Duplicate	Nitrite (as N)	DLM	L1310386-1, -2, -3, -4, -5, -6
Duplicate	Bromide (Br)	DLM	L1310386-2, -3, -4
Duplicate	Total Kjeldahl Nitrogen	DLM	L1310386-1, -2, -3, -4, -6
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L1310386-1, -2, -3, -4
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L1310386-1, -2, -3, -4
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L1310386-1, -2, -3, -4
Matrix Spike	Molybdenum (Mo)-Dissolved	MS-B	L1310386-1, -2, -3, -4
Matrix Spike	Potassium (K)-Dissolved	MS-B	L1310386-1, -2, -3, -4
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1310386-1, -2, -3, -4
Matrix Spike	Phosphorus (P)-Total	MS-B	L1310386-2, -3, -4, -5, -6
Matrix Spike	Aluminum (Al)-Dissolved	MS-B	L1310386-1, -2, -3, -4
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L1310386-1, -2, -3, -4
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L1310386-1, -2, -3, -4
Matrix Spike	Cobalt (Co)-Dissolved	MS-B	L1310386-1, -2, -3, -4
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L1310386-1, -2, -3, -4
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L1310386-1, -2, -3, -4
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1310386-1, -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
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.
RRV	Reported Result Verified By Repeat Analysis

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-SCR-VA	Water	Alkalinity by colour or titration	EPA 310.2 OR APHA 2320

This analysis is carried out using procedures adapted from EPA Method 310.2 "Alkalinity". Total Alkalinity is determined using the methyl orange colourimetric method.
OR
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.

ANIONS-BR-IC-VA	Water	Bromide by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-CL-IC-VA	Water	Chloride by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-F-IC-VA	Water	Fluoride by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-NO2-IC-VA	Water	Nitrite in Water by Ion Chromatography	EPA 300.0

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrite is detected by UV absorbance.

Reference Information

ANIONS-NO3-IC-VA Water Nitrate in Water by Ion Chromatography EPA 300.0

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrate is detected by UV absorbance.

ANIONS-SO4-IC-VA Water Sulfate by Ion Chromatography APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

EC-PCT-VA Water Conductivity (Automated) APHA 2510 Auto. Conduc.

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

F-SIE-VA Water Fluoride by SIE APHA 4500-F "Fluoride"

This analysis is carried out using procedures adapted from APHA Method 4500-F "Fluoride". Fluoride is determined using a selective ion electrode. This method has a significant negative interference (i.e. results could be biased low) when Al3+ is present in the sample at a concentration greater than 2.5 mg/L.

F-SIE-VA Water Fluoride by SIE APHA 4500-F Fluoride

This analysis is carried out using procedures adapted from APHA Method 4500-F "Fluoride". Fluoride is determined using a selective ion electrode. This method has a significant negative interference (i.e. results could be biased low) when Al3+ is present in the sample at a concentration greater than 2.5 mg/L.

FE-DIS-LOW-ICP-VA Water Dissolved Fe 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).

FE-TOT-LOW-ICP-VA Water Total Fe 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).

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 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-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-DIS-ULTRA-MS-VA Water Diss. Metals in Water by ICPMS (Ultra) EPA SW-846 3005A/6020A

Reference Information

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 involves preliminary sample treatment by filtration (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - mass spectrometry (EPA Method 6020A).

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).

MET-TOT-ULTRA-MS-VA Water Total Metals in Water by ICPMS (Ultra) EPA SW-846 3005A/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 either hotblock or microwave oven, or filtration (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - mass spectrometry (EPA Method 6020A).

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.

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

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorous is determined colourimetrically after persulphate digestion of the sample.

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.

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

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.

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.

TKN-F-VA Water TKN in Water by Fluorescence APHA 4500-NORG D.

This analysis is carried out using procedures adapted from APHA Method 4500-Norg D. "Block Digestion and Flow Injection Analysis". Total Kjeldahl Nitrogen is determined using block digestion followed by Flow-injection analysis with fluorescence detection.

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.

TURBIDITY-VA Water Turbidity by Meter APHA 2130 "Turbidity"

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

TURBIDITY-VA Water Turbidity by Meter APHA 2130 Turbidity

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

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

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

Reference Information

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

Chain of Custody Numbers:

10-295953

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.

10- 295953

ALS Environmental

Chain of Custody / Analytical Request Form
Canada Toll Free: 1 800 668 9878
www.alsglobal.com

Page 1 of 1

Report To	Report Format / Distribution	Service Request: (Rush subject to availability - Contact ALS to confirm TAT)
Company: Rescan / ERM Canada	Standard: X Other (specify):	X Regular (Standard Turnaround Times - Business Days)
Contact: Tyler Gale	Select: PDF X Excel X Digital Fax	Priority(2-4 Business Days)-50% surcharge - Contact ALS to confirm TAT
Address: 1111 W. Hastings St. Vancouver BC	Email 1: Tyler.Gale@erm.com	Emergency (1-2 Business Days)-100% Surcharge - Contact ALS to confirm TAT
	Email 2: Rusto.Martinka@erm.com Cody.Cameron@erm.com	Same Day or Weekend Emergency - Contact ALS to confirm TAT
Phone: 604-689-9460 Fax:		
Invoice To Same as Report ? (circle) Yes or No (if No, provide details)	**Client / Project Information**	**Analysis Request**
Copy of Invoice with Report? (circle) Yes or No	Job #: 0194096-0012	(Indicate Filtered or Preserved, F/P)
Company:	PO / AFE:	
Contact:	LSD:	
Address:		
Phone: Fax:	Quote #:	
Lab Work Order # (lab use only) L1310386	**ALS Contact:** Amber Springer	**Sampler:** Tyler Gale

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	General Chemistry	Nutrients	Total Metals	Dissolved Metals	Glycols	Number of Containers
IWB-1-2013		01-Jun-13		Water	X	X	X	X	X	5
Zone 1-1-2013		01-Jun-13		"	X	X	X	X	X	5
Zone5-1-2013		01-Jun-13		"	X	X	X	X	X	5
Zone4-1-2013		02-Jun-13	10:00	"	X	X	X	X	X	5
ALS Travel Blank				"	X	X	X	X	X	3
ALS Field Blank				"	X	X	X	X	X	3

L1310386-COFC

Special Instructions / Regulation with water or land use (CCME- Freshwater Aquatic Life/BC CSR-Commercial/AB Tier 1-Natural/ETC) / Hazardous Details

Most samples very high TDS, Calcium and Chloride (possibly hundreds of g/L).

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.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by:	Date:	Time:	Received by:	Date:	Time:	Temperature: Cooler 1 May 3.4 Avg 2.0 °C	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF
				June 3/13	12:30					

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

GENF 18.01 Front

Cooler 1 May 3.4 Avg 2.0

WHITE PAPER CO. 604 951-3900

GENERAL TERMS AND CONDITIONS:

These terms and conditions are incorporated in and form part of the Agreement between ALS Laboratory Group – Environmental Division ("ALS") and the party named in the Offer (the "Client").

1. Definitions. Capitalized Terms not defined in these Terms and Conditions have the definitions set out in the other Agreement documents.
2. The Services. ALS will provide the Services to the Client as described in the Offer and in any change of custody form provided with any sample.
3. Prices. ALS may review and change all prices, fees, surcharges or other charges set out in the Agreement if there are changes to ALS's cost beyond ALS's control, including changes in legislative requirements, Client variations of sample numbers and Client requests for changes to standard reporting requirements. Notwithstanding Condition 3, all quotations are reviewed and updated on a yearly basis.
4. Payment Terms. The Client shall pay ALS within 30 days of the invoice date OAC. ALS may, for reasonable business reasons, require the Client to arrange for payment in advance.
5. Quotation Numbers. The Client shall provide the quotation number to ALS (where applicable) to ensure correct pricing.
6. Taxes. Applicable taxes are not included in prices, surcharges and additional fees and will be added at the time of invoicing.
7. Quality Control. ALS has an extensive QA/QC program and all analytical data reported is analyzed using approved, referenced procedures followed by checks and reviews of senior managers and quality assurance personnel.
8. No Guarantee of Results. Results are obtained from chemical measurements. The Client is responsible for informing itself on the limitation of the results and acknowledges that the results are not guaranteed.
9. Standard of Care. ALS will use reasonable care and diligence as required by the laws of the province or territory where the sample is tested.
10. Storage. Where possible, ALS will store samples for 30 days from the date a final report is issued to the Client, after which ALS may discard the sample.
11. Holds. If the Client requests a sample be placed on hold, ALS will store the sample for 60 days for the quoted price, after which ALS will invoice the Client and discard the sample.
12. Archives. If the Client requests a sample be archived, ALS will store the sample for 6 months for the quoted price, after which ALS will invoice the Client and discard the sample.
13. Handling Protocol. Legal sample handling protocol must be arranged before samples are collected. ALS may charge a 20% surcharge on the list price plus the hourly technologist or chemist rates for legal sample protocol. Samples processed under legal protocol are stored indefinitely (storage charges may apply).
14. Samples. The quality, condition, content and source of samples stored and tested are not known to ALS except as declared and described on the chain of custody form completed and submitted by the Client and accompanying the sample.
15. Risk of Loss. ALS will use reasonable care to protect samples during storage, however all samples are stored at the Client's risk and the Client is responsible for obtaining appropriate insurance, if desired. The Client acknowledges that during the performance of the Services samples may be altered, lost, damaged or destroyed and the Client releases ALS from any claim the Client may have for any loss or damage to the sample.
16. Environmental. The Client must comply with all applicable environment legislation, including labeling all hazardous samples to comply with WHMIS and TDG regulations, and must provide appropriate material safety data sheets that include the nature of the hazard and a contact name and phone number to call for information. The Client will indemnify ALS for all loss or damages, including any fine or cost of complying with an order of any government authority, resulting from the Client's breach of this paragraph.
17. Hazardous Materials Disposal. ALS may return, at the Client's cost, hazardous material to the Client for disposal.
18. Hazardous Materials Surcharge. ALS may apply an additional surcharge for handling of hazardous samples or samples with Naturally Occuring Radioactive Materials (NORM), H2S, CN, etc.
19. Sample Containers. ALS may ship sample containers to the Client's location by the most cost effective means using ALS preferred courier suppliers, within the specified project timeline.
20. Additional Charges. ALS may charge the Client (a) its cost for emergency bottle shipments and shipments to and from a remote site, and (b) where pick up and delivery services are provided, subject in each instance to a minimum charge of $25.00.
21. Large Bottle Orders. The Client shall provide ALS with 24 hours notice for large bottle orders.
22. Re-Tests. ALS reserves the right to re-test any samples that remains in its possession. Re-tests requested by the Client may be charged.
23. Waiver. The Client is responsible for making any assessment regarding the suitability of the Services and the intended results for the Client's purposes and waives any claims against ALS it may have as a result of the interpretation of the results. The Client shall indemnify ALS for all claims made by any third party against ALS in respect of all losses however arising from the performance of the Services or the use of any report provided in the performance of the Services.
24. Limitation of Liability. In no event shall ALS be liable for any consequential, indirect, incidental, special, exemplary or punitive damages, whether foreseeable of unforeseeable, (including claims for loss of profits or revenue or losses caused by stoppage of other work or impairment of other assets) incurred by the Client arising out of breach or failure of express of implied warranty, breach of contract, breach of warranty, misrepresentation, negligence, strict liability in tort or otherwise. In any event, the liability of ALS to the Client shall be limited to the cost of testing the sample as requested in the chain of custody form under which the sample was originally deposited. For the purposes of this paragraph and paragraphs 8, 15, 16, 23 and 25, as the applicable, "ALS" includes without limitations its directors, officers, employees and affiliates and the "Client" includes without limitation any third party that may have a claim against ALS through the Client.
25. Notice of Liability. Notwithstanding paragraph 24, ALS shall not be liable to the Client unless the Client provides notice in writing to ALS of such loss or damage, together with full particulars thereof, within 30 days of the Client's receipt of the report of the analysis of the sample giving rise to such liability. The provisions of this paragraph allocate the risk under the Agreement between the Client and ALS, and the fees to be paid by the Client to ALS reflect this allocation of risks and the limitations of liability in this Agreement.
26. Entire Agreement. The Agreement is the entire agreement between the parties and supercedes and takes precedence over any terms and conditions contained in any documentation provided by the Client. ALS's execution of any subsequent documentation from the Client only acknowledges receipt and not acceptance of any terms or conditions therein. If there is a conflict between these terms and conditions and any other Agreement document, these terms and conditions prevail.

GENF 19.00 Terms

RESCAN ENVIRONMENTAL SERVICES
ATTN: Tyler Gale
Sixth Floor
1111 West Hastings Street
Vancouver BC V6E 2J3

Date Received: 03-JUN-13
Report Date: 27-JUN-13 11:46 (MT)
Version: FINAL

Client Phone: 604-689-9460

Certificate of Analysis

Lab Work Order #: L1310404

Project P.O. #: NOT SUBMITTED
Job Reference: 0194096-0012
C of C Numbers: 10-295955
Legal Site Desc:

Amber Springer
Account Manager

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ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1310404-1	L1310404-2	L1310404-3		
	Description	Water	Water	Water		
	Sampled Date	02-JUN-13	19-MAY-13	27-MAY-13		
	Sampled Time	13:00	10:00	14:00		
	Client ID	ZONE3-1-2013	WB-13-551M	DF02		
Grouping	**Analyte**					
WATER						
Physical Tests	Conductivity (uS/cm)	180000	145000	150000		
	Hardness (as CaCO3) (mg/L)	142000	115000	120000		
	pH (pH)	7.64	7.71	8.20		
	Total Suspended Solids (mg/L)	142	2670	503		
	Total Dissolved Solids (mg/L)	208000	135000	144000		
	Turbidity (NTU)	31.0	255	134		
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	42.1	4.4	25.4		
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<2.0	<2.0	<2.0		
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<2.0	<2.0	<2.0		
	Alkalinity, Total (as CaCO3) (mg/L)	42.1	4.4	25.4		
	Ammonia, Total (as N) (mg/L)	4.31	3.85	3.22		
	Bromide (Br) (mg/L)	1550	1100	1170		
	Chloride (Cl) (mg/L)	112000	84700	85400 DLM		
	Fluoride (F) (mg/L)	0.46	0.49	<2.0 DLM		
	Nitrate (as N) (mg/L)	<0.50 DLM	<0.50 DLM	<0.50 DLM		
	Nitrite (as N) (mg/L)	<0.10 DLM	<0.10 DLM	<0.10 DLM		
	Total Kjeldahl Nitrogen (mg/L)	<25 DLM	<25 DLM	<25 DLM		
	Orthophosphate-Dissolved (as P) (mg/L)	0.069	0.0233	0.0423		
	Phosphorus (P)-Total (mg/L)	2.70	0.097	0.057		
	Sulfate (SO4) (mg/L)	<50 DLM	<50 DLM	<50 DLM		
Total Metals	Aluminum (Al)-Total (mg/L)	1.14	11.0	4.81		
	Antimony (Sb)-Total (mg/L)	<0.010 DLA	<0.010 DLA	<0.010 DLA		
	Arsenic (As)-Total (mg/L)	0.0101	0.0160	0.0098		
	Barium (Ba)-Total (mg/L)	2.91	2.59	1.86		
	Beryllium (Be)-Total (mg/L)	<0.040 DLA	<0.040 DLA	<0.040 DLA		
	Bismuth (Bi)-Total (mg/L)	<0.10 DLA	<0.10 DLA	<0.10 DLA		
	Boron (B)-Total (mg/L)	14.5	9.8	10.3		
	Cadmium (Cd)-Total (mg/L)	<0.0020 DLA	<0.0020 DLA	<0.0020 DLA		
	Calcium (Ca)-Total (mg/L)	57000	42400	41100		
	Chromium (Cr)-Total (mg/L)	0.055	0.197	0.047		
	Cobalt (Co)-Total (mg/L)	<0.020 DLA	<0.020 DLA	<0.020 DLA		
	Copper (Cu)-Total (mg/L)	<0.10 DLA	0.29	<0.10 DLA		
	Iron (Fe)-Total (mg/L)	5.0	79.3	18.6		
	Lead (Pb)-Total (mg/L)	<0.010 DLA	0.104	0.024		
	Lithium (Li)-Total (mg/L)	41.6	31.4	31.2		
	Magnesium (Mg)-Total (mg/L)	51.1	47.1	35.1		
	Manganese (Mn)-Total (mg/L)	0.165	0.943	0.468		

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1310404-1	L1310404-2	L1310404-3		
	Description	Water	Water	Water		
	Sampled Date	02-JUN-13	19-MAY-13	27-MAY-13		
	Sampled Time	13:00	10:00	14:00		
	Client ID	ZONE3-1-2013	WB-13-551M	DF02		
Grouping	**Analyte**					
WATER						
Total Metals	Mercury (Hg)-Total (mg/L)	<0.000010	<0.000010	<0.000010		
	Molybdenum (Mo)-Total (mg/L)	0.413	0.373	0.240		
	Nickel (Ni)-Total (mg/L)	0.068	0.199	0.095		
	Phosphorus (P)-Total (mg/L)	DLA <30	DLA <30	DLA <30		
	Potassium (K)-Total (mg/L)	2310	1690	1570		
	Selenium (Se)-Total (mg/L)	DLA <0.020	DLA <0.020	DLA <0.020		
	Silicon (Si)-Total (mg/L)	DLA <5.0	27.9	7.7		
	Silver (Ag)-Total (mg/L)	DLA <0.0020	0.0095	0.0032		
	Sodium (Na)-Total (mg/L)	1150	924	820		
	Strontium (Sr)-Total (mg/L)	976	657	652		
	Thallium (Tl)-Total (mg/L)	DLA <0.010	DLA <0.010	DLA <0.010		
	Tin (Sn)-Total (mg/L)	DLA <0.020	DLA <0.020	DLA <0.020		
	Titanium (Ti)-Total (mg/L)	DLA <1.0	DLA <1.0	DLA <1.0		
	Uranium (U)-Total (mg/L)	DLA <0.0020	DLA <0.0020	DLA <0.0020		
	Vanadium (V)-Total (mg/L)	DLA <0.20	DLA <0.20	DLA <0.20		
	Zinc (Zn)-Total (mg/L)	DLA <0.60	DLA <0.60	DLA <0.60		
Dissolved Metals	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD		
	Aluminum (Al)-Dissolved (mg/L)	0.22	0.30	0.23		
	Antimony (Sb)-Dissolved (mg/L)	DLA <0.010	DLA <0.010	DLA <0.010		
	Arsenic (As)-Dissolved (mg/L)	0.0064	0.0129	0.0138		
	Barium (Ba)-Dissolved (mg/L)	2.95	2.81	2.14		
	Beryllium (Be)-Dissolved (mg/L)	DLA <0.040	DLA <0.040	DLA <0.040		
	Bismuth (Bi)-Dissolved (mg/L)	DLA <0.10	DLA <0.10	DLA <0.10		
	Boron (B)-Dissolved (mg/L)	14.6	10.7	12.2		
	Cadmium (Cd)-Dissolved (mg/L)	DLA <0.0020	DLA <0.0020	DLA <0.0020		
	Calcium (Ca)-Dissolved (mg/L)	56800	46000	48000		
	Chromium (Cr)-Dissolved (mg/L)	DLA <0.020	0.069	DLA <0.020		
	Cobalt (Co)-Dissolved (mg/L)	DLA <0.020	DLA <0.020	DLA <0.020		
	Copper (Cu)-Dissolved (mg/L)	DLA <0.040	0.214	0.040		
	Iron (Fe)-Dissolved (mg/L)	DLA <1.0	DLA <1.0	DLA <1.0		
	Lead (Pb)-Dissolved (mg/L)	DLA <0.010	DLA <0.010	DLA <0.010		
	Lithium (Li)-Dissolved (mg/L)	42.9	35.8	36.1		
	Magnesium (Mg)-Dissolved (mg/L)	52.1	44.0	37.8		
	Manganese (Mn)-Dissolved (mg/L)	0.128	0.737	0.378		
	Mercury (Hg)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010		
	Molybdenum (Mo)-Dissolved (mg/L)	0.382	0.388	0.284		
	Nickel (Ni)-Dissolved (mg/L)	0.051	0.174	0.079		

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1310404-1	L1310404-2	L1310404-3		
	Description	Water	Water	Water		
	Sampled Date	02-JUN-13	19-MAY-13	27-MAY-13		
	Sampled Time	13:00	10:00	14:00		
	Client ID	ZONE3-1-2013	WB-13-551M	DF02		
Grouping	**Analyte**					
WATER						
Dissolved Metals	Phosphorus (P)-Dissolved (mg/L)	<30 DLA	<30 DLA	<30 DLA		
	Potassium (K)-Dissolved (mg/L)	2380	1950	1810		
	Selenium (Se)-Dissolved (mg/L)	<0.020 DLA	<0.020 DLA	<0.020 DLA		
	Silicon (Si)-Dissolved (mg/L)	<5.0 DLA	<5.0 DLA	<5.0 DLA		
	Silver (Ag)-Dissolved (mg/L)	<0.0020 DLA	<0.0020 DLA	<0.0020 DLA		
	Sodium (Na)-Dissolved (mg/L)	1170	1010	932		
	Strontium (Sr)-Dissolved (mg/L)	974	735	772		
	Thallium (Tl)-Dissolved (mg/L)	<0.010 DLA	<0.010 DLA	<0.010 DLA		
	Tin (Sn)-Dissolved (mg/L)	<0.020 DLA	<0.020 DLA	<0.020 DLA		
	Titanium (Ti)-Dissolved (mg/L)	<1.0 DLA	<1.0 DLA	<1.0 DLA		
	Uranium (U)-Dissolved (mg/L)	<0.0020 DLA	<0.0020 DLA	<0.0020 DLA		
	Vanadium (V)-Dissolved (mg/L)	<0.20 DLA	<0.20 DLA	<0.20 DLA		
	Zinc (Zn)-Dissolved (mg/L)	<0.20 DLA	<0.20 DLA	0.23		
Glycols	Diethylene Glycol (mg/L)	<250 DLA				
	Ethylene Glycol (mg/L)	<250 DLA				
	1,2-Propylene Glycol (mg/L)	1690				

* 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	Sulfate (SO4)	DLM	L1310404-1, -2, -3
Duplicate	Chloride (Cl)	DLM	L1310404-2, -3
Duplicate	Chloride (Cl)	DLM	L1310404-1, -2, -3
Duplicate	Nitrite (as N)	DLM	L1310404-1, -2, -3
Duplicate	Bromide (Br)	DLM	L1310404-1, -2, -3
Duplicate	Total Kjeldahl Nitrogen	DLM	L1310404-1, -2, -3
Matrix Spike	Phosphorus (P)-Total	MS-B	L1310404-1, -2, -3
Matrix Spike	Cadmium (Cd)-Dissolved	MS-B	L1310404-1, -2, -3
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L1310404-1, -2, -3
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L1310404-1, -2, -3
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1310404-1, -2, -3
Matrix Spike	Zinc (Zn)-Dissolved	MS-B	L1310404-1, -2, -3
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L1310404-1, -2, -3
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L1310404-1, -2, -3
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L1310404-1, -2, -3
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1310404-1, -2, -3
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L1310404-1, -2, -3
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L1310404-1, -2, -3
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L1310404-1, -2, -3
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1310404-1, -2, -3

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLA	Detection Limit Adjusted For required dilution
DLM	Detection Limit Adjusted For Sample Matrix Effects
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-SCR-VA	Water	Alkalinity by colour or titration	EPA 310.2 OR APHA 2320

This analysis is carried out using procedures adapted from EPA Method 310.2 "Alkalinity". Total Alkalinity is determined using the methyl orange colourimetric method.
OR
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.

ANIONS-BR-IC-VA	Water	Bromide by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-CL-IC-VA	Water	Chloride by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-F-IC-VA	Water	Fluoride by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-NO2-IC-VA	Water	Nitrite in Water by Ion Chromatography	EPA 300.0

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrite is detected by UV absorbance.

ANIONS-NO3-IC-VA	Water	Nitrate in Water by Ion Chromatography	EPA 300.0

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrate is detected by UV absorbance.

ANIONS-SO4-IC-VA	Water	Sulfate by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.

Reference Information

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

F-SIE-VA Water Fluoride by SIE APHA 4500-F "Fluoride"

This analysis is carried out using procedures adapted from APHA Method 4500-F "Fluoride". Fluoride is determined using a selective ion electrode. This method has a significant negative interference (i.e. results could be biased low) when Al3+ is present in the sample at a concentration greater than 2.5 mg/L.

F-SIE-VA Water Fluoride by SIE APHA 4500-F Fluoride

This analysis is carried out using procedures adapted from APHA Method 4500-F "Fluoride". Fluoride is determined using a selective ion electrode. This method has a significant negative interference (i.e. results could be biased low) when Al3+ is present in the sample at a concentration greater than 2.5 mg/L.

FE-DIS-LOW-ICP-VA Water Dissolved Fe 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).

FE-TOT-LOW-ICP-VA Water Total Fe 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).

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 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-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-DIS-ULTRA-MS-VA Water Diss. Metals in Water by ICPMS (Ultra) EPA SW-846 3005A/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 involves preliminary sample treatment by filtration (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - mass spectrometry (EPA Method 6020A).

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

Reference Information

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).

MET-TOT-ULTRA-MS-VA Water Total Metals in Water by ICPMS (Ultra) EPA SW-846 3005A/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 either hotblock or microwave oven, or filtration (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - mass spectrometry (EPA Method 6020A).

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.

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

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorous is determined colourimetrically after persulphate digestion of the sample.

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.

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

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.

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.

TKN-F-VA Water TKN in Water by Fluorescence APHA 4500-NORG D.

This analysis is carried out using procedures adapted from APHA Method 4500-Norg D. "Block Digestion and Flow Injection Analysis". Total Kjeldahl Nitrogen is determined using block digestion followed by Flow-injection analysis with fluorescence detection.

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.

TURBIDITY-VA Water Turbidity by Meter APHA 2130 "Turbidity"

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

TURBIDITY-VA Water Turbidity by Meter APHA 2130 Turbidity

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

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

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

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

Chain of Custody Numbers:

10-295955

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.

10- 295955

ALS Environmental

Chain of Custody / Analytical Request Form
Canada Toll Free: 1 800 668 9878
www.alsglobal.com

Page 1 of 1

Report To		Report Format / Distribution		Service Request: (Rush subject to availability - Contact ALS to confirm TAT)	
Company:	Rescan | ERM	Standard:	X Other (specify):	X	Regular (Standard Turnaround Times - Business Days)
Contact:	Tyler Gale	Select: PDF	X Excel X Digital Fax		Priority(2-4 Business Days)-50% surcharge - Contact ALS to confirm TAT
Address:	1111 W. Hastings St.	Email 1:	Tyler.Gale@~~ERM~~rescan.com		Emergency (1-2 Business Days)-100% Surcharge - Contact ALS to confirm TAT
	Vancouver BC	Email 2:	Cody.Cameron@erm.com		Same Day or Weekend Emergency - Contact ALS to confirm TAT
Phone:	604-689-9460 Fax:		Rusto.Martinka@erm.com		

Invoice To	Same as Report ? (circle) Yes or No (if No, provide details)	Client / Project Information	
	Copy of Invoice with Report? (circle) Yes or No	Job #:	1094090-0012
Company:		PO / AFE:	
Contact:		LSD:	
Address:			
Phone:	Fax:	Quote #:	

Lab Work Order # (lab use only)		ALS Contact:	Sampler:

Analysis Request (Indicate Filtered or Preserved, F/P)

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	General Chem.	Nutrients (P)	Total Metals (P)	Dissolved Metals (F)	Glycols (P)	Number of Containers
Zone3-1-2013		2-Jun-13	13:00	Water	—	—	—	—	—	5
WB-13-55|m		19-May-13	10:00	"	—	—	—	—		4
DF02		27-May-13	14:00	"	—	—	—	—		4

L1310404-COFC

Special Instructions / Regulation with water or land use (CCME- Freshwater Aquatic Life/BC CSR-Commercial/AB Tier 1-Natural/ETC) / Hazardous Details

Expect very high TDS, Calcium, Chloride (tens to hundreds of g/L). Empty sample bottles and preservative capsules have been used (dirty).

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.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by:	Date:	Time:	Received by:	Date:	Time:	Temperature:	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF
				June 3/13	12:30	Mar 3.9 Arr 2.4 °C				

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION — WHITE - LABORATORY COPY — YELLOW - CLIENT COPY — GENF 18.01 Front

WHITE PAPER CO. 604 951-3900

GENERAL TERMS AND CONDITIONS:

These terms and conditions are incorporated in and form part of the Agreement between ALS Laboratory Group – Environmental Division ("ALS") and the party named in the Offer (the "Client").

1. Definitions. Capitalized Terms not defined in these Terms and Conditions have the definitions set out in the other Agreement documents.
2. The Services. ALS will provide the Services to the Client as described in the Offer and in any change of custody form provided with any sample.
3. Prices. ALS may review and change all prices, fees, surcharges or other charges set out in the Agreement if there are changes to ALS's cost beyond ALS's control, including changes in legislative requirements, Client variations of sample numbers and Client requests for changes to standard reporting requirements. Notwithstanding Condition 3, all quotations are reviewed and updated on a yearly basis.
4. Payment Terms. The Client shall pay ALS within 30 days of the invoice date OAC. ALS may, for reasonable business reasons, require the Client to arrange for payment in advance.
5. Quotation Numbers. The Client shall provide the quotation number to ALS (where applicable) to ensure correct pricing.
6. Taxes. Applicable taxes are not included in prices, surcharges and additional fees and will be added at the time of invoicing.
7. Quality Control. ALS has an extensive QA/QC program and all analytical data reported is analyzed using approved, referenced procedures followed by checks and reviews of senior managers and quality assurance personnel.
8. No Guarantee of Results. Results are obtained from chemical measurements. The Client is responsible for informing itself on the limitation of the results and acknowledges that the results are not guaranteed.
9. Standard of Care. ALS will use reasonable care and diligence as required by the laws of the province or territory where the sample is tested.
10. Storage. Where possible, ALS will store samples for 30 days from the date a final report is issued to the Client, after which ALS may discard the sample.
11. Holds. If the Client requests a sample be placed on hold, ALS will store the sample for 60 days for the quoted price, after which ALS will invoice the Client and discard the sample.
12. Archives. If the Client requests a sample be archived, ALS will store the sample for 6 months for the quoted price, after which ALS will invoice the Client and discard the sample.
13. Handling Protocol. Legal sample handling protocol must be arranged before samples are collected. ALS may charge a 20% surcharge on the list price plus the hourly technologist or chemist rates for legal sample protocol. Samples processed under legal protocol are stored indefinitely (storage charges may apply).
14. Samples. The quality, condition, content and source of samples stored and tested are not known to ALS except as declared and described on the chain of custody form completed and submitted by the Client and accompanying the sample.
15. Risk of Loss. ALS will use reasonable care to protect samples during storage, however all samples are stored at the Client's risk and the Client is responsible for obtaining appropriate insurance, if desired. The Client acknowledges that during the performance of the Services samples may be altered, lost, damaged or destroyed and the Client releases ALS from any claim the Client may have for any loss or damage to the sample.
16. Environmental. The Client must comply with all applicable environment legislation, including labeling all hazardous samples to comply with WHMIS and TDG regulations, and must provide appropriate material safety data sheets that include the nature of the hazard and a contact name and phone number to call for information. The Client will indemnify ALS for all loss or damages, including any fine or cost of complying with an order of any government authority, resulting from the Client's breach of this paragraph.
17. Hazardous Materials Disposal. ALS may return, at the Client's cost, hazardous material to the Client for disposal.
18. Hazardous Materials Surcharge. ALS may apply an additional surcharge for handling of hazardous samples or samples with Naturally Occuring Radioactive Materials (NORM), H2S, CN, etc.
19. Sample Containers. ALS may ship sample containers to the Client's location by the most cost effective means using ALS preferred courier suppliers, within the specified project timeline.
20. Additional Charges. ALS may charge the Client (a) its cost for emergency bottle shipments and shipments to and from a remote site, and (b) where pick up and delivery services are provided, subject in each instance to a minimum charge of $25.00.
21. Large Bottle Orders. The Client shall provide ALS with 24 hours notice for large bottle orders.
22. Re-Tests. ALS reserves the right to re-test any samples that remains in its possession. Re-tests requested by the Client may be charged.
23. Waiver. The Client is responsible for making any assessment regarding the suitability of the Services and the intended results for the Client's purposes and waives any claims against ALS it may have as a result of the interpretation of the results. The Client shall indemnify ALS for all claims made by any third party against ALS in respect of all losses however arising from the performance of the Services or the use of any report provided in the performance of the Services.
24. Limitation of Liability. In no event shall ALS be liable for any consequential, indirect, incidental, special, exemplary or punitive damages, whether foreseeable of unforeseeable, (including claims for loss of profits or revenue or losses caused by stoppage of other work or impairment of other assets) incurred by the Client arising out of breach or failure of express of implied warranty, breach of contract, breach of warranty, misrepresentation, negligence, strict liability in tort or otherwise. In any event, the liability of ALS to the Client shall be limited to the cost of testing the sample as requested in the chain of custody form under which the sample was originally deposited. For the purposes of this paragraph and paragraphs 8, 15, 16, 23 and 25, as the applicable, "ALS" includes without limitations its directors, officers, employees and affiliates and the "Client" includes without limitation any third party that may have a claim against ALS through the Client.
25. Notice of Liability. Notwithstanding paragraph 24, ALS shall not be liable to the Client unless the Client provides notice in writing to ALS of such loss or damage, together with full particulars thereof, within 30 days of the Client's receipt of the report of the analysis of the sample giving rise to such liability. The provisions of this paragraph allocate the risk under the Agreement between the Client and ALS, and the fees to be paid by the Client to ALS reflect this allocation of risks and the limitations of liability in this Agreement.
26. Entire Agreement. The Agreement is the entire agreement between the parties and supercedes and takes precedence over any terms and conditions contained in any documentation provided by the Client. ALS's execution of any subsequent documentation from the Client only acknowledges receipt and not acceptance of any terms or conditions therein. If there is a conflict between these terms and conditions and any other Agreement document, these terms and conditions prevail.

GENF 19.00 Terms

RESCAN ENVIRONMENTAL SERVICES
ATTN: Tyler Gale
Sixth Floor
1111 West Hastings Street
Vancouver BC V6E 2J3

Date Received: 27-JUN-13
Report Date: 15-JUL-13 17:25 (MT)
Version: FINAL

Client Phone: 604-689-9460

Certificate of Analysis

Lab Work Order #: L1323663

Project P.O. #:	NOT SUBMITTED
Job Reference:	0194096-0012
C of C Numbers:	10-186497
Legal Site Desc:	

Comments: Both glycols vials were received broken - analysis was not possible.

Amber Springer
Account Manager

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1323663-1				
	Description	Water				
	Sampled Date	26-JUN-13				
	Sampled Time	13:00				
	Client ID	ZONE3-2-2013				
Grouping	**Analyte**					
WATER						
Physical Tests	Conductivity (uS/cm)	155000				
	Hardness (as CaCO3) (mg/L)	111000				
	pH (pH)	7.50				
	Total Suspended Solids (mg/L)	371				
	Total Dissolved Solids (mg/L)	159000 AI				
	Turbidity (NTU)	17.1				
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	22.0				
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<2.0				
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<2.0				
	Alkalinity, Total (as CaCO3) (mg/L)	22.0				
	Ammonia, Total (as N) (mg/L)	3.05				
	Bromide (Br) (mg/L)	1140				
	Chloride (Cl) (mg/L)	90200				
	Fluoride (F) (mg/L)	<2.0 DLM				
	Nitrate (as N) (mg/L)	2.30				
	Nitrite (as N) (mg/L)	<0.10 DLM				
	Total Kjeldahl Nitrogen (mg/L)	<50 DLM				
	Orthophosphate-Dissolved (as P) (mg/L)	0.0695				
	Phosphorus (P)-Total (mg/L)	0.147				
	Sulfate (SO4) (mg/L)	<50 DLM				
Total Metals	Aluminum (Al)-Total (mg/L)	<0.60 DLA				
	Antimony (Sb)-Total (mg/L)	<0.010 DLA				
	Arsenic (As)-Total (mg/L)	<0.0060 DLA				
	Barium (Ba)-Total (mg/L)	5.83				
	Beryllium (Be)-Total (mg/L)	<0.040 DLA				
	Bismuth (Bi)-Total (mg/L)	<0.10 DLA				
	Boron (B)-Total (mg/L)	11.3				
	Cadmium (Cd)-Total (mg/L)	<0.0020 DLA				
	Calcium (Ca)-Total (mg/L)	46100				
	Chromium (Cr)-Total (mg/L)	<0.020 DLA				
	Cobalt (Co)-Total (mg/L)	<0.020 DLA				
	Copper (Cu)-Total (mg/L)	<0.10 DLA				
	Iron (Fe)-Total (mg/L)	1.00				
	Lead (Pb)-Total (mg/L)	<0.010 DLA				
	Lithium (Li)-Total (mg/L)	33.3				
	Magnesium (Mg)-Total (mg/L)	471				
	Manganese (Mn)-Total (mg/L)	1.45				

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1323663-1				
	Description	Water				
	Sampled Date	26-JUN-13				
	Sampled Time	13:00				
	Client ID	ZONE3-2-2013				
Grouping	**Analyte**					
WATER						
Total Metals	Mercury (Hg)-Total (mg/L)	<0.000010				
	Molybdenum (Mo)-Total (mg/L)	0.271				
	Nickel (Ni)-Total (mg/L)	0.040				
	Phosphorus (P)-Total (mg/L)	<15				
	Potassium (K)-Total (mg/L)	1800				
	Selenium (Se)-Total (mg/L)	<0.020 DLA				
	Silicon (Si)-Total (mg/L)	<2.5				
	Silver (Ag)-Total (mg/L)	<0.0020 DLA				
	Sodium (Na)-Total (mg/L)	3910				
	Strontium (Sr)-Total (mg/L)	821				
	Thallium (Tl)-Total (mg/L)	<0.010 DLA				
	Tin (Sn)-Total (mg/L)	<0.020 DLA				
	Titanium (Ti)-Total (mg/L)	<0.50				
	Uranium (U)-Total (mg/L)	<0.0020 DLA				
	Vanadium (V)-Total (mg/L)	<0.20 DLA				
	Zinc (Zn)-Total (mg/L)	<0.60 DLA				
Dissolved Metals	Dissolved Metals Filtration Location	FIELD				
	Aluminum (Al)-Dissolved (mg/L)	<0.20 DLA				
	Antimony (Sb)-Dissolved (mg/L)	<0.010 DLA				
	Arsenic (As)-Dissolved (mg/L)	<0.0060 DLA				
	Barium (Ba)-Dissolved (mg/L)	5.64				
	Beryllium (Be)-Dissolved (mg/L)	<0.040 DLA				
	Bismuth (Bi)-Dissolved (mg/L)	<0.10 DLA				
	Boron (B)-Dissolved (mg/L)	10.8				
	Cadmium (Cd)-Dissolved (mg/L)	<0.0020 DLA				
	Calcium (Ca)-Dissolved (mg/L)	43800				
	Chromium (Cr)-Dissolved (mg/L)	<0.020 DLA				
	Cobalt (Co)-Dissolved (mg/L)	<0.020 DLA				
	Copper (Cu)-Dissolved (mg/L)	<0.040 DLA				
	Iron (Fe)-Dissolved (mg/L)	<0.50				
	Lead (Pb)-Dissolved (mg/L)	<0.010 DLA				
	Lithium (Li)-Dissolved (mg/L)	32.9				
	Magnesium (Mg)-Dissolved (mg/L)	437				
	Manganese (Mn)-Dissolved (mg/L)	1.34				
	Mercury (Hg)-Dissolved (mg/L)	<0.000010				
	Molybdenum (Mo)-Dissolved (mg/L)	0.251				
	Nickel (Ni)-Dissolved (mg/L)	0.020				

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1323663-1				
	Description	Water				
	Sampled Date	26-JUN-13				
	Sampled Time	13:00				
	Client ID	ZONE3-2-2013				
Grouping	**Analyte**					
WATER						
Dissolved Metals	Phosphorus (P)-Dissolved (mg/L)	<15				
	Potassium (K)-Dissolved (mg/L)	1600				
	Selenium (Se)-Dissolved (mg/L)	<0.020 DLA				
	Silicon (Si)-Dissolved (mg/L)	<2.5				
	Silver (Ag)-Dissolved (mg/L)	<0.0020 DLA				
	Sodium (Na)-Dissolved (mg/L)	3590				
	Strontium (Sr)-Dissolved (mg/L)	760				
	Thallium (Tl)-Dissolved (mg/L)	<0.010 DLA				
	Tin (Sn)-Dissolved (mg/L)	<0.020 DLA				
	Titanium (Ti)-Dissolved (mg/L)	<0.50				
	Uranium (U)-Dissolved (mg/L)	<0.0020 DLA				
	Vanadium (V)-Dissolved (mg/L)	<0.20 DLA				
	Zinc (Zn)-Dissolved (mg/L)	<0.20 DLA				

* 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	Aluminum (Al)-Dissolved	DLA	L1323663-1
Duplicate	Bismuth (Bi)-Dissolved	DLA	L1323663-1
Duplicate	Cadmium (Cd)-Dissolved	DLA	L1323663-1
Duplicate	Copper (Cu)-Dissolved	DLA	L1323663-1
Duplicate	Lead (Pb)-Dissolved	DLA	L1323663-1
Duplicate	Silver (Ag)-Dissolved	DLA	L1323663-1
Duplicate	Tin (Sn)-Dissolved	DLA	L1323663-1
Duplicate	Zinc (Zn)-Dissolved	DLA	L1323663-1
Duplicate	Fluoride (F)	DLM	L1323663-1
Duplicate	Nitrite (as N)	DLM	L1323663-1
Duplicate	Bromide (Br)	DLM	L1323663-1
Duplicate	Bromide (Br)	DLM	L1323663-1
Method Blank	Boron (B)-Total	MB-LOR	L1323663-1
Matrix Spike	Phosphorus (P)-Total	MS-B	L1323663-1
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L1323663-1
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L1323663-1
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L1323663-1
Matrix Spike	Potassium (K)-Dissolved	MS-B	L1323663-1
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1323663-1
Matrix Spike	Uranium (U)-Dissolved	MS-B	L1323663-1
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L1323663-1
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L1323663-1
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L1323663-1
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1323663-1
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L1323663-1
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L1323663-1
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L1323663-1
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1323663-1
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L1323663-1
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L1323663-1
Matrix Spike	Total Kjeldahl Nitrogen	MSTN	L1323663-1

Qualifiers for Individual Parameters Listed:

Qualifier	Description
AI	Analytical interferences may be present. Result may be biased high.
DLA	Detection Limit Adjusted For required dilution
DLM	Detection Limit Adjusted For Sample Matrix Effects
MB-LOR	Method Blank exceeds ALS DQO. Limits of Reporting have been adjusted for samples with positive hits below 5x blank level.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.
MSTN	TKN Matrix Spike recovery was low due to interference from high nitrate, which causes negative bias on TKN.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-SCR-VA	Water	Alkalinity by colour or titration	EPA 310.2 OR APHA 2320

This analysis is carried out using procedures adapted from EPA Method 310.2 "Alkalinity". Total Alkalinity is determined using the methyl orange colourimetric method.
OR
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.

ANIONS-BR-IC-VA	Water	Bromide by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-CL-IC-VA	Water	Chloride by Ion Chromatography	APHA 4110 B.

Reference Information

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-F-IC-VA Water Fluoride by Ion Chromatography APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-NO2-IC-VA Water Nitrite in Water by Ion Chromatography EPA 300.0

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrite is detected by UV absorbance.

ANIONS-NO3-IC-VA Water Nitrate in Water by Ion Chromatography EPA 300.0

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrate is detected by UV absorbance.

ANIONS-SO4-IC-VA Water Sulfate by Ion Chromatography APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

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.

FE-DIS-LOW-ICP-VA Water Dissolved Fe 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).

FE-TOT-LOW-ICP-VA Water Total Fe 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).

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-DIS-ULTRA-MS-VA Water Diss. Metals in Water by ICPMS (Ultra) EPA SW-846 3005A/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 involves preliminary sample treatment by filtration (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - mass spectrometry (EPA Method 6020A).

Reference Information

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).

MET-TOT-ULTRA-MS-VA	Water	Total Metals in Water by ICPMS (Ultra)	EPA SW-846 3005A/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 either hotblock or microwave oven, or filtration (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - mass spectrometry (EPA Method 6020A).

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.

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

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorous is determined colourimetrically after persulphate digestion of the sample.

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.

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

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.

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.

TKN-F-VA	Water	TKN in Water by Fluorescence	APHA 4500-NORG D.

This analysis is carried out using procedures adapted from APHA Method 4500-Norg D. "Block Digestion and Flow Injection Analysis". Total Kjeldahl Nitrogen is determined using block digestion followed by Flow-injection analysis with fluorescence detection.

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.

TURBIDITY-VA	Water	Turbidity by Meter	APHA 2130 "Turbidity"

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

TURBIDITY-VA	Water	Turbidity by Meter	APHA 2130 Turbidity

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

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

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

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

Reference Information

Chain of Custody Numbers:

10-186497

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.

10-186497

ALS Environmental

Chain of Custody / Analytical Request Form
Canada Toll Free: 1 800 668 9878
www.alsglobal.com

Page 1 of 1

Report To	Report Format / Distribution	Service Request: (Rush subject to availability - Contact ALS to confirm TAT)
Company: Rescan - ERM	Standard: X Other (specify):	X Regular (Standard Turnaround Times - Business Days)
Contact: Tyler Gale	Select: PDF X Excel X Digital Fax	Priority(2-4 Business Days)-50% surcharge - Contact ALS to confirm TAT
Address: 1111 W. Hastings St. Vancouver BC	Email 1: Tyler.Gale@erm.com	Emergency (1-2 Business Days)-100% Surcharge - Contact ALS to confirm TAT
	Email 2: Rusto.Martinka@erm.com	Same Day or Weekend Emergency - Contact ALS to confirm TAT
Phone: 604-689-9460 Fax:	Email 3: Daniel.Helm@erm.com	
Invoice To Same as Report ? (circle) (Yes) or No (if No, provide details)	**Client / Project Information**	
Copy of Invoice with Report? (circle) Yes or No	Job #: 0194096-0012	
Company:	PO / AFE:	
Contact:	LSD:	
Address:		
Phone: Fax:	Quote #:	
Lab Work Order # (lab use only) L1323663	**ALS Contact:** Amber Springer **Sampler:** Tyler Gale	

Analysis Request (Indicate Filtered or Preserved, F/P)

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	General Chem	Nutrients (P)	Total Metals (P)	Dissolved Metals (F/P)	Glycols (P)							Number of Containers
Zone3-2-2013		26-Jun-13	13:00	Water	X	X	X	X	X							5

L1323663-COFC

Special Instructions / Regulation with water or land use (CCME- Freshwater Aquatic Life/BC CSR-Commercial/AB Tier 1-Natural/ETC) / Hazardous Details

Expect very high TDS (100s of g/L), Chloride and Calcium (10s of g/L). Glycols up to 1000s of mg/L.

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.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by:	Date:	Time:	Received by:	Date:	Time:	Temperature:	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF
				Jun. 27/13	11:30	8.3 °C				

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION — WHITE - LABORATORY COPY — YELLOW - CLIENT COPY — GENF 18.01 Front

WHITE PAPER CO. 604 951-3900

RESCAN ENVIRONMENTAL SERVICES
ATTN: Tyler Gale
Sixth Floor
1111 West Hastings Street
Vancouver BC V6E 2J3

Date Received: 08-JUL-13
Report Date: 23-JUL-13 16:06 (MT)
Version: FINAL

Client Phone: 604-689-9460

Certificate of Analysis

Lab Work Order #: L1328754

Project P.O. #: NOT SUBMITTED
Job Reference: 0194096-0012
C of C Numbers: 10-186496
Legal Site Desc:

Amber Springer
Account Manager

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1328754-1	L1328754-2			
	Description	WATER	WATER			
	Sampled Date	03-JUL-13	03-JUL-13			
	Sampled Time	20:00	16:30			
	Client ID	ZONE3-3-2013	BLANK			
Grouping	**Analyte**					
WATER						
Physical Tests	Conductivity (uS/cm)	140000	3.7			
	Hardness (as CaCO3) (mg/L)	93100	4.07			
	pH (pH)	7.37	5.82			
	Total Suspended Solids (mg/L)	134	<3.0			
	Total Dissolved Solids (mg/L)	143000 AI	<10			
	Turbidity (NTU)	8.30	<0.10			
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	16.8	<2.0			
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<2.0	<2.0			
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<2.0	<2.0			
	Alkalinity, Total (as CaCO3) (mg/L)	16.8	<2.0			
	Ammonia, Total (as N) (mg/L)	1.93	<0.0050			
	Bromide (Br) (mg/L)	660	<0.050			
	Chloride (Cl) (mg/L)	77600	0.87			
	Fluoride (F) (mg/L)	0.94	<0.030			
	Nitrate (as N) (mg/L)	<0.50 DLM	0.0085			
	Nitrite (as N) (mg/L)	<0.10 DLM	<0.0010			
	Total Kjeldahl Nitrogen (mg/L)	2.57	<0.050			
	Orthophosphate-Dissolved (as P) (mg/L)	0.0311	0.0060			
	Phosphorus (P)-Total (mg/L)	0.183	0.0074			
	Sulfate (SO4) (mg/L)	<50 DLM	<0.50			
Total Metals	Aluminum (Al)-Total (mg/L)	<0.60 DLA	<0.0030			
	Antimony (Sb)-Total (mg/L)	<0.010 DLA	<0.000050			
	Arsenic (As)-Total (mg/L)	<0.0060 DLA	<0.000030			
	Barium (Ba)-Total (mg/L)	6.49	0.000118 RRV			
	Beryllium (Be)-Total (mg/L)	<0.040 DLA	<0.00020			
	Bismuth (Bi)-Total (mg/L)	<0.10 DLA	<0.00050			
	Boron (B)-Total (mg/L)	7.9	<0.0050			
	Cadmium (Cd)-Total (mg/L)	<0.0020 DLA	<0.000010			
	Calcium (Ca)-Total (mg/L)	36100	0.388 RRV			
	Chromium (Cr)-Total (mg/L)	<0.020 DLA	0.00016 RRV			
	Cobalt (Co)-Total (mg/L)	<0.020 DLA	<0.00010			
	Copper (Cu)-Total (mg/L)	<0.10 DLA	<0.00050			
	Iron (Fe)-Total (mg/L)	2.95	<0.010			
	Lead (Pb)-Total (mg/L)	<0.010 DLA	0.000123 RRV			
	Lithium (Li)-Total (mg/L)	22.4	<0.0050			
	Magnesium (Mg)-Total (mg/L)	650	0.0054 RRV			
	Manganese (Mn)-Total (mg/L)	1.87	0.000188 RRV			

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1328754-1	L1328754-2			
	Description	WATER	WATER			
	Sampled Date	03-JUL-13	03-JUL-13			
	Sampled Time	20:00	16:30			
	Client ID	ZONE3-3-2013	BLANK			
Grouping	**Analyte**					
WATER						
Total Metals	Mercury (Hg)-Total (mg/L)	<0.000010	<0.000010			
	Molybdenum (Mo)-Total (mg/L)	0.184	0.000182 RRV			
	Nickel (Ni)-Total (mg/L)	0.023	0.00050 RRV			
	Phosphorus (P)-Total (mg/L)	<15 DLA	<0.30			
	Potassium (K)-Total (mg/L)	1170	<0.050			
	Selenium (Se)-Total (mg/L)	<0.020 DLA	<0.00010			
	Silicon (Si)-Total (mg/L)	<2.5 DLA	<0.050			
	Silver (Ag)-Total (mg/L)	<0.0020 DLA	<0.000010			
	Sodium (Na)-Total (mg/L)	5080	0.103			
	Strontium (Sr)-Total (mg/L)	640	0.00701 RRV			
	Thallium (Tl)-Total (mg/L)	<0.010 DLA	<0.000050			
	Tin (Sn)-Total (mg/L)	<0.020 DLA	<0.00010			
	Titanium (Ti)-Total (mg/L)	0.67	<0.010			
	Uranium (U)-Total (mg/L)	<0.0020 DLA	<0.000010			
	Vanadium (V)-Total (mg/L)	<0.20 DLA	<0.0010			
	Zinc (Zn)-Total (mg/L)	<0.60 DLA	<0.0030			
Dissolved Metals	Dissolved Metals Filtration Location	FIELD	FIELD			
	Aluminum (Al)-Dissolved (mg/L)	<0.20 DLA	<0.0030			
	Antimony (Sb)-Dissolved (mg/L)	<0.010 DLA	<0.000050			
	Arsenic (As)-Dissolved (mg/L)	<0.0060 DLA	<0.000030			
	Barium (Ba)-Dissolved (mg/L)	6.46	0.000494 DTC			
	Beryllium (Be)-Dissolved (mg/L)	<0.040 DLA	<0.00020			
	Bismuth (Bi)-Dissolved (mg/L)	<0.10 DLA	<0.00050			
	Boron (B)-Dissolved (mg/L)	8.2	<0.0050			
	Cadmium (Cd)-Dissolved (mg/L)	<0.0020 DLA	<0.000010			
	Calcium (Ca)-Dissolved (mg/L)	36200	1.59 DTC			
	Chromium (Cr)-Dissolved (mg/L)	<0.020 DLA	<0.00010			
	Cobalt (Co)-Dissolved (mg/L)	<0.020 DLA	<0.00010			
	Copper (Cu)-Dissolved (mg/L)	<0.040 DLA	<0.00050			
	Iron (Fe)-Dissolved (mg/L)	<0.50 DLA	<0.010			
	Lead (Pb)-Dissolved (mg/L)	<0.010 DLA	<0.000050			
	Lithium (Li)-Dissolved (mg/L)	23.2	<0.0050			
	Magnesium (Mg)-Dissolved (mg/L)	658	0.0231 DTC			
	Manganese (Mn)-Dissolved (mg/L)	1.86	0.000690 DTC			
	Mercury (Hg)-Dissolved (mg/L)	<0.000010	<0.000010			
	Molybdenum (Mo)-Dissolved (mg/L)	0.185	0.000133 RRV			
	Nickel (Ni)-Dissolved (mg/L)	<0.020 DLA	0.00051 RRV			

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1328754-1	L1328754-2			
	Description	WATER	WATER			
	Sampled Date	03-JUL-13	03-JUL-13			
	Sampled Time	20:00	16:30			
	Client ID	ZONE3-3-2013	BLANK			
Grouping	**Analyte**					
WATER						
Dissolved Metals	Phosphorus (P)-Dissolved (mg/L)	<15 DLA	<0.30			
	Potassium (K)-Dissolved (mg/L)	1170	0.059 RRV			
	Selenium (Se)-Dissolved (mg/L)	<0.020 DLA	<0.00010			
	Silicon (Si)-Dissolved (mg/L)	<2.5 DLA	<0.050			
	Silver (Ag)-Dissolved (mg/L)	<0.0020 DLA	<0.000010			
	Sodium (Na)-Dissolved (mg/L)	5070	0.245 DTC			
	Strontium (Sr)-Dissolved (mg/L)	653	0.0267 DTC			
	Thallium (Tl)-Dissolved (mg/L)	<0.010 DLA	<0.000050			
	Tin (Sn)-Dissolved (mg/L)	<0.020 DLA	<0.00010			
	Titanium (Ti)-Dissolved (mg/L)	0.66	<0.010			
	Uranium (U)-Dissolved (mg/L)	<0.0020 DLA	<0.000010			
	Vanadium (V)-Dissolved (mg/L)	<0.20 DLA	<0.0010			
	Zinc (Zn)-Dissolved (mg/L)	<0.20 DLA	0.0061 RRV			
Glycols	Diethylene Glycol (mg/L)	<5.0	<5.0			
	Ethylene Glycol (mg/L)	<5.0	<5.0			
	1,2-Propylene Glycol (mg/L)	228	<5.0			

* 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	Bismuth (Bi)-Dissolved	DLA	L1328754-1, -2
Duplicate	Lithium (Li)-Dissolved	DLA	L1328754-1, -2
Duplicate	Molybdenum (Mo)-Dissolved	DLA	L1328754-1, -2
Duplicate	Potassium (K)-Dissolved	DLA	L1328754-1, -2
Duplicate	Tin (Sn)-Dissolved	DLA	L1328754-1, -2
Duplicate	Bromide (Br)	DLM	L1328754-2
Matrix Spike	Phosphorus (P)-Total	MS-B	L1328754-1, -2
Matrix Spike	Barium (Ba)-Total	MS-B	L1328754-1
Matrix Spike	Calcium (Ca)-Total	MS-B	L1328754-1
Matrix Spike	Magnesium (Mg)-Total	MS-B	L1328754-1
Matrix Spike	Strontium (Sr)-Total	MS-B	L1328754-1
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L1328754-1, -2
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L1328754-1, -2
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1328754-1, -2

Qualifiers for Individual Parameters Listed:

Qualifier	Description
AI	Analytical interferences may be present. Result may be biased high.
DLA	Detection Limit Adjusted For required dilution
DLM	Detection Limit Adjusted For Sample Matrix Effects
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**
ALK-SCR-VA	Water	Alkalinity by colour or titration	EPA 310.2 OR APHA 2320

This analysis is carried out using procedures adapted from EPA Method 310.2 "Alkalinity". Total Alkalinity is determined using the methyl orange colourimetric method.
OR
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.

ANIONS-BR-IC-VA	Water	Bromide by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-CL-IC-VA	Water	Chloride by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-F-IC-VA	Water	Fluoride by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-NO2-IC-VA	Water	Nitrite in Water by Ion Chromatography	EPA 300.0

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrite is detected by UV absorbance.

ANIONS-NO3-IC-VA	Water	Nitrate in Water by Ion Chromatography	EPA 300.0

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrate is detected by UV absorbance.

ANIONS-SO4-IC-VA	Water	Sulfate by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

F-SIE-VA	Water	Fluoride by SIE	APHA 4500-F "Fluoride"

Reference Information

This analysis is carried out using procedures adapted from APHA Method 4500-F "Fluoride". Fluoride is determined using a selective ion electrode. This method has a significant negative interference (i.e. results could be biased low) when Al3+ is present in the sample at a concentration greater than 2.5 mg/L.

F-SIE-VA Water Fluoride by SIE APHA 4500-F Fluoride

This analysis is carried out using procedures adapted from APHA Method 4500-F "Fluoride". Fluoride is determined using a selective ion electrode. This method has a significant negative interference (i.e. results could be biased low) when Al3+ is present in the sample at a concentration greater than 2.5 mg/L.

FE-DIS-LOW-ICP-VA Water Dissolved Fe 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).

FE-TOT-LOW-ICP-VA Water Total Fe 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).

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 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-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-DIS-ULTRA-MS-VA Water Diss. Metals in Water by ICPMS (Ultra) EPA SW-846 3005A/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 involves preliminary sample treatment by filtration (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - mass spectrometry (EPA Method 6020A).

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

Reference Information

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).

MET-TOT-ULTRA-MS-VA Water Total Metals in Water by ICPMS (Ultra) EPA SW-846 3005A/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 either hotblock or microwave oven, or filtration (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - mass spectrometry (EPA Method 6020A).

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.

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

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorous is determined colourimetrically after persulphate digestion of the sample.

PH-MAN-VA Water pH by Manual Meter 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-MAN-VA Water pH by Manual Meter 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.

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.

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

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.

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.

TKN-F-VA Water TKN in Water by Fluorescence APHA 4500-NORG D.

This analysis is carried out using procedures adapted from APHA Method 4500-Norg D. "Block Digestion and Flow Injection Analysis". Total Kjeldahl Nitrogen is determined using block digestion followed by Flow-injection analysis with fluorescence detection.

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.

TURBIDITY-VA Water Turbidity by Meter APHA 2130 "Turbidity"

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

TURBIDITY-VA Water Turbidity by Meter APHA 2130 Turbidity

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

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

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

Laboratory Location

Reference Information

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

Chain of Custody Numbers:

10-186496

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.

10-186496

ALS Environmental

Chain of Custody / Analytical Request Form
Canada Toll Free: 1 800 668 9878
www.alsglobal.com

Page 1 of 1

Report To Rescan - ERM	**Report Format / Distribution**	**Service Request:** (Rush subject to availability - Contact ALS to confirm TAT)
Company:	Standard: X Other (specify):	X Regular (Standard Turnaround Times - Business Days)
Contact: Tyler Gale	Select: PDF X Excel X Digital Fax	Priority (2-4 Business Days)-50% surcharge - Contact ALS to confirm TAT
Address: 1111 W. Hastings St. Vancouver BC	Email 1: Tyler.Gale@erm.com	Emergency (1-2 Business Days)-100% Surcharge - Contact ALS to confirm TAT
Phone: 604 689 9460 Fax:	Email 2: Rusto.Martinka@erm.com Daniel.Helm@gmail.com	Same Day or Weekend Emergency - Contact ALS to confirm TAT
Invoice To Same as Report ? (circle) Yes or No (If No, provide details)	**Client / Project Information**	**Analysis Request**
Copy of Invoice with Report? (circle) Yes or No	Job #: ~~0190~~ 0194096-0012	(Indicate Filtered or Preserved, F/P)
Company:	PO / AFE:	
Contact:	LSD:	
Address:		
Phone: Fax:	Quote #:	
Lab Work Order # (lab use only) L1328754	ALS Contact: Amber Springer	Sampler: Daniel Helm

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	General Chem	Nutrients	Total Metals	Dissolved Metals	Glycols	Number of Containers
					F/P	F/P	F/P	F/P	F/P	
Zone3-3-2013		03-Jul-13	20:00	Water	X	X	X	X	X	5
Blank		03-Jul-13	16:30	Water	X	X	X	X	X	5

Short Holding Time

Rush Processing

L1328754-COFC

Special Instructions / Regulation with water or land use (CCME- Freshwater Aquatic Life/BC CSR-Commercial/AB Tier 1-Natural/ETC) / Hazardous Details

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.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by:	Date:	Time:	Received by:	Date:	Time:	Temperature:	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF
Daniel Helm	4 Jul 2013	9:00	Brittany	July 8	13:00	8.5 °C				

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION | WHITE - LABORATORY COPY | YELLOW - CLIENT COPY | GENF 18.01 Front

RESCAN ENVIRONMENTAL SERVICES
ATTN: Tyler Gale
Sixth Floor
1111 West Hastings Street
Vancouver BC V6E 2J3

Date Received: 11-JUL-13
Report Date: 25-JUL-13 15:26 (MT)
Version: FINAL

Client Phone: 604-689-9460

Certificate of Analysis

Lab Work Order #: L1331208

Project P.O. #: NOT SUBMITTED
Job Reference: 0194096-0012
C of C Numbers: 10-186495
Legal Site Desc:

Amber Springer
Account Manager

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1331208-1				
	Description	water				
	Sampled Date	07-JUL-13				
	Sampled Time	16:00				
	Client ID	ZONE-4-2-2013				
Grouping	**Analyte**					
WATER						
Physical Tests	Conductivity (uS/cm)	138000				
	Hardness (as CaCO3) (mg/L)	94200				
	pH (pH)	7.43				
	Total Suspended Solids (mg/L)	516				
	Total Dissolved Solids (mg/L)	127000				
	Turbidity (NTU)	11.6				
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	18.4				
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<2.0				
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<2.0				
	Alkalinity, Total (as CaCO3) (mg/L)	18.4				
	Ammonia, Total (as N) (mg/L)	2.07				
	Bromide (Br) (mg/L)	696				
	Chloride (Cl) (mg/L)	62800				
	Fluoride (F) (mg/L)	<2.0 DLM				
	Nitrate (as N) (mg/L)	<0.50 DLM				
	Nitrite (as N) (mg/L)	<0.10 DLM				
	Total Kjeldahl Nitrogen (mg/L)	18.4				
	Orthophosphate-Dissolved (as P) (mg/L)	0.169				
	Phosphorus (P)-Total (mg/L)	0.425				
	Sulfate (SO4) (mg/L)	<50 DLM				
Total Metals	Aluminum (Al)-Total (mg/L)	<0.60 DLA				
	Antimony (Sb)-Total (mg/L)	<0.010 DLA				
	Arsenic (As)-Total (mg/L)	<0.0060 DLA				
	Barium (Ba)-Total (mg/L)	5.45				
	Beryllium (Be)-Total (mg/L)	<0.010 DLA				
	Bismuth (Bi)-Total (mg/L)	<0.10 DLA				
	Boron (B)-Total (mg/L)	8.3				
	Cadmium (Cd)-Total (mg/L)	<0.0020 DLA				
	Calcium (Ca)-Total (mg/L)	34100				
	Chromium (Cr)-Total (mg/L)	<0.020 DLA				
	Cobalt (Co)-Total (mg/L)	<0.020 DLA				
	Copper (Cu)-Total (mg/L)	<0.10 DLA				
	Iron (Fe)-Total (mg/L)	1.66				
	Lead (Pb)-Total (mg/L)	<0.010 DLA				
	Lithium (Li)-Total (mg/L)	24.3				
	Magnesium (Mg)-Total (mg/L)	531				
	Manganese (Mn)-Total (mg/L)	1.91				

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1331208-1				
	Description	water				
	Sampled Date	07-JUL-13				
	Sampled Time	16:00				
	Client ID	ZONE-4-2-2013				
Grouping	**Analyte**					
WATER						
Total Metals	Mercury (Hg)-Total (mg/L)	<0.000010				
	Molybdenum (Mo)-Total (mg/L)	0.192				
	Nickel (Ni)-Total (mg/L)	<0.020 DLA				
	Phosphorus (P)-Total (mg/L)	<15 DLA				
	Potassium (K)-Total (mg/L)	1250				
	Selenium (Se)-Total (mg/L)	<0.020 DLA				
	Silicon (Si)-Total (mg/L)	<2.5 DLA				
	Silver (Ag)-Total (mg/L)	<0.0020 DLA				
	Sodium (Na)-Total (mg/L)	3970				
	Strontium (Sr)-Total (mg/L)	607				
	Thallium (Tl)-Total (mg/L)	<0.010 DLA				
	Tin (Sn)-Total (mg/L)	<0.020 DLA				
	Titanium (Ti)-Total (mg/L)	0.56				
	Uranium (U)-Total (mg/L)	<0.0020 DLA				
	Vanadium (V)-Total (mg/L)	<0.10 DLA				
	Zinc (Zn)-Total (mg/L)	<0.60 DLA				
Dissolved Metals	Dissolved Metals Filtration Location	FIELD				
	Aluminum (Al)-Dissolved (mg/L)	<0.20 DLA				
	Antimony (Sb)-Dissolved (mg/L)	<0.010 DLA				
	Arsenic (As)-Dissolved (mg/L)	<0.0060 DLA				
	Barium (Ba)-Dissolved (mg/L)	5.61				
	Beryllium (Be)-Dissolved (mg/L)	<0.010 DLA				
	Bismuth (Bi)-Dissolved (mg/L)	<0.10 DLA				
	Boron (B)-Dissolved (mg/L)	8.9				
	Cadmium (Cd)-Dissolved (mg/L)	<0.0020 DLA				
	Calcium (Ca)-Dissolved (mg/L)	36800				
	Chromium (Cr)-Dissolved (mg/L)	<0.020 DLA				
	Cobalt (Co)-Dissolved (mg/L)	<0.020 DLA				
	Copper (Cu)-Dissolved (mg/L)	<0.040 DLA				
	Iron (Fe)-Dissolved (mg/L)	<0.50 DLA				
	Lead (Pb)-Dissolved (mg/L)	<0.010 DLA				
	Lithium (Li)-Dissolved (mg/L)	25.5				
	Magnesium (Mg)-Dissolved (mg/L)	553				
	Manganese (Mn)-Dissolved (mg/L)	1.93				
	Mercury (Hg)-Dissolved (mg/L)	<0.000010				
	Molybdenum (Mo)-Dissolved (mg/L)	0.201				
	Nickel (Ni)-Dissolved (mg/L)	0.021				

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1331208-1				
	Description	water				
	Sampled Date	07-JUL-13				
	Sampled Time	16:00				
	Client ID	ZONE-4-2-2013				
Grouping	**Analyte**					
WATER						
Dissolved Metals	Phosphorus (P)-Dissolved (mg/L)	<15 DLA				
	Potassium (K)-Dissolved (mg/L)	1270				
	Selenium (Se)-Dissolved (mg/L)	<0.020 DLA				
	Silicon (Si)-Dissolved (mg/L)	<2.5 DLA				
	Silver (Ag)-Dissolved (mg/L)	<0.0020 DLA				
	Sodium (Na)-Dissolved (mg/L)	4080				
	Strontium (Sr)-Dissolved (mg/L)	651				
	Thallium (Tl)-Dissolved (mg/L)	<0.010 DLA				
	Tin (Sn)-Dissolved (mg/L)	<0.020 DLA				
	Titanium (Ti)-Dissolved (mg/L)	0.54				
	Uranium (U)-Dissolved (mg/L)	<0.0020 DLA				
	Vanadium (V)-Dissolved (mg/L)	<0.10 DLA				
	Zinc (Zn)-Dissolved (mg/L)	0.24				
Glycols	Diethylene Glycol (mg/L)	<100 DLA				
	Ethylene Glycol (mg/L)	<100 DLA				
	1,2-Propylene Glycol (mg/L)	2260				

* 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	Nitrite (as N)	DLM	L1331208-1
Duplicate	Nitrate (as N)	DLM	L1331208-1
Method Blank	Strontium (Sr)-Total	MB-LOR	L1331208-1
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L1331208-1
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L1331208-1
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L1331208-1
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1331208-1
Matrix Spike	Uranium (U)-Dissolved	MS-B	L1331208-1
Matrix Spike	Barium (Ba)-Total	MS-B	L1331208-1
Matrix Spike	Calcium (Ca)-Total	MS-B	L1331208-1
Matrix Spike	Magnesium (Mg)-Total	MS-B	L1331208-1
Matrix Spike	Manganese (Mn)-Total	MS-B	L1331208-1
Matrix Spike	Strontium (Sr)-Total	MS-B	L1331208-1
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L1331208-1
Matrix Spike	Lithium (Li)-Dissolved	MS-B	L1331208-1
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1331208-1
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1331208-1

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. Limits of Reporting have been adjusted for samples with positive hits below 5x 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**
ALK-SCR-VA	Water	Alkalinity by colour or titration	EPA 310.2 OR APHA 2320

This analysis is carried out using procedures adapted from EPA Method 310.2 "Alkalinity". Total Alkalinity is determined using the methyl orange colourimetric method.
OR
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.

ANIONS-BR-IC-VA	Water	Bromide by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-CL-IC-VA	Water	Chloride by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-F-IC-VA	Water	Fluoride by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-NO2-IC-VA	Water	Nitrite in Water by Ion Chromatography	EPA 300.0

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrite is detected by UV absorbance.

ANIONS-NO3-IC-VA	Water	Nitrate in Water by Ion Chromatography	EPA 300.0

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrate is detected by UV absorbance.

ANIONS-SO4-IC-VA	Water	Sulfate by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

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.

		Dissolved Fe in Water by ICPOES	EPA SW-846 3005A/6010B

Reference Information

FE-DIS-LOW-ICP-VA Water

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).

FE-TOT-LOW-ICP-VA Water Total Fe 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).

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 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-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-DIS-ULTRA-MS-VA Water Diss. Metals in Water by ICPMS (Ultra) EPA SW-846 3005A/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 involves preliminary sample treatment by filtration (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - mass spectrometry (EPA Method 6020A).

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).

MET-TOT-ULTRA-MS-VA Water Total Metals in Water by ICPMS (Ultra) EPA SW-846 3005A/6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the

Reference Information

American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven, or filtration (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - mass spectrometry (EPA Method 6020A).

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.

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

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorous is determined colourimetrically after persulphate digestion of the sample.

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.

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

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.

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.

TKN-F-VA	Water	TKN in Water by Fluorescence	APHA 4500-NORG D.

This analysis is carried out using procedures adapted from APHA Method 4500-Norg D. "Block Digestion and Flow Injection Analysis". Total Kjeldahl Nitrogen is determined using block digestion followed by Flow-injection analysis with fluorescence detection.

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.

TURBIDITY-VA	Water	Turbidity by Meter	APHA 2130 "Turbidity"

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

TURBIDITY-VA	Water	Turbidity by Meter	APHA 2130 Turbidity

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

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

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

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

Chain of Custody Numbers:

10-186495

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.

10-186495

ALS Environmental

Chain of Custody / Analytical Request Form
Canada Toll Free: 1 800 668 9878
www.alsglobal.com

Page 1 of

Report To	Report Format / Distribution	Service Request: (Rush subject to availability - Contact ALS to confirm TAT)
Company: Rescan - ERM	Standard: X Other (specify):	X Regular (Standard Turnaround Times - Business Days)
Contact: Tyler Gale	Select: PDF X Excel X Digital Fax	Priority (2-4 Business Days)-50% surcharge - Contact ALS to confirm TAT
Address: 1111 W. Hastings St. Vancouver BC	Email 1: Tyler.Gale@erm.com	Emergency (1-2 Business Days)-100% Surcharge - Contact ALS to confirm TAT
Phone: 604 689 9460 Fax:	Email 2: Rusto.Martinka@erm.com Daniel.Helm@erm.com	Same Day or Weekend Emergency - Contact ALS to confirm TAT
Invoice To Same as Report ? (circle) Yes or No (if No, provide details)	**Client / Project Information**	**Analysis Request**
Copy of Invoice with Report? (circle) Yes or No	Job #: 0194096-0012	(Indicate Filtered or Preserved, F/P)
Company:	PO / AFE:	
Contact:	LSD:	
Address:		
Phone:	Quote #:	
Lab Work Order # (lab) L1331208-COFC	ALS Contact: Amber Springer	Sampler: Daniel Helm

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	General Chem	Nutrients	Total Metals	Dissolved Metals	Glycols	Number of Containers
					F	P	P	F	P	
	Zone-4-2-2013	07-Jul-13	16:00	Water	X	X	X	X	X	5

Short Holding Time

Rush Processing

Special Instructions / Regulation with water or land use (CCME- Freshwater Aquatic Life/BC CSR-Commercial/AB Tier 1-Natural/ETC) / Hazardous Details

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.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by:	Date:	Time:	Received by:	Date:	Time:	Temperature:	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF
			TN	3July13	13:00	18 °C				

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION | WHITE - LABORATORY COPY | YELLOW - CLIENT COPY | GENF 18.01 Front

RESCAN ENVIRONMENTAL SERVICES
ATTN: Tyler Gale
Sixth Floor
1111 West Hastings Street
Vancouver BC V6E 2J3

Date Received: 19-JUL-13
Report Date: 01-AUG-13 11:17 (MT)
Version: FINAL

Client Phone: 604-689-9460

Certificate of Analysis

Lab Work Order #: L1335008

Project P.O. #: NOT SUBMITTED
Job Reference: 0194096-0012
C of C Numbers: 10-295673
Legal Site Desc:

Amber Springer
Account Manager

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1335008-1	L1335008-2	L1335008-3	L1335008-4	
	Description	Water	Water	Water	Water	
	Sampled Date	15-JUL-13	15-JUL-13	16-JUL-13	15-JUL-13	
	Sampled Time	13:00	18:00	13:30	15:00	
	Client ID	ZONE3-4-2013	ZONE6-1-2013	ZONE4-3-2013	ZONE3-4A-2013	
Grouping	**Analyte**					
WATER						
Physical Tests	Conductivity (uS/cm)	120000	120000	137000		
	Hardness (as CaCO3) (mg/L)	70600	72200	87200		
	pH (pH)	7.10	7.23	7.82		
	Total Suspended Solids (mg/L)	165	178	231		
	Total Dissolved Solids (mg/L)	111000 AI	118000 AI	150000 AI		
	Turbidity (NTU)	48.1	41.7	7.42		
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	7.8	8.5	20.9		
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<2.0	<2.0	<2.0		
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<2.0	<2.0	<2.0		
	Alkalinity, Total (as CaCO3) (mg/L)	7.8	8.5	20.9		
	Ammonia, Total (as N) (mg/L)	1.00	1.01	2.09		
	Bromide (Br) (mg/L)	503	524	724		
	Chloride (Cl) (mg/L)	58300	61200	73100		
	Fluoride (F) (mg/L)	0.93	0.92	0.50		
	Nitrate (as N) (mg/L)	<0.50 DLM	<0.50 DLM	<0.50 DLM		
	Nitrite (as N) (mg/L)	<0.10 DLM	<0.10 DLM	<0.10 DLM		
	Total Kjeldahl Nitrogen (mg/L)	2.49	1.80	3.09		
	Orthophosphate-Dissolved (as P) (mg/L)	0.0208	0.0320	0.173		
	Phosphorus (P)-Total (mg/L)	0.212	0.299	0.535		
	Sulfate (SO4) (mg/L)	<50 DLM	<50 DLM	<50 DLM		
Total Metals	Aluminum (Al)-Total (mg/L)	<0.30 DLA	<0.30 DLA	<0.60 DLA		
	Antimony (Sb)-Total (mg/L)	<0.0050 DLA	<0.0050 DLA	<0.010 DLA		
	Arsenic (As)-Total (mg/L)	<0.0030 DLA	<0.0030 DLA	<0.0060 DLA		
	Barium (Ba)-Total (mg/L)	7.36	7.70	5.78		
	Beryllium (Be)-Total (mg/L)	<0.0050 DLA	<0.0050 DLA	<0.010 DLA		
	Bismuth (Bi)-Total (mg/L)	<0.050 DLA	<0.050 DLA	<0.10 DLA		
	Boron (B)-Total (mg/L)	5.46	5.72	8.4		
	Cadmium (Cd)-Total (mg/L)	<0.0010 DLA	<0.0010 DLA	<0.0020 DLA		
	Calcium (Ca)-Total (mg/L)	25200	27000	33500		
	Chromium (Cr)-Total (mg/L)	0.016	0.015	<0.020 DLA		
	Cobalt (Co)-Total (mg/L)	<0.010 DLA	<0.010 DLA	<0.020 DLA		
	Copper (Cu)-Total (mg/L)	<0.050 DLA	<0.050 DLA	<0.10 DLA		
	Iron (Fe)-Total (mg/L)	4.59	4.73	1.54		
	Lead (Pb)-Total (mg/L)	<0.0050 DLA	<0.0050 DLA	<0.010 DLA		
	Lithium (Li)-Total (mg/L)	14.4	14.7	23.3		
	Magnesium (Mg)-Total (mg/L)	789	850	540		
	Manganese (Mn)-Total (mg/L)	2.38	2.59	1.98		

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1335008-1	L1335008-2	L1335008-3	L1335008-4	
	Description	Water	Water	Water	Water	
	Sampled Date	15-JUL-13	15-JUL-13	16-JUL-13	15-JUL-13	
	Sampled Time	13:00	18:00	13:30	15:00	
	Client ID	ZONE3-4-2013	ZONE6-1-2013	ZONE4-3-2013	ZONE3-4A-2013	
Grouping	**Analyte**					
WATER						
Total Metals	Mercury (Hg)-Total (mg/L)	<0.000010	<0.000010	<0.000010		
	Molybdenum (Mo)-Total (mg/L)	0.113	0.119	0.182		
	Nickel (Ni)-Total (mg/L)	0.014	0.016	<0.020 DLA		
	Phosphorus (P)-Total (mg/L)	<15 DLA	<15 DLA	<15 DLA		
	Potassium (K)-Total (mg/L)	630	686	1190		
	Selenium (Se)-Total (mg/L)	<0.010 DLA	<0.010 DLA	<0.020 DLA		
	Silicon (Si)-Total (mg/L)	<2.5 DLA	<2.5 DLA	<2.5 DLA		
	Silver (Ag)-Total (mg/L)	<0.0010 DLA	<0.0010 DLA	<0.0020 DLA		
	Sodium (Na)-Total (mg/L)	5760	5930	4210		
	Strontium (Sr)-Total (mg/L)	502	518	598		
	Thallium (Tl)-Total (mg/L)	<0.0050 DLA	<0.0050 DLA	<0.010 DLA		
	Tin (Sn)-Total (mg/L)	<0.010 DLA	<0.010 DLA	<0.020 DLA		
	Titanium (Ti)-Total (mg/L)	0.68	0.68	0.63		
	Uranium (U)-Total (mg/L)	<0.0010 DLA	<0.0010 DLA	<0.0020 DLA		
	Vanadium (V)-Total (mg/L)	<0.050 DLA	<0.050 DLA	<0.10 DLA		
	Zinc (Zn)-Total (mg/L)	<0.30 DLA	<0.30 DLA	<0.60 DLA		
Dissolved Metals	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD		
	Aluminum (Al)-Dissolved (mg/L)	<0.10 DLA	<0.10 DLA	<0.20 DLA		
	Antimony (Sb)-Dissolved (mg/L)	<0.0050 DLA	<0.0050 DLA	<0.010 DLA		
	Arsenic (As)-Dissolved (mg/L)	<0.0030	<0.0030 DLA	<0.0060 DLA		
	Barium (Ba)-Dissolved (mg/L)	7.46	7.36	5.64		
	Beryllium (Be)-Dissolved (mg/L)	<0.0050 DLA	<0.0050 DLA	<0.010 DLA		
	Bismuth (Bi)-Dissolved (mg/L)	<0.050 DLA	<0.050 DLA	<0.10 DLA		
	Boron (B)-Dissolved (mg/L)	5.76	5.91	8.6		
	Cadmium (Cd)-Dissolved (mg/L)	<0.0010 DLA	<0.0010 DLA	<0.0020 DLA		
	Calcium (Ca)-Dissolved (mg/L)	27000	27600	34100		
	Chromium (Cr)-Dissolved (mg/L)	<0.010 DLA	<0.010 DLA	<0.020 DLA		
	Cobalt (Co)-Dissolved (mg/L)	<0.010 DLA	<0.010 DLA	<0.020 DLA		
	Copper (Cu)-Dissolved (mg/L)	<0.020 DLA	<0.020 DLA	<0.040 DLA		
	Iron (Fe)-Dissolved (mg/L)	3.37	3.10	<0.50 DLA		
	Lead (Pb)-Dissolved (mg/L)	<0.0050 DLA	<0.0050 DLA	<0.010 DLA		
	Lithium (Li)-Dissolved (mg/L)	14.9	15.3	22.9		
	Magnesium (Mg)-Dissolved (mg/L)	789	804	518		
	Manganese (Mn)-Dissolved (mg/L)	2.51	2.51	1.89		
	Mercury (Hg)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010		
	Molybdenum (Mo)-Dissolved (mg/L)	0.117	0.121	0.180		
	Nickel (Ni)-Dissolved (mg/L)	<0.010 DLA	<0.010 DLA	<0.020 DLA		

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1335008-1	L1335008-2	L1335008-3	L1335008-4	
	Description	Water	Water	Water	Water	
	Sampled Date	15-JUL-13	15-JUL-13	16-JUL-13	15-JUL-13	
	Sampled Time	13:00	18:00	13:30	15:00	
	Client ID	ZONE3-4-2013	ZONE6-1-2013	ZONE4-3-2013	ZONE3-4A-2013	
Grouping	**Analyte**					
WATER						
Dissolved Metals	Phosphorus (P)-Dissolved (mg/L)	<15 DLA	<15 DLA	<15 DLA		
	Potassium (K)-Dissolved (mg/L)	651	671	1120		
	Selenium (Se)-Dissolved (mg/L)	<0.010 DLA	<0.010 DLA	<0.020 DLA		
	Silicon (Si)-Dissolved (mg/L)	<2.5 DLA	<2.5 DLA	<2.5 DLA		
	Silver (Ag)-Dissolved (mg/L)	<0.0010 DLA	<0.0010 DLA	<0.0020 DLA		
	Sodium (Na)-Dissolved (mg/L)	5790	5700	4010		
	Strontium (Sr)-Dissolved (mg/L)	532	541	596		
	Thallium (Tl)-Dissolved (mg/L)	<0.0050 DLA	<0.0050 DLA	<0.010 DLA		
	Tin (Sn)-Dissolved (mg/L)	<0.010 DLA	<0.010 DLA	<0.020 DLA		
	Titanium (Ti)-Dissolved (mg/L)	0.66	0.68	0.61		
	Uranium (U)-Dissolved (mg/L)	<0.0010 DLA	<0.0010 DLA	<0.0020 DLA		
	Vanadium (V)-Dissolved (mg/L)	<0.050 DLA	<0.050 DLA	<0.10 DLA		
	Zinc (Zn)-Dissolved (mg/L)	<0.10 DLA	<0.10 DLA	<0.20 DLA		
Glycols	Diethylene Glycol (mg/L)	<50 DLA	<50 DLA	<250 DLA	<50 DLA	
	Ethylene Glycol (mg/L)	<50 DLA	<50 DLA	<250 DLA	<50 DLA	
	1,2-Propylene Glycol (mg/L)	673	663	2530	697	

* 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	Calcium (Ca)-Total	MB-LOR	L1335008-1, -2, -3
Method Blank	Strontium (Sr)-Total	MB-LOR	L1335008-1, -2, -3
Method Blank	Zinc (Zn)-Total	MB-LOR	L1335008-1, -2, -3
Method Blank	Sodium (Na)-Total	MB-LOR	L1335008-1, -2, -3
Matrix Spike	Magnesium (Mg)-Total	MS-B	L1335008-1, -2, -3
Matrix Spike	Aluminum (Al)-Dissolved	MS-B	L1335008-1, -2, -3
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L1335008-1, -2, -3
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L1335008-1, -2, -3

Qualifiers for Individual Parameters Listed:

Qualifier	Description
AI	Analytical interferences may be present. Result may be biased high.
DLA	Detection Limit Adjusted For required dilution
DLM	Detection Limit Adjusted For Sample Matrix Effects
MB-LOR	Method Blank exceeds ALS DQO. Limits of Reporting have been adjusted for samples with positive hits below 5x 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**
ALK-SCR-VA	Water	Alkalinity by colour or titration	EPA 310.2 OR APHA 2320

This analysis is carried out using procedures adapted from EPA Method 310.2 "Alkalinity". Total Alkalinity is determined using the methyl orange colourimetric method.
OR
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.

ANIONS-BR-IC-VA	Water	Bromide by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-CL-IC-VA	Water	Chloride by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-NO2-IC-VA	Water	Nitrite in Water by Ion Chromatography	EPA 300.0

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrite is detected by UV absorbance.

ANIONS-NO3-IC-VA	Water	Nitrate in Water by Ion Chromatography	EPA 300.0

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrate is detected by UV absorbance.

ANIONS-SO4-IC-VA	Water	Sulfate by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

F-SIE-VA	Water	Fluoride by SIE	APHA 4500-F "Fluoride"

This analysis is carried out using procedures adapted from APHA Method 4500-F "Fluoride". Fluoride is determined using a selective ion electrode. This method has a significant negative interference (i.e. results could be biased low) when Al3+ is present in the sample at a concentration greater than 2.5 mg/L.

F-SIE-VA	Water	Fluoride by SIE	APHA 4500-F Fluoride

This analysis is carried out using procedures adapted from APHA Method 4500-F "Fluoride". Fluoride is determined using a selective ion electrode. This method has a significant negative interference (i.e. results could be biased low) when Al3+ is present in the sample at a concentration greater than 2.5 mg/L.

FE-DIS-LOW-ICP-VA	Water	Dissolved Fe 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).

Reference Information

FE-TOT-LOW-ICP-VA Water Total Fe 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).

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 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-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-DIS-ULTRA-MS-VA Water Diss. Metals in Water by ICPMS (Ultra) EPA SW-846 3005A/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 involves preliminary sample treatment by filtration (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - mass spectrometry (EPA Method 6020A).

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).

MET-TOT-ULTRA-MS-VA Water Total Metals in Water by ICPMS (Ultra) EPA SW-846 3005A/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 either hotblock or microwave oven, or filtration (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - mass spectrometry (EPA Method 6020A).

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

Reference Information

of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

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

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorous is determined colourimetrically after persulphate digestion of the sample.

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.

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

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.

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.

TKN-F-VA	Water	TKN in Water by Fluorescence	APHA 4500-NORG D.

This analysis is carried out using procedures adapted from APHA Method 4500-Norg D. "Block Digestion and Flow Injection Analysis". Total Kjeldahl Nitrogen is determined using block digestion followed by Flow-injection analysis with fluorescence detection.

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.

TURBIDITY-VA	Water	Turbidity by Meter	APHA 2130 "Turbidity"

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

TURBIDITY-VA	Water	Turbidity by Meter	APHA 2130 Turbidity

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

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

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

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

Chain of Custody Numbers:

10-295673

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.

10- 295673

ALS Environmental

Chain of Custody / Analytical Request Form
Canada Toll Free: 1 800 668 9878
www.alsglobal.com

Page 1 of 1

Report To	Report Format / Distribution	Service Request: (Rush subject to availability - Contact ALS to confirm TAT)
Company: Rescan - ERM	Standard: X Other (specify):	X Regular (Standard Turnaround Times - Business Days)
Contact: Tyler Gale	Select: PDF X Excel X Digital Fax	Priority(2-4 Business Days)-50% surcharge - Contact ALS to confirm TAT
Address: 1111 W. Hastings St. Vancouver BC	Email 1: Tyler.Gale@erm.com	Emergency (1-2 Business Days)-100% Surcharge - Contact ALS to confirm TAT
Phone: 604 689 9460 Fax:	Email 2: Yaming.Chen@erm.com	Same Day or Weekend Emergency - Contact ALS to confirm TAT
Invoice To Same as Report ? (circle) Yes or No (If No, provide details)	**Client / Project Information**	**Analysis Request**
Copy of Invoice with Report? (circle) Yes or No	Job #: 0194096-0012	(Indicate Filtered or Preserved, F/P)
Company:	PO / AFE:	
Contact:	LSD:	
Address:		
Phone: Fax:	Quote #:	
Lab Work Order # (lab use only)	**ALS Contact:** / **Sampler:**	

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	General Chem	Nutrients	Total Metals	Dissolved Metals	Glycols	Number of Containers
Zone3-4-2013		15-Jul-13	13:00	Water						5
Zone6-1-2013		15-Jul-13	18:00	"						5
Zone4-3-2013		16-Jul-13	13:30	"						5
Zone3-4A-2013		15-Jul-13	15:00	"					X	1

Short Holding Time

Rush Processing

L1335008-COFC

Special Instructions / Regulation with water or land use (CCME- Freshwater Aquatic Life/BC CSR-Commercial/AB Tier 1-Natu

pect very high TDS (~100 g/L), Calcium, chloride and Sodium (10s of g/L) in all samples. Please minimize impact of dilution detection limits as much as possible

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.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
	Date:	Time:	Received by:	Date:	Time:	Temperature:	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF
ale	16-Jul-13	Morning		16/7/13	10:30	max 7.2 avg 6.7 °C				

Y.C July 19/13 19:20 9.7°C.

RESCAN ENVIRONMENTAL SERVICES
ATTN: Tyler Gale
1111 West Hastings Street
6/Floor
Vancouver BC V6E 2J3

Date Received: 05-SEP-13
Report Date: 11-SEP-13 17:14 (MT)
Version: FINAL

Client Phone: 604-689-9460

Certificate of Analysis

Lab Work Order #: L1358466

Project P.O. #: NOT SUBMITTED
Job Reference: 0194096-0012
C of C Numbers: 10-295672
Legal Site Desc:

Amber Springer
Account Manager

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ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1358466-1	L1358466-2	L1358466-3	L1358466-4	
	Description	Water	Water	Water	Water	
	Sampled Date	02-SEP-13	03-SEP-13	04-SEP-13	04-SEP-13	
	Sampled Time	12:00	12:00	12:00	16:00	
	Client ID	ZONE4-4-2013	ZONE5-2-2013	ZONE3-5-2013	ZONE6-2-2013	
Grouping	**Analyte**					
WATER						
Physical Tests	Conductivity (uS/cm)	136000	145000	106000	106000	
	Hardness (as CaCO3) (mg/L)	87000	105000	59000	57300	
	pH (pH)	7.70	7.95	6.99	6.80	
	Total Suspended Solids (mg/L)	93.1	147	102	122	
	Total Dissolved Solids (mg/L)	125000	135000	88500	91400	
	Turbidity (NTU)	9.15	4.60	56.5	61.1	
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	19.1	19.4	10.3	9.5	
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<2.0	<2.0	<2.0	<2.0	
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<2.0	<2.0	<2.0	<2.0	
	Alkalinity, Total (as CaCO3) (mg/L)	19.1	19.4	10.3	9.5	
	Ammonia, Total (as N) (mg/L)	2.06	2.43	0.631	0.633	
	Bromide (Br) (mg/L)	902	1030	553	553	
	Chloride (Cl) (mg/L)	71500	79600	51800	51800	
	Fluoride (F) (mg/L)	0.62	0.67	0.72	0.71	
	Nitrate (as N) (mg/L)	<0.50 DLM	<0.50 DLM	<0.50 DLM	<0.50 DLM	
	Nitrite (as N) (mg/L)	<0.10 DLM	<0.10 DLM	<0.10 DLM	<0.10 DLM	
	Total Kjeldahl Nitrogen (mg/L)	19.8	16.6	14.7	19.0	
	Orthophosphate-Dissolved (as P) (mg/L)	0.132	0.146	0.0141	0.0049	
	Phosphorus (P)-Total (mg/L)	0.400	0.313	0.276	0.314	
	Sulfate (SO4) (mg/L)	<50 DLM	<50 DLM	<50 DLM	<50 DLM	
Total Metals	Aluminum (Al)-Total (mg/L)		<0.60 DLA	<0.30 DLA	<0.30 DLA	
	Antimony (Sb)-Total (mg/L)		<0.010 DLA	<0.0050 DLA	<0.0050 DLA	
	Arsenic (As)-Total (mg/L)		<0.0060 DLA	<0.0030 DLA	<0.0030 DLA	
	Barium (Ba)-Total (mg/L)		3.17	8.31	8.44	
	Beryllium (Be)-Total (mg/L)		<0.010 DLA	<0.0050 DLA	<0.0050 DLA	
	Bismuth (Bi)-Total (mg/L)		<0.10 DLA	<0.050 DLA	<0.050 DLA	
	Boron (B)-Total (mg/L)		10.1	4.67	4.83	
	Cadmium (Cd)-Total (mg/L)		<0.0020 DLA	<0.0010 DLA	<0.0010 DLA	
	Calcium (Ca)-Total (mg/L)		42700	21800	21900	
	Chromium (Cr)-Total (mg/L)		<0.020 DLA	0.014 DLA	0.013 DLA	
	Cobalt (Co)-Total (mg/L)		<0.020 DLA	<0.010 DLA	<0.010 DLA	
	Copper (Cu)-Total (mg/L)		<0.10 DLA	<0.050 DLA	<0.050 DLA	
	Iron (Fe)-Total (mg/L)		<1.0 DLA	6.88 DLA	6.71 DLA	
	Lead (Pb)-Total (mg/L)		<0.010 DLA	<0.0050 DLA	<0.0050 DLA	
	Lithium (Li)-Total (mg/L)		30.1	9.90	10.2	
	Magnesium (Mg)-Total (mg/L)		446	959	974	
	Manganese (Mn)-Total (mg/L)		1.15	3.10	3.15	

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1358466-1	L1358466-2	L1358466-3	L1358466-4	
	Description	Water	Water	Water	Water	
	Sampled Date	02-SEP-13	03-SEP-13	04-SEP-13	04-SEP-13	
	Sampled Time	12:00	12:00	12:00	16:00	
	Client ID	ZONE4-4-2013	ZONE5-2-2013	ZONE3-5-2013	ZONE6-2-2013	
Grouping	**Analyte**					
WATER						
Total Metals	Mercury (Hg)-Total (mg/L)		<0.000010	<0.000010	<0.000010	
	Molybdenum (Mo)-Total (mg/L)		0.256	0.0687	0.0697	
	Nickel (Ni)-Total (mg/L)		0.035	0.021	0.018	
	Phosphorus (P)-Total (mg/L)		<30 DLA	<15 DLA	<15 DLA	
	Potassium (K)-Total (mg/L)		1420	428	436	
	Selenium (Se)-Total (mg/L)		<0.020 DLA	<0.010 DLA	<0.010 DLA	
	Silicon (Si)-Total (mg/L)		<5.0 DLA	<2.5 DLA	<2.5 DLA	
	Silver (Ag)-Total (mg/L)		<0.0020 DLA	<0.0010 DLA	<0.0010 DLA	
	Sodium (Na)-Total (mg/L)		3220	6940	7020	
	Strontium (Sr)-Total (mg/L)		674	414	416	
	Thallium (Tl)-Total (mg/L)		<0.010	<0.0050 DLA	<0.0050 DLA	
	Tin (Sn)-Total (mg/L)		<0.020 DLA	<0.010 DLA	<0.010 DLA	
	Titanium (Ti)-Total (mg/L)		<1.1 DLA	<0.60 DLA	<0.60 DLA	
	Uranium (U)-Total (mg/L)		<0.0020 DLA	<0.0010 DLA	<0.0010 DLA	
	Vanadium (V)-Total (mg/L)		<0.10 DLA	<0.050 DLA	<0.050 DLA	
	Zinc (Zn)-Total (mg/L)		<0.60 DLA	0.43	0.38	
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	
	Aluminum (Al)-Dissolved (mg/L)	<0.20 DLA	<0.20 DLA	0.11	<0.10 DLA	
	Antimony (Sb)-Dissolved (mg/L)	<0.010 DLA	<0.010 DLA	<0.0050 DLA	<0.0050 DLA	
	Arsenic (As)-Dissolved (mg/L)	<0.0060 DLA	<0.0060 DLA	<0.0030 DLA	<0.0030 DLA	
	Barium (Ba)-Dissolved (mg/L)	5.71	2.91	8.41	7.97	
	Beryllium (Be)-Dissolved (mg/L)	<0.010 DLA	<0.010 DLA	<0.0050 DLA	<0.0050 DLA	
	Bismuth (Bi)-Dissolved (mg/L)	<0.10 DLA	<0.10 DLA	<0.050 DLA	<0.050 DLA	
	Boron (B)-Dissolved (mg/L)	7.9	9.9	4.77	4.69	
	Cadmium (Cd)-Dissolved (mg/L)	<0.0020 DLA	<0.0020 DLA	<0.0010 DLA	<0.0010 DLA	
	Calcium (Ca)-Dissolved (mg/L)	33900	41200	22000	21400	
	Chromium (Cr)-Dissolved (mg/L)	<0.020 DLA	<0.020 DLA	<0.010 DLA	<0.010 DLA	
	Cobalt (Co)-Dissolved (mg/L)	<0.020 DLA	<0.020 DLA	<0.010 DLA	<0.010 DLA	
	Copper (Cu)-Dissolved (mg/L)	0.053	<0.040 DLA	<0.020 DLA	<0.020 DLA	
	Iron (Fe)-Dissolved (mg/L)	<1.0 DLA	<1.0 DLA	6.16	6.22	
	Lead (Pb)-Dissolved (mg/L)	<0.010 DLA	<0.010 DLA	<0.0050 DLA	<0.0050 DLA	
	Lithium (Li)-Dissolved (mg/L)	22.0	29.3	10.1	9.93	
	Magnesium (Mg)-Dissolved (mg/L)	565	421	980	929	
	Manganese (Mn)-Dissolved (mg/L)	2.05	1.10	3.20	2.95	
	Mercury (Hg)-Dissolved (mg/L)	0.000179	<0.000010	<0.000010	<0.000010	
	Molybdenum (Mo)-Dissolved (mg/L)	0.183	0.239	0.0701	0.0645	

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1358466-1	L1358466-2	L1358466-3	L1358466-4	
	Description	Water	Water	Water	Water	
	Sampled Date	02-SEP-13	03-SEP-13	04-SEP-13	04-SEP-13	
	Sampled Time	12:00	12:00	12:00	16:00	
	Client ID	ZONE4-4-2013	ZONE5-2-2013	ZONE3-5-2013	ZONE6-2-2013	
Grouping	**Analyte**					
WATER						
Dissolved Metals	Nickel (Ni)-Dissolved (mg/L)	<0.020 DLA	<0.020 DLA	0.012	<0.010 DLA	
	Phosphorus (P)-Dissolved (mg/L)	<30 DLA	<30 DLA	<15 DLA	<15 DLA	
	Potassium (K)-Dissolved (mg/L)	1140	1360	440	415	
	Selenium (Se)-Dissolved (mg/L)	<0.020 DLA	<0.020 DLA	<0.010 DLA	<0.010 DLA	
	Silicon (Si)-Dissolved (mg/L)	<5.0 DLA	<5.0 DLA	<2.5 DLA	<2.5 DLA	
	Silver (Ag)-Dissolved (mg/L)	<0.0020 DLA	<0.0020 DLA	<0.0010 DLA	<0.0010 DLA	
	Sodium (Na)-Dissolved (mg/L)	4290	3070	7170	6710	
	Strontium (Sr)-Dissolved (mg/L)	591	660	416	396	
	Thallium (Tl)-Dissolved (mg/L)	<0.010 DLA	<0.010 DLA	<0.0050 DLA	<0.0050 DLA	
	Tin (Sn)-Dissolved (mg/L)	<0.020 DLA	<0.020 DLA	<0.010 DLA	<0.010 DLA	
	Titanium (Ti)-Dissolved (mg/L)	<1.1 DLA	<1.1 DLA	<0.60 DLA	<0.60 DLA	
	Uranium (U)-Dissolved (mg/L)	<0.0020 DLA	<0.0020 DLA	<0.0010 DLA	<0.0010 DLA	
	Vanadium (V)-Dissolved (mg/L)	<0.10 DLA	<0.10 DLA	<0.050 DLA	<0.050 DLA	
	Zinc (Zn)-Dissolved (mg/L)	0.34	<0.20 DLA	0.18	0.17	
Glycols	Diethylene Glycol (mg/L)	<100 DLA	<100 DLA	<100 DLA	<100 DLA	
	Ethylene Glycol (mg/L)	<100 DLA	<100 DLA	<100 DLA	<100 DLA	
	1,2-Propylene Glycol (mg/L)	1290	1050	500	500	

* 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	Bromide (Br)	DLM	L1358466-1, -2, -3, -4
Duplicate	Chloride (Cl)	DLM	L1358466-1, -2, -3, -4
Duplicate	Bromide (Br)	DLM	L1358466-1, -2, -3, -4
Duplicate	Nitrite (as N)	DLM	L1358466-1, -2, -3, -4
Duplicate	Bromide (Br)	DLM	L1358466-1, -2, -3, -4
Duplicate	Nitrite (as N)	DLM	L1358466-1, -2, -3, -4
Duplicate	Nitrate (as N)	DLM	L1358466-1, -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

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-SCR-VA	Water	Alkalinity by colour or titration	EPA 310.2 OR APHA 2320

This analysis is carried out using procedures adapted from EPA Method 310.2 "Alkalinity". Total Alkalinity is determined using the methyl orange colourimetric method.
OR
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.

ANIONS-BR-IC-VA	Water	Bromide by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-CL-IC-VA	Water	Chloride by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-NO2-IC-VA	Water	Nitrite in Water by Ion Chromatography	EPA 300.0

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrite is detected by UV absorbance.

ANIONS-NO3-IC-VA	Water	Nitrate in Water by Ion Chromatography	EPA 300.0

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrate is detected by UV absorbance.

ANIONS-SO4-IC-VA	Water	Sulfate by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

F-SIE-VA	Water	Fluoride by SIE	APHA 4500-F "Fluoride"

This analysis is carried out using procedures adapted from APHA Method 4500-F "Fluoride". Fluoride is determined using a selective ion electrode. This method has a significant negative interference (i.e. results could be biased low) when Al3+ is present in the sample at a concentration greater than 2.5 mg/L.

F-SIE-VA	Water	Fluoride by SIE	APHA 4500-F Fluoride

This analysis is carried out using procedures adapted from APHA Method 4500-F "Fluoride". Fluoride is determined using a selective ion electrode. This method has a significant negative interference (i.e. results could be biased low) when Al3+ is present in the sample at a concentration greater than 2.5 mg/L.

FE-DIS-LOW-ICP-VA	Water	Dissolved Fe 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).

FE-TOT-LOW-ICP-VA	Water	Total Fe 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

Reference Information

6010B).

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 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-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-DIS-ULTRA-MS-VA Water Diss. Metals in Water by ICPMS (Ultra) EPA SW-846 3005A/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 involves preliminary sample treatment by filtration (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - mass spectrometry (EPA Method 6020A).

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).

MET-TOT-ULTRA-MS-VA Water Total Metals in Water by ICPMS (Ultra) EPA SW-846 3005A/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 either hotblock or microwave oven, or filtration (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - mass spectrometry (EPA Method 6020A).

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.

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

Reference Information

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorous is determined colourimetrically after persulphate digestion of the sample.

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.

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

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.

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.

TKN-F-VA	Water	TKN in Water by Fluorescence	APHA 4500-NORG D.

This analysis is carried out using procedures adapted from APHA Method 4500-Norg D. "Block Digestion and Flow Injection Analysis". Total Kjeldahl Nitrogen is determined using block digestion followed by Flow-injection analysis with fluorescence detection.

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.

TURBIDITY-VA	Water	Turbidity by Meter	APHA 2130 "Turbidity"

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

TURBIDITY-VA	Water	Turbidity by Meter	APHA 2130 Turbidity

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

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

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

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

Chain of Custody Numbers:

10-295672

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.

10- 295672

ALS Environmental

Chain of Custody / Analytical Request Form
Canada Toll Free: 1 800 668 9878
www.alsglobal.com

Page 1 of 1

Report To	Report Format / Distribution	Service Request: (Rush subject to availability - Contact ALS to confirm TAT)
Company: Rescan - ERM	Standard: X Other (specify):	Regular (Standard Turnaround Times - Business Days)
Contact: Tyler Gale	Select: PDF X Excel X Digital Fax	X Priority(2-4 Business Days)-50% surcharge - Contact ALS to confirm TAT
Address: 1111 W. Hastings St. Vancouver B.C.	Email 1: Tyler.Gale@erm.com	Emergency (1-2 Business Days)-100% Surcharge - Contact ALS to confirm TAT
	Email 2: Rusto.Martinka@erm.com	Same Day or Weekend Emergency - Contact ALS to confirm TAT
Phone: Fax:		

Invoice To	Client / Project Information
Same as Report ? (circle) (Yes) or No (if No, provide details)	
Copy of Invoice with Report? (circle) Yes or No	Job #: 0194096-0012
Company:	PO / AFE:
Contact:	LSD:
Address:	
Phone: Fax:	Quote #:
Lab Work Order # (lab use only) L1358466	**ALS Contact:** Amber Springer **Sampler:** Tyler Gale

Analysis Request (Indicate Filtered or Preserved, F/P)

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	General Chem (P)	Nutrients (P)	Total Metals (P)	Dissolved Metals (F/P)	Glycols (P)	Number of Containers
	Zone 4-4-2013	Sept. 02/13	12:00	Water	X	X		X	X	4
	Zone 5-2-2013	03-Sep-13	12:00	Water	X	X	X	X	X	5
	Zone 3-5-2013	04-Sep-13	12:00	Water	X	X	X	X	X	5
	Zone 6-2-2013	04-Sep-13	16:00	Water	X	X	X	X	X	5

Special Instructions / Regulation with water or land use (CCME- Freshwater Aquatic Life/BC CSR- ...s

Please minimize dilution to minize effect on detection limits. Expect TDS of 10s to 100s of g/L, Calcium, Chloride, Sodium 10s of g/L in all samples.

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.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by:	Date:	Time:	Received by:	Date:	Time:	Temperature:	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF
Tyler Gale	Sept. 5/13	Morning		Sept. 5/13	2:05	max 3.3 avg 2.4 °C				

RESCAN ENVIRONMENTAL SERVICES
ATTN: Tyler Gale
1111 West Hastings Street
6/Floor
Vancouver BC V6E 2J3

Date Received: 23-SEP-13
Report Date: 25-SEP-13 16:15 (MT)
Version: FINAL

Client Phone: 604-689-9460

Certificate of Analysis

Lab Work Order #: L1366894

Project P.O. #: NOT SUBMITTED
Job Reference: 0194096-0012
C of C Numbers: 10-251297
Legal Site Desc:

Amber Springer
Account Manager

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1366894-1	L1366894-2			
	Description	Water	Water			
	Sampled Date	16-SEP-13	17-SEP-13			
	Sampled Time					
	Client ID	ZONE5-3-2013	ZONE3-6-2013			
Grouping	**Analyte**					
WATER						
Physical Tests	Conductivity (uS/cm)	91700	102000			
	Hardness (as CaCO3) (mg/L)	51900	52400			
	pH (pH)	8.01	6.92			
	Total Suspended Solids (mg/L)	28.9	53.4			
	Total Dissolved Solids (mg/L)	73400	82900			
	Turbidity (NTU)	9.76	58.7			
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	16.2	10.7			
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<2.0	<2.0			
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<2.0	<2.0			
	Alkalinity, Total (as CaCO3) (mg/L)	16.2	10.7			
	Ammonia, Total (as N) (mg/L)	0.591	0.477			
	Bromide (Br) (mg/L)	618	584			
	Chloride (Cl) (mg/L)	45400	50300			
	Fluoride (F) (mg/L)	0.57	0.70			
	Nitrate (as N) (mg/L)	<0.50 DLM	<0.50 DLM			
	Nitrite (as N) (mg/L)	<0.10 DLM	<0.10 DLM			
	Total Kjeldahl Nitrogen (mg/L)	0.913	0.722			
	Orthophosphate-Dissolved (as P) (mg/L)	0.0768	0.0409			
	Phosphorus (P)-Total (mg/L)	0.237	0.176			
	Sulfate (SO4) (mg/L)	<50 DLM	<50 DLM			
Total Metals	Aluminum (Al)-Total (mg/L)	<0.30 DLA	<0.30 DLA			
	Antimony (Sb)-Total (mg/L)	<0.0050 DLA	<0.0050 DLA			
	Arsenic (As)-Total (mg/L)	0.0079	0.0068			
	Barium (Ba)-Total (mg/L)	2.74	8.37			
	Beryllium (Be)-Total (mg/L)	<0.0050 DLA	<0.0050 DLA			
	Bismuth (Bi)-Total (mg/L)	<0.050 DLA	<0.050 DLA			
	Boron (B)-Total (mg/L)	5.21	4.08			
	Cadmium (Cd)-Total (mg/L)	<0.0010 DLA	<0.0010 DLA			
	Calcium (Ca)-Total (mg/L)	19400	19400			
	Chromium (Cr)-Total (mg/L)	0.010	<0.010 DLA			
	Cobalt (Co)-Total (mg/L)	<0.010 DLA	<0.010 DLA			
	Copper (Cu)-Total (mg/L)	<0.050 DLA	<0.050 DLA			
	Iron (Fe)-Total (mg/L)	1.15	6.85			
	Lead (Pb)-Total (mg/L)	<0.0050 DLA	<0.0050 DLA			
	Lithium (Li)-Total (mg/L)	11.6	7.89			
	Magnesium (Mg)-Total (mg/L)	786	1010			
	Manganese (Mn)-Total (mg/L)	2.01	3.17			

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1366894-1	L1366894-2			
	Description	Water	Water			
	Sampled Date	16-SEP-13	17-SEP-13			
	Sampled Time					
	Client ID	ZONE5-3-2013	ZONE3-6-2013			
Grouping	**Analyte**					
WATER						
Total Metals	Mercury (Hg)-Total (mg/L)	<0.000010	<0.000010			
	Molybdenum (Mo)-Total (mg/L)	0.0885	0.0590			
	Nickel (Ni)-Total (mg/L)	0.017	0.019			
	Phosphorus (P)-Total (mg/L)	<6.0 DLA	<6.0 DLA			
	Potassium (K)-Total (mg/L)	435	361			
	Selenium (Se)-Total (mg/L)	<0.010 DLA	<0.010 DLA			
	Silicon (Si)-Total (mg/L)	<1.0 DLA	1.0			
	Silver (Ag)-Total (mg/L)	<0.0010 DLA	0.0070			
	Sodium (Na)-Total (mg/L)	5090	7140			
	Strontium (Sr)-Total (mg/L)	342	398			
	Thallium (Tl)-Total (mg/L)	<0.0050 DLA	<0.0050 DLA			
	Tin (Sn)-Total (mg/L)	<0.010 DLA	<0.010 DLA			
	Titanium (Ti)-Total (mg/L)	<0.20 DLA	<0.20 DLA			
	Uranium (U)-Total (mg/L)	<0.0010 DLA	<0.0010 DLA			
	Vanadium (V)-Total (mg/L)	<0.050 DLA	<0.050 DLA			
	Zinc (Zn)-Total (mg/L)	0.38	0.50			
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD			
	Dissolved Metals Filtration Location	FIELD	FIELD			
	Aluminum (Al)-Dissolved (mg/L)	<0.10 DLA	<0.10 DLA			
	Antimony (Sb)-Dissolved (mg/L)	<0.0050 DLA	<0.0050 DLA			
	Arsenic (As)-Dissolved (mg/L)	0.0080	0.0075			
	Barium (Ba)-Dissolved (mg/L)	2.82	8.68			
	Beryllium (Be)-Dissolved (mg/L)	<0.0050 DLA	<0.0050 DLA			
	Bismuth (Bi)-Dissolved (mg/L)	<0.050 DLA	<0.050 DLA			
	Boron (B)-Dissolved (mg/L)	5.30	4.08			
	Cadmium (Cd)-Dissolved (mg/L)	<0.0010 DLA	<0.0010 DLA			
	Calcium (Ca)-Dissolved (mg/L)	19500	19300			
	Chromium (Cr)-Dissolved (mg/L)	<0.010 DLA	<0.010 DLA			
	Cobalt (Co)-Dissolved (mg/L)	<0.010 DLA	<0.010 DLA			
	Copper (Cu)-Dissolved (mg/L)	<0.020 DLA	<0.020 DLA			
	Iron (Fe)-Dissolved (mg/L)	0.89	6.16			
	Lead (Pb)-Dissolved (mg/L)	<0.0050 DLA	<0.0050 DLA			
	Lithium (Li)-Dissolved (mg/L)	11.8	8.09			
	Magnesium (Mg)-Dissolved (mg/L)	801	1040			
	Manganese (Mn)-Dissolved (mg/L)	2.03	3.24			
	Mercury (Hg)-Dissolved (mg/L)	<0.000010	<0.000010			
	Molybdenum (Mo)-Dissolved (mg/L)	0.0873	0.0563			

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1366894-1	L1366894-2			
	Description	Water	Water			
	Sampled Date	16-SEP-13	17-SEP-13			
	Sampled Time					
	Client ID	ZONE5-3-2013	ZONE3-6-2013			
Grouping	**Analyte**					
WATER						
Dissolved Metals	Nickel (Ni)-Dissolved (mg/L)	0.011	0.011			
	Phosphorus (P)-Dissolved (mg/L)	<6.0 DLA	<6.0 DLA			
	Potassium (K)-Dissolved (mg/L)	446	370			
	Selenium (Se)-Dissolved (mg/L)	<0.010 DLA	<0.010 DLA			
	Silicon (Si)-Dissolved (mg/L)	<1.0 DLA	<1.0 DLA			
	Silver (Ag)-Dissolved (mg/L)	<0.0010 DLA	<0.0010 DLA			
	Sodium (Na)-Dissolved (mg/L)	5200	7180			
	Strontium (Sr)-Dissolved (mg/L)	338	399			
	Thallium (Tl)-Dissolved (mg/L)	<0.0050 DLA	<0.0050 DLA			
	Tin (Sn)-Dissolved (mg/L)	<0.010 DLA	<0.010 DLA			
	Titanium (Ti)-Dissolved (mg/L)	<0.20 DLA	<0.20 DLA			
	Uranium (U)-Dissolved (mg/L)	<0.0010 DLA	<0.0010 DLA			
	Vanadium (V)-Dissolved (mg/L)	<0.050 DLA	<0.050 DLA			
	Zinc (Zn)-Dissolved (mg/L)	0.24	0.35			
Glycols	Diethylene Glycol (mg/L)	<100 DLA	<100 DLA			
	Ethylene Glycol (mg/L)	<100 DLA	<100 DLA			
	1,2-Propylene Glycol (mg/L)	1800	760			

* 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	Aluminum (Al)-Dissolved	DLA	L1366894-1, -2
Duplicate	Bismuth (Bi)-Dissolved	DLA	L1366894-1, -2
Duplicate	Cadmium (Cd)-Dissolved	DLA	L1366894-1, -2
Duplicate	Cobalt (Co)-Dissolved	DLA	L1366894-1, -2
Duplicate	Copper (Cu)-Dissolved	DLA	L1366894-1, -2
Duplicate	Lead (Pb)-Dissolved	DLA	L1366894-1, -2
Duplicate	Silver (Ag)-Dissolved	DLA	L1366894-1, -2
Duplicate	Tin (Sn)-Dissolved	DLA	L1366894-1, -2
Duplicate	Uranium (U)-Dissolved	DLA	L1366894-1, -2
Duplicate	Antimony (Sb)-Dissolved	DLA	L1366894-1, -2
Duplicate	Beryllium (Be)-Dissolved	DLA	L1366894-1, -2
Duplicate	Chromium (Cr)-Dissolved	DLA	L1366894-1, -2
Duplicate	Selenium (Se)-Dissolved	DLA	L1366894-1, -2
Duplicate	Thallium (Tl)-Dissolved	DLA	L1366894-1, -2
Duplicate	Vanadium (V)-Dissolved	DLA	L1366894-1, -2
Duplicate	Phosphorus (P)-Dissolved	DLA	L1366894-1, -2
Duplicate	Silicon (Si)-Dissolved	DLA	L1366894-1, -2
Duplicate	Titanium (Ti)-Dissolved	DLA	L1366894-1, -2
Duplicate	Chloride (Cl)	DLM	L1366894-1, -2
Duplicate	Nitrite (as N)	DLM	L1366894-1, -2
Duplicate	Nitrate (as N)	DLM	L1366894-1, -2

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLA	Detection Limit Adjusted For required dilution
DLM	Detection Limit Adjusted For Sample Matrix Effects

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-SCR-VA	Water	Alkalinity by colour or titration	EPA 310.2 OR APHA 2320

This analysis is carried out using procedures adapted from EPA Method 310.2 "Alkalinity". Total Alkalinity is determined using the methyl orange colourimetric method.
OR
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.

ANIONS-BR-IC-VA	Water	Bromide by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-CL-IC-VA	Water	Chloride by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-NO2-IC-VA	Water	Nitrite in Water by Ion Chromatography	EPA 300.0

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrite is detected by UV absorbance.

ANIONS-NO3-IC-VA	Water	Nitrate in Water by Ion Chromatography	EPA 300.0

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrate is detected by UV absorbance.

ANIONS-SO4-IC-VA	Water	Sulfate by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

F-SIE-VA	Water	Fluoride by SIE	APHA 4500-F "Fluoride"

Reference Information

This analysis is carried out using procedures adapted from APHA Method 4500-F "Fluoride". Fluoride is determined using a selective ion electrode. This method has a significant negative interference (i.e. results could be biased low) when Al3+ is present in the sample at a concentration greater than 2.5 mg/L.

F-SIE-VA Water Fluoride by SIE APHA 4500-F Fluoride

This analysis is carried out using procedures adapted from APHA Method 4500-F "Fluoride". Fluoride is determined using a selective ion electrode. This method has a significant negative interference (i.e. results could be biased low) when Al3+ is present in the sample at a concentration greater than 2.5 mg/L.

FE-DIS-LOW-ICP-VA Water Dissolved Fe 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).

FE-TOT-LOW-ICP-VA Water Total Fe 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).

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 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-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-DIS-ULTRA-MS-VA Water Diss. Metals in Water by ICPMS (Ultra) EPA SW-846 3005A/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 involves preliminary sample treatment by filtration (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - mass spectrometry (EPA Method 6020A).

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

Reference Information

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).

MET-TOT-ULTRA-MS-VA Water Total Metals in Water by ICPMS (Ultra) EPA SW-846 3005A/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 either hotblock or microwave oven, or filtration (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - mass spectrometry (EPA Method 6020A).

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.

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

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorous is determined colourimetrically after persulphate digestion of the sample.

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.

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

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.

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.

TKN-F-VA Water TKN in Water by Fluorescence APHA 4500-NORG D.

This analysis is carried out using procedures adapted from APHA Method 4500-Norg D. "Block Digestion and Flow Injection Analysis". Total Kjeldahl Nitrogen is determined using block digestion followed by Flow-injection analysis with fluorescence detection.

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.

TURBIDITY-VA Water Turbidity by Meter APHA 2130 "Turbidity"

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

TURBIDITY-VA Water Turbidity by Meter APHA 2130 Turbidity

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

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

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

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

Chain of Custody Numbers:

10-251297

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.

L1366894-COFC

10-251297

Chain of Custody / Analytical Request Form

Canada Toll Free: 1 800 668 9878

www.alsglobal.com

Report To		Report Format / Distribution		Service Request: (Rush subject to availability - Contact ALS to confirm TAT)	
Company:	Roscan	Standard:	Other (specify):		Regular (Standard Turnaround Times - Business Days)
Contact:	Tyler Gale	Select: PDF	Excel Digital Fax	X	Priority (2-4 Business Days)-50% surcharge - Contact ALS to confirm TAT
Address:	Vancouver, BC	Email 1:	Tyler.Gale@roscan.com		Emergency (1-2 Business Days)-100% Surcharge - Contact ALS to confirm TAT
		Email 2:			Same Day or Weekend Emergency - Contact ALS to confirm TAT
Phone:	Fax:				

Invoice To	Same as Report ? (circle) Yes or No (if No, provide details)	Client / Project Information	
	Copy of Invoice with Report? (circle) Yes or No	Job #:	0194096-0012
Company:		PO / AFE:	
Contact:		LSD:	
Address:			
Phone:	Fax:	Quote #:	

Lab Work Order # (lab use only)	L1366894	ALS Contact:	Amber	Sampler:	Rusto

Analysis Request (Indicate Filtered or Preserved, F/P)

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	General	Nutrients	Total Metals	Diss. Metals	Glycols	Number of Containers
	Zone 5-3-2013	16-09-13		Water	X	X	X	X	X	5
	Zone 3-6-2013	17-09-13		Water	X	X	X	X	X	5

RUSH

Priority processing

Special Instructions / Regulation with water or land use (CCME- Freshwater Aquatic Life/BC CSR-Commercial/AB Tier 1-Natural/ETC) / Hazardous Details

Expect high TDS (10-100 g/L) as well as Ca, Cl, Na.

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.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by: Rusto	Date: 18-09-13	Time: 12:00	Received by: Paige	Date: Sept. 23	Time: 12:00	Temperature: 7 °C	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF

L1366894-COFC

10-251297

Chain of Custody / Analytical Request Form
Canada Toll Free: 1 800 668 9878
www.alsglobal.com

Page 1 of 1

Report To	Report Format / Distribution	Service Request: (Rush subject to availability - Contact ALS to confirm TAT)
Company: Roscan	Standard: Other (specify):	Regular (Standard Turnaround Times - Business Days)
Contact: Tyler Gale	Select: PDF Excel Digital Fax	X Priority (2-4 Business Days)-50% surcharge - Contact ALS to confirm TAT
Address: Vancouver, BC	Email 1: Tyler.Gale@roscan.com	Emergency (1-2 Business Days)-100% Surcharge - Contact ALS to confirm TAT
	Email 2:	Same Day or Weekend Emergency - Contact ALS to confirm TAT
Phone: Fax:		

Invoice To	Client / Project Information
Same as Report ? (circle) Yes or No (if No, provide details)	Job #: 0194096-0012
Copy of Invoice with Report? (circle) Yes or No	PO / AFE:
Company:	LSD:
Contact:	
Address:	Quote #:
Phone: Fax:	

Lab Work Order # (lab use only): L1366894 | **ALS Contact:** Amber | **Sampler:** Rusto

Analysis Request (Indicate Filtered or Preserved, F/P)

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	F/P General	F/P Nutrients	F/P Total Metals	F/P Diss. Metals	F/P Glycols	Number of Containers
	Zone 5-3-2013	16-09-13		Water	X	X	X	X	X	5
	Zone 3-6-2013	17-09-13		Water	X	X	X	X	X	5

RUSH

Priority processing

Special Instructions / Regulation with water or land use (CCME- Freshwater Aquatic Life/BC CSR-Commercial/AB Tier 1-Natural/ETC) / Hazardous Details

Expect high TDS (to ~100 g/L) as well as Ca, Cl, Na.

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.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by: Rusto	Date: 18-09-13	Time: 12:00	Received by: Paige	Date: Sept. 23	Time: 12:00	Temperature: 7 °C	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION | WHITE - LABORATORY COPY | YELLOW - CLIENT COPY | GENF 18.01 Front

Appendix V6-2B

Completion Report, Westbay System Monitoring Well: 13-GSE-319

Sabina
GOLD & SILVER CORP.

Schlumberger Water Services

Schlumberger Canada Limited
3480 Gilmore Way, Suite 110
Burnaby, BC V5G 4Y1
Canada
Tel. +1.604.430.4272
Fax. +1.604.430.3538

COMPLETION REPORT

Westbay System Monitoring Well:

13-GSE-319

Back River, NU

Prepared for:

Rescan Environmental Services Ltd.
Sixth Floor, 1111 W. Hastings St.
Vancouver, BC
V6E 2J3
Canada

Prepared by:

Schlumberger Water Services
WB927
June 27, 2013

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3. Installation 1

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3.2 Layout of Westbay Casing Components 2

3.3 Lowering of Westbay Components 2

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APPENDIX

Monitoring Well: 13-GSE-319

1. Introduction

This report and the attached appendix documents the technical services carried out by Schlumberger Water Services (SWS) under Rescan Environmental Services Ltd. (Rescan) P.O. No. 0194096-0012 dated May 1, 2013. A Westbay System completion was installed in borehole 13-GSE-319 at the Sabina Gold & Silver Corp., Back River Development, Nunavut.

Westbay technical services representatives Mr. Mark Lessard and Mr. Dennis Oertel were on site for the installation of the Westbay System well from May 20 to June 2, 2013. All field work was supervised on site by Rescan representatives Mr. Tyler Gale, Mr. Cody Cameron and Mr. Rusto Martinka.

This report documents the installation tasks and related QA checks.

2. Previous Activities

The borehole was drilled by Major Drilling Group International Inc. using a diamond core rotary method at a nominal 96-mm diameter (HQ-size). The borehole angle was set to a nominal plunge angle of 78 degrees below horizontal. A brine mixture with added polymers was used as a drilling fluid and to keep the borehole from freezing. A nominal 4-inch permanent surface casing was installed in the borehole to a depth of about 9 meters (30-ft). A gyroscopic directional survey was performed in the borehole prior to the installation of the Westbay casing. Core logging was used to determine the positioning of the sampling zones. The borehole was flushed with brine immediately prior to lowering of the Westbay casing.

(Note: depth for the borehole is with respect to top of surface casing. There is no correction for borehole angle from vertical. Monitoring well reference elevation was not available at the time of writing).

Table 1, Summary of Westbay System Well Installation

Monitoring Well No.	Installation Date	Borehole Depth (m)	MP38 Casing Length (m)	No. Monitoring Zones
13-GSE-319	May 27 – 31	782.6	782.4	5

3. Installation

The Westbay completion in borehole 13-GSE-319 was installed according to the procedure described below.

3.1 Preparation of Monitoring Well Design

Monitoring zone locations for the borehole was provided to Schlumberger Water Services by Mr. Tyler Gale of Rescan. The well design was created based on the requested monitoring zone locations. The well design was used to prepare a Casing Installation Log, which specifies the location of components in the well. This log was reviewed by Mr. Gale prior to installation of the well. The Casing Installation Log as approved was used as an installation guide in the field. A field copy of the log is in the appendix.

A measurement port coupling was included in each monitoring zone to provide the capability to measure fluid pressures and collect fluid samples. Measurement port couplings were also included in QA zones to provide QA testing capabilities and to permit operation of the squeeze relief venting capabilities of the Model 6055 packer inflation tool. A pumping port coupling was included in each monitoring zone to provide purging and hydraulic conductivity testing capabilities. A pumping port was also placed above the two packers located directly above the expected base of permafrost. This pumping port was placed as part of a procedure to introduce a glycol/water mixture into the annulus in the permafrost zone. The well design included a long tailpipe below the bottom packer. This tailpipe was used to rest the Westbay casing string on the borehole bottom during retrieval of the temporary guide tube. Mr. Gale requested that optional synthetic (PET) filters were not to be installed over the measurement port couplings in the monitoring zones.

3.2 Layout of Westbay Casing Components

Prior to installation, the Westbay System casing components were set out on racks at the borehole, according to the sequence indicated on the Casing Installation Log. Each casing length was numbered beginning with the lowermost as an aid to confirming the proper sequence of components. The appropriate Westbay System couplings were attached to the casing sections. Magnetic location collars were attached 0.6-m below the top of the measurement port in each sampling zone and one at 10-m below ground surface. Each casing component was visually inspected. Serial numbers for each packer, pumping port and measurement port coupling were recorded on the Casing Installation Log. The well component layout was confirmed with the log before the components were lowered into the borehole.

3.3 Lowering of Westbay Components

The Westbay casing components were lowered into the borehole by hand through HQ drill rods (nominal 76-mm ID) used as a temporary guide tube. Each Westbay casing, packer and coupling was confirmed to be in the correct sequence during lowering. A record of placement of each casing component and coupling are noted on the Casing Installation Log by check marks. The joints in the monitoring zones were tested with a minimum internal hydraulic pressure of 150 psi for one minute to confirm hydraulic seals. At the request of Rescan, no testing of other Westbay casing joints were done, as part of a plan to minimize installation time.

A 2:1 water/propylene glycol mixture supplied by Rescan was added to the Westbay casing when necessary to counter buoyancy effects while components were lowered into the borehole and for testing of joint seals.

3.4 Positioning of Westbay Components

After the components were lowered into the well and the guide tube was removed, the Westbay casing string was positioned as illustrated on the Casing Installation Log. The Westbay casing string was supported in this position while packer inflation was carried out. The positioning of the Westbay casing components is based on the "nominal" lengths of Westbay casing components. The positioning calculations do not include allowances for borehole temperature or deviation effects.

The attached figure titled “MOSDAX Transducer Position” provides information to correlate the position of MOSDAX Transducer sensors to the reference position at the top of the Measurement Port. The attached figure titled “Dimensions of Packer Seals and Monitoring Zones” outlines the calculations used to determine the packer depths and zone length.

The Summary Casing Log, which shows the final "as-built" locations of the components in the well, is included in the appendix. The depths of key items in the well are shown on Table 2 in the appendix.

3.5 Inflation of Westbay System Packers and Placement of Antifreeze Solution

The Westbay packers were inflated using a 2:1 proplyene glycol/water mixture provided by Rescan. The Westbay Model No. 6055 vented inflation tool was used for packer inflation. All of the packers appear to have inflated normally. The data for inflation of each packer are provided on the Westbay Packer Inflation Records included in the appendix.

The packers were inflated in a specific sequence as part of a procedure to introduce and control an antifreeze solution in the well annulus through the permafrost zone:

- Two packers positioned immediately above the expected base of permafrost were inflated.
- The pumping port above the upper inflated packer was opened.
- A 2:1 mixture of water and propylene glycol supplied by Rescan was pumped inside the Westbay casing, out the pumping port and into the well annulus. Pumping continued until a return flow of the mixture was observed from the well annulus at ground level, indicating that the well annulus was full of the antifreeze mixture.
- The Westbay packers in the permafrost were inflated, confining the antifreeze mixture.
- The pumping port port was closed.
- The remaining Westbay packers in the well were inflated.

4. Fluid Pressure Measurements

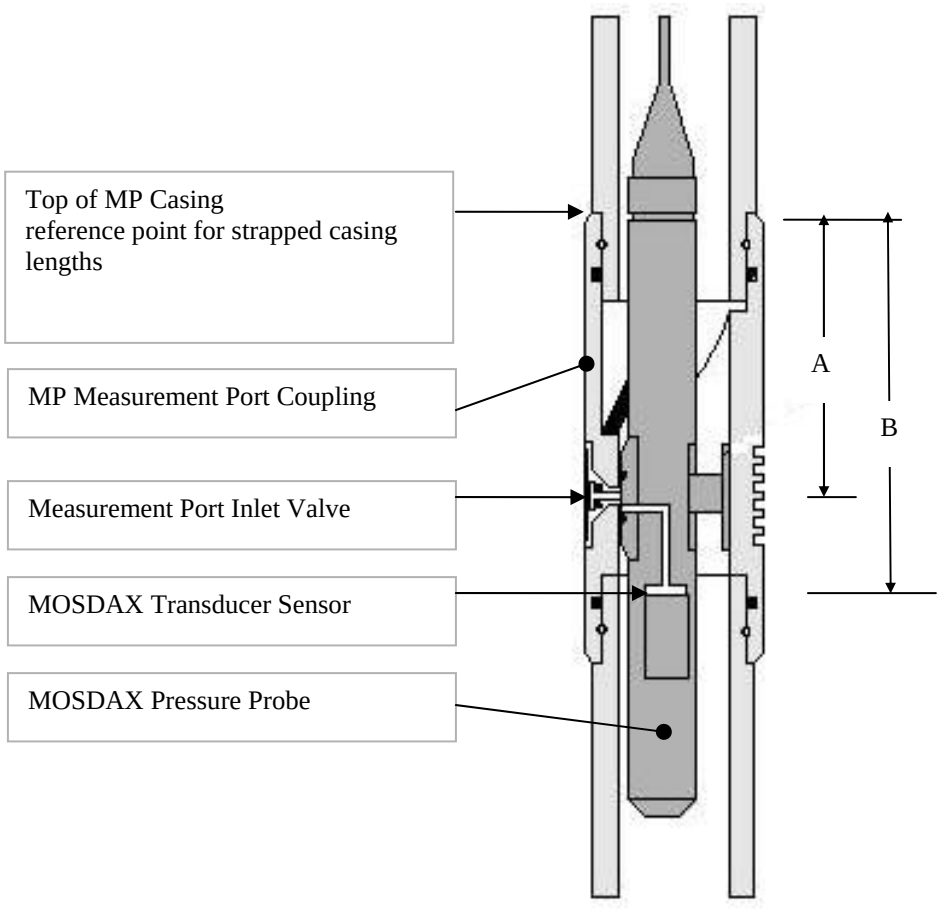
In order to minimize the time required to lower the Westbay casing and complete the tasks for placement of antifreeze in the borehole annulus, the standard SWS procedure to measure a profile of pressure measurements before packer inflation was not done.

After packer inflation was completed, fluid pressures were measured at each measurement port. At that time, the in-situ formation pressures may not have recovered from the pre-installation activities. Longer term monitoring may be required to establish representative fluid pressures.

A plot of the Post-Inflation Piezometric levels is shown on Figure 1 in the Appendix. The calculations were not corrected for borehole deviation or fluid density. The calculated results are reported as equivalent fresh water levels. The data were examined to confirm proper operation of the measurement ports and as a check on the presence of annulus seals between monitoring zones. The calculation sheet for the pressure profile is enclosed in the appendix.

MOSDAX Transducer Position

In an MP System Measurement Port Coupling



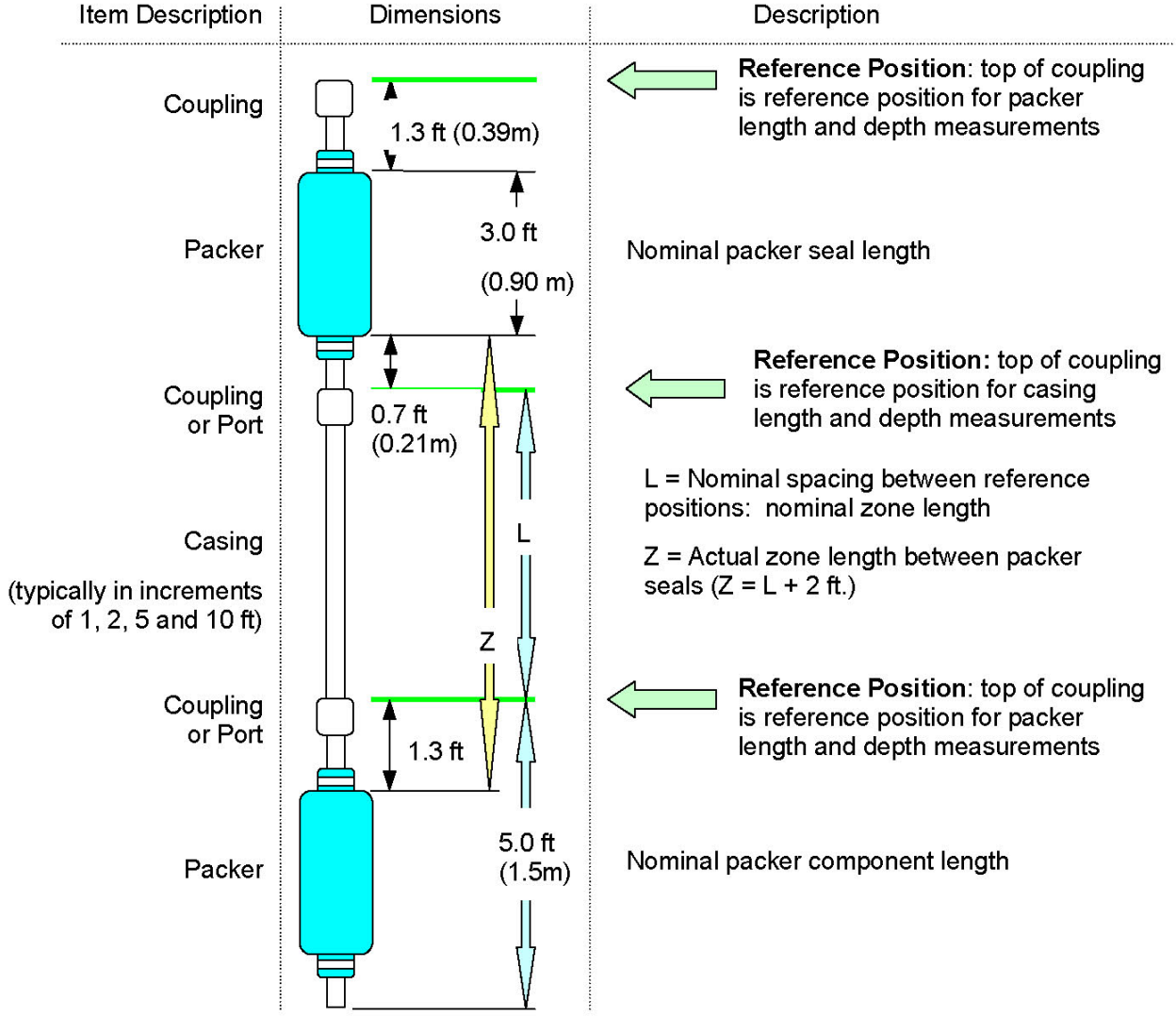
System	Measurement Port Type	A	B
Plastic MP38	0222, 0205	4.5" (114.3 mm)	6.5" (165.1 mm)

Technical Note

Schlumberger WATER SERVICES

Dimensions of Packer Seals and Monitoring Zones

Westbay System – Plastic MP38



Discussion Points:

- The top of a coupling (Regular Coupling, Measurement Port or Pumping Port) is the reference point for describing nominal depths and nominal lengths. Actual positions of packer seals and zone lengths are determined with respect to the appropriate reference positions.
- Packer Position Example: A packer with a nominal depth of 50 ft (15.2m), will have a nominal packer seal position of 51.3 to 54.3 ft. (15.59 to 16.49m)
- Zone Length Example: A zone whose upper packer is at 50 ft (15.2m) and bottom packer is at 70 ft (21.3m) will have a nominal zone length of 15 ft (4.6m) and an actual zone length (between packer seals) of 15.0+1.3+0.7 = 17.0ft. (4.6 + 0.39 + 0.2 = 5.19m)
- Information on the position of Measurement Port Valve and MOSDAX Transducer sensor, used for detailed calculation of piezometric level measurements, are described separately.

Schlumberger Private

APPENDIX

Monitoring Well 13-GSE-319

As-Built Casing Summary	-6 pages
Summary Casing Log	-6 pages
Post- Inflation Piezometric Pressure/Levels	
Field Data and Calculation Sheet (May 31, 2013)	-1 page
Figure 1, Post-Inflation Profile	-1 page
Casing Installation Log (field copy)	-18 pages
Westbay Packer Inflation Records	-17 pages

Item No.	Component Part Number	Component S/N	Coupling P/N	Component Discription	Coupling S/N	Accessory P/N	Accessory Depth (m)	Depth (m) *
280	0203							-3.0
279	20101		0202					-2.9
278	20102		0202					-2.6
277	20102		0202					-2.0
276	20102		0202					-1.4
275	20102		0202					-0.8
274	20105		0202					-0.2
273	20105		0202					1.3
272	20110		0202					2.9
271	20110		0202			0216	0.6	5.9
270	20110		0202					8.9
269	20110		0202					12.0
268	20110		0202					15.0
267	20110		0202					18.1
266	20110		0202					21.1
265	20110		0202					24.2
264	20110		0202					27.2
263	20110		0202					30.3
262	20110		0202					33.3
261	20110		0202					36.4
260	20110		0202					39.4
259	20110		0202					42.5
258	20110		0202					45.5
257	20110		0202					48.6
256	20110		0202					51.6
255	20110		0202					54.7
254	20110		0202					57.7
253	20110		0202					60.8
252	20110		0202					63.8
251	20110		0202					66.9
250	20110		0202					69.9
249	20110		0202					73.0
248	20110		0202					76.0
247	20110		0202					79.0
246	0238	18314	0202					82.1
245	20110		0205	Measurement Port	7655	0216	0.6	**83.6**
244	20105		0202					86.7
243	20110		0202			`		88.2
242	20110		0202					91.2
241	20110		0202					94.3
240	20110		0202					97.3
239	20110		0202					100.4
238	20110		0202					103.4
237	20110		0202					106.5
236	20110		0202					109.5
235	20110		0202					112.6
234	20110		0202					115.6
233	20110		0202					118.7
232	20110		0202					121.7
231	20110		0202					124.8

Item No.	Component Part Number	Component S/N	Coupling P/N	Component Discription	Coupling S/N	Accessory P/N	Accessory Depth (m)	Depth (m) *
230	20110		0202					127.8
229	20110		0202					130.9
228	20110		0202					133.9
227	20110		0202					137.0
226	20110		0202					140.0
225	20110		0202					143.1
224	20110		0202					146.1
223	20110		0202					149.2
222	20110		0202					152.2
221	20110		0202					155.2
220	20110		0202					158.3
219	20110		0202					161.3
218	20110		0202					164.4
217	20110		0202					167.4
216	20110		0202					170.5
215	20110		0202					173.5
214	20110		0202					176.6
213	0238	18313	0202					179.6
212	20110		0205	Measurement Port	7649	0216	0.6	**181.2**
211	20105		0202					184.2
210	20110		0202					185.7
209	20110		0202					188.8
208	20110		0202					191.8
207	20110		0202					194.9
206	20110		0202					197.9
205	20110		0202					201.0
204	20110		0202					204.0
203	20110		0202					207.1
202	20110		0202					210.1
201	20110		0202					213.2
200	20110		0202					216.2
199	20110		0202					219.3
198	20110		0202					222.3
197	20110		0202					225.3
196	20110		0202					228.4
195	20110		0202					231.4
194	20110		0202					234.5
193	20110		0202					237.5
192	20110		0202					240.6
191	20110		0202					243.6
190	20110		0202					246.7
189	20110		0202					249.7
188	20110		0202					252.8
187	20110		0202					255.8
186	20110		0202					258.9
185	20110		0202					261.9
184	20110		0202					265.0
183	20110		0202					268.0
182	20110		0202					271.1
181	20110		0202					274.1

Item No.	Component Part Number	Component S/N	Coupling P/N	Component Discription	Coupling S/N	Accessory P/N	Accessory Depth (m)	Depth (m) *
180	20110		0202					277.2
179	0238	18312	0202					280.2
178	20110		0205	Measurement Port	7630	0216	0.6	**281.7**
177	20105		0202					284.8
176	20110		0202					286.3
175	20110		0202					289.4
174	20110		0202					292.4
173	20110		0202					295.4
172	20110		0202					298.5
171	20110		0202					301.5
170	20110		0202					304.6
169	20110		0202					307.6
168	20110		0202					310.7
167	20110		0202					313.7
166	20110		0202					316.8
165	20110		0202					319.8
164	20110		0202					322.9
163	20110		0202					325.9
162	20110		0202					329.0
161	20110		0202					332.0
160	20110		0202					335.1
159	20110		0202					338.1
158	20110		0202					341.2
157	20110		0202					344.2
156	20110		0202					347.3
155	20110		0202					350.3
154	20110		0202					353.4
153	20110		0202					356.4
152	20110		0202					359.5
151	20110		0202					362.5
150	20110		0202					365.6
149	20110		0202					368.6
148	20110		0202					371.6
147	20110		0202					374.7
146	20110		0202					377.7
145	0238	18311	0202					380.8
144	20110		0205	Measurement Port	7653	0216	0.6	**382.3**
143	20105		0202					385.4
142	20110		0202					386.9
141	20110		0202					389.9
140	20110		0202					393.0
139	20110		0202					396.0
138	20110		0202					399.1
137	20110		0202					402.1
136	20110		0202					405.2
135	20110		0202					408.2
134	20110		0202					411.3
133	20110		0202					414.3
132	20110		0202					417.4
131	20110		0202					420.4

Item No.	Component Part Number	Component S/N	Coupling P/N	Component Discription	Coupling S/N	Accessory P/N	Accessory Depth (m)	Depth (m) *
130	20110		0202					423.5
129	20110		0202					426.5
128	20110		0202					429.6
127	20110		0202					432.6
126	20110		0202					435.7
125	20110		0202					438.7
124	20110		0202					441.7
123	20110		0202					444.8
122	20110		0206	Pumping Port	306	0216	0.6	**447.8**
121	0238	18290	0202					451.0
120	20110		0205	Measurement Port	7648			**452.5**
119	0238	18289	0202					455.5
118	20110		0205	Measurement Port	7631			**457.1**
117	20110		0202					460.1
116	20110		0202					463.2
115	20110		0202					466.2
114	20110		0202					469.3
113	20110		0202					472.3
112	20110		0202					475.3
111	20110		0202					478.4
110	20110		0202					481.4
109	20110		0202					484.5
108	20110		0202					487.5
107	20110		0202					490.6
106	20110		0202					493.6
105	20110		0202					496.7
104	20110		0202					499.7
103	20110		0202					502.8
102	20110		0202					505.8
101	20110		0202					508.9
100	20110		0202					511.9
99	20110		0202					515.0
98	20110		0202					518.0
97	20110		0202					521.1
96	20110		0202					524.1
95	20110		0202					527.2
94	20110		0202					530.2
93	0238	18287	0202					533.3
92	20105		0205	Measurement Port	7657	0216	0.6	**534.8**
91	20105		0206	Pumping Port	301			**536.3**
90	0238	18288	0202					537.9
89	20110		0205	Measurement Port	7654			**539.4**
88	20110		0202					542.5
87	20110		0202					545.5
86	20110		0202					548.6
85	20110		0202					551.6
84	20110		0202					554.7
83	20110		0202					557.7
82	20110		0202					560.8
81	20110		0202					563.8

Item No.	Component Part Number	Component S/N	Coupling P/N	Component Discription	Coupling S/N	Accessory P/N	Accessory Depth (m)	Depth (m) *
80	20110		0202					566.9
79	20110		0202					569.9
78	20110		0202					573.0
77	20110		0202					576.0
76	20110		0202					579.1
75	20110		0202					582.1
74	20110		0202					585.1
73	20110		0202					588.2
72	20110		0202					591.2
71	20110		0202					594.3
70	20110		0202					597.3
69	20110		0202					600.4
68	20110		0202					603.4
67	20110		0202					606.5
66	20110		0202					609.5
65	20110		0202					612.6
64	20110		0202					615.6
63	20110		0202					618.7
62	20110		0202					621.7
61	0238	18285	0202					624.8
60	20105		0205	Measurement Port	7659	0216	0.6	**626.3**
59	20105		0206	Pumping Port	302			**627.8**
58	0238	18286	0202					629.4
57	20110		0205	Measurement Port	7651			**630.9**
56	20110		0202					634.0
55	20110		0202					637.0
54	20110		0202					640.1
53	20110		0202					643.1
52	0238	18295	0202					646.2
51	20105		0205	Measurement Port	7660	0216	0.6	**647.7**
50	20105		0206	Pumping Port	303			**649.2**
49	0238	18294	0202					650.8
48	20110		0205	Measurement Port	7652			**652.4**
47	20105		0202					655.4
46	20110		0202					656.9
45	20110		0202					660.0
44	20110		0202					663.0
43	20110		0202					666.1
42	0238	18292	0202					669.1
41	20105		0205	Measurement Port	7656	0216	0.6	**670.6**
40	20110		0206	Pumping Port	305			**672.2**
39	20101		0202					675.3
38	0238	18293	0202					675.6
37	20110		0205	Measurement Port	7650			**677.1**
36	20110		0202					680.2
35	20110		0202					683.2
34	20110		0202					686.3
33	20110		0202					689.3
32	20110		0202					692.4
31	0238	18291	0202					695.4

Item No.	Component Part Number	Component S/N	Coupling P/N	Component Discription	Coupling S/N	Accessory P/N	Accessory Depth (m)	Depth (m) *
30	20105		0205	Measurement Port	7658	0216	0.6	**696.9**
29	20105		0206	Pumping Port	304			**698.5**
28	0238	18300	0202					700.1
27	20110		0205	Measurement Port	7629			**701.6**
26	20110		0202					704.6
25	20110		0202					707.7
24	20110		0202					710.7
23	20110		0202					713.8
22	20110		0202					716.8
21	20110		0202					719.9
20	20110		0202					722.9
19	20110		0202					726.0
18	20110		0202					729.0
17	20110		0202					732.1
16	20110		0202					735.1
15	20110		0202					738.1
14	20110		0202					741.2
13	20110		0202					744.2
12	20110		0202					747.3
11	20110		0202					750.3
10	20110		0202					753.4
9	20110		0202					756.4
8	20110		0202					759.5
7	20110		0202					762.5
6	20110		0202					765.6
5	20110		0202					768.6
4	20110		0202					771.7
3	20110		0202					774.7
2	20110		0202					777.8
1	20105		0202					780.8
0	0203							782.3

Depths are with respect to top of the 4-inch steel surface casing.

* Component positions are referenced to the top of the subject Westbay System coupling.

* Packer positions are referenced to the top Westbay System coupling on the packer.

Monitoring zone dimensions are determined as described on the attached “Dimensions of Packer Seals and Monitoring Zones”.

The position of a MOSDAX Transducer in a Measurement Port is illustrated in the attached “MOSDAX Transducer Position”.

This information may be used in calculating piezometric levels.

Summary Casing Log

Company: Rescan
Well: 13-GSE-319
Site: Sabina
Project: Back River Project

Job No: WB927
Author: ML

Well Information

Reference Datum: Top of 4-in SC.
Elevation of Datum: 0.00 m.
MP Casing Top: 0.00 m.
MP Casing Length: 782.39 m.

Borehole Depth: 782.60 m.
Borehole Inclination: 77 Degrees
Borehole Diameter: 96.00 mm

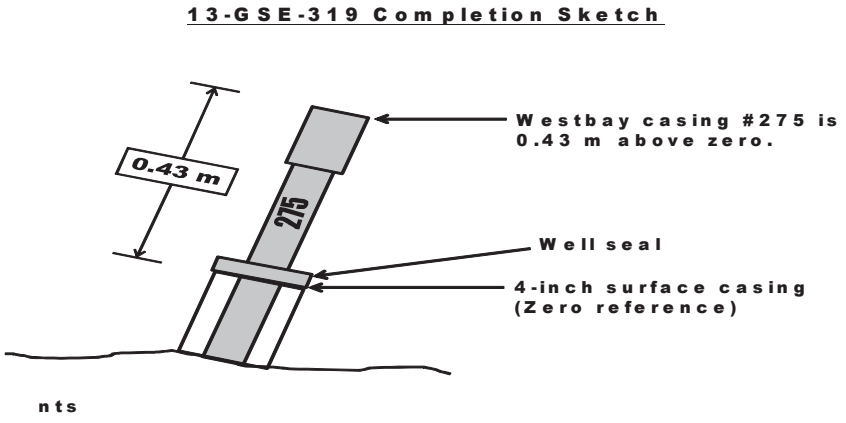
Well Description:
MP38
Other References:

File Information

File Name: WB-13.WWD
Report Date: Thu Jun 06 13:21:23 2013

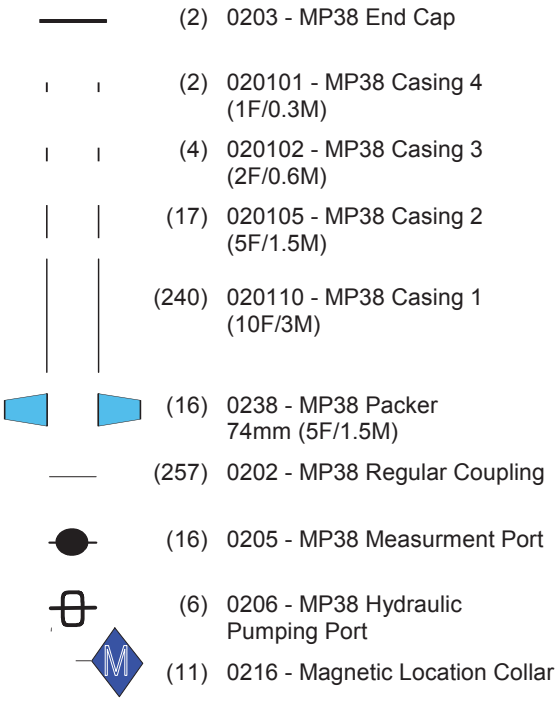
File Date: Jun 06 13:19:40 2013

Sketch of Wellhead Completion



Legend

(Qty) MP Components (Library - WD Library 7/27/00)	Geology	Backfill/Casing



(2) 0203 - MP38 End Cap

(2) 020101 - MP38 Casing 4 (1F/0.3M)

(4) 020102 - MP38 Casing 3 (2F/0.6M)

(17) 020105 - MP38 Casing 2 (5F/1.5M)

(240) 020110 - MP38 Casing 1 (10F/3M)

(16) 0238 - MP38 Packer 74mm (5F/1.5M)

(257) 0202 - MP38 Regular Coupling

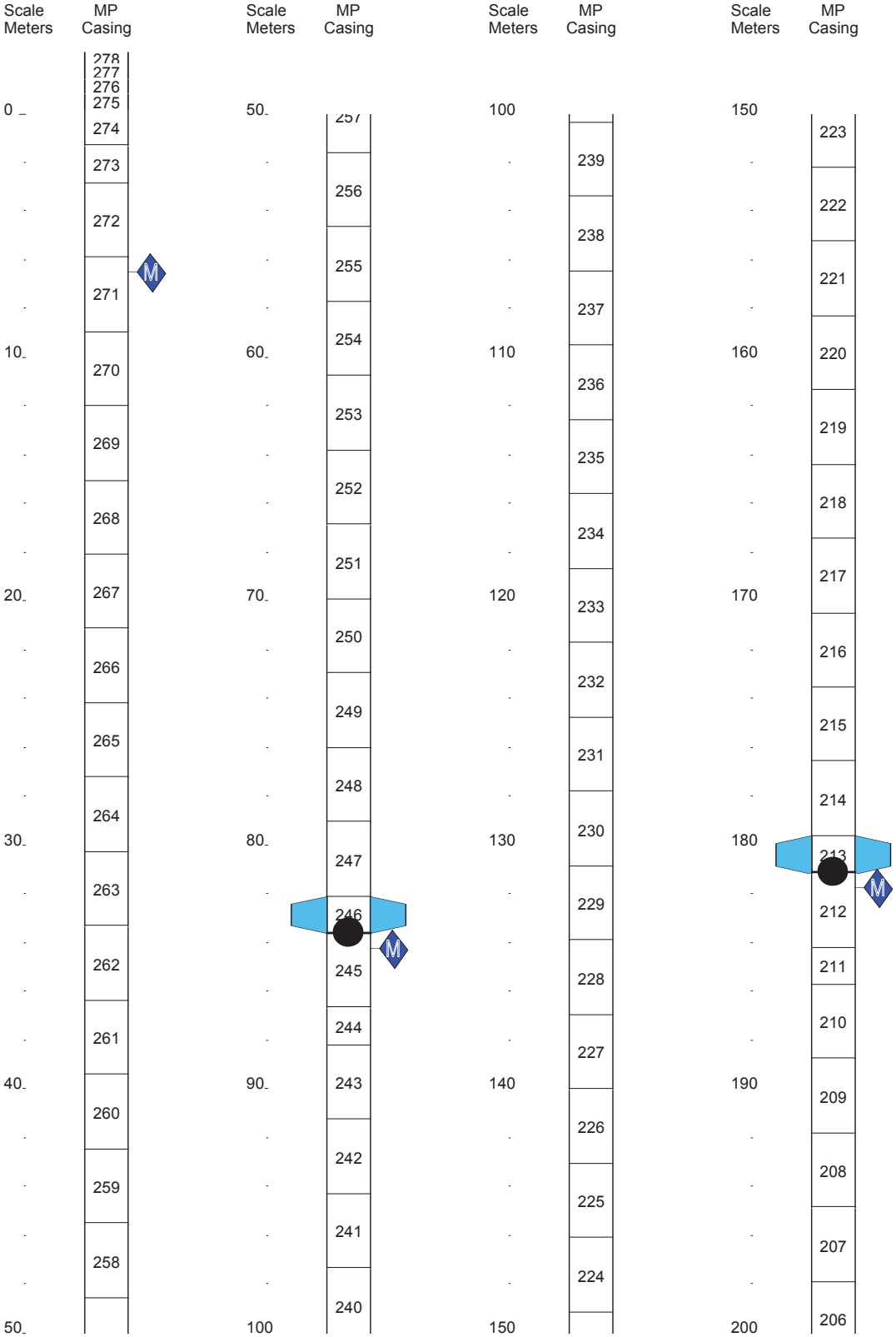
(16) 0205 - MP38 Measurment Port

(6) 0206 - MP38 Hydraulic Pumping Port

(11) 0216 - Magnetic Location Collar

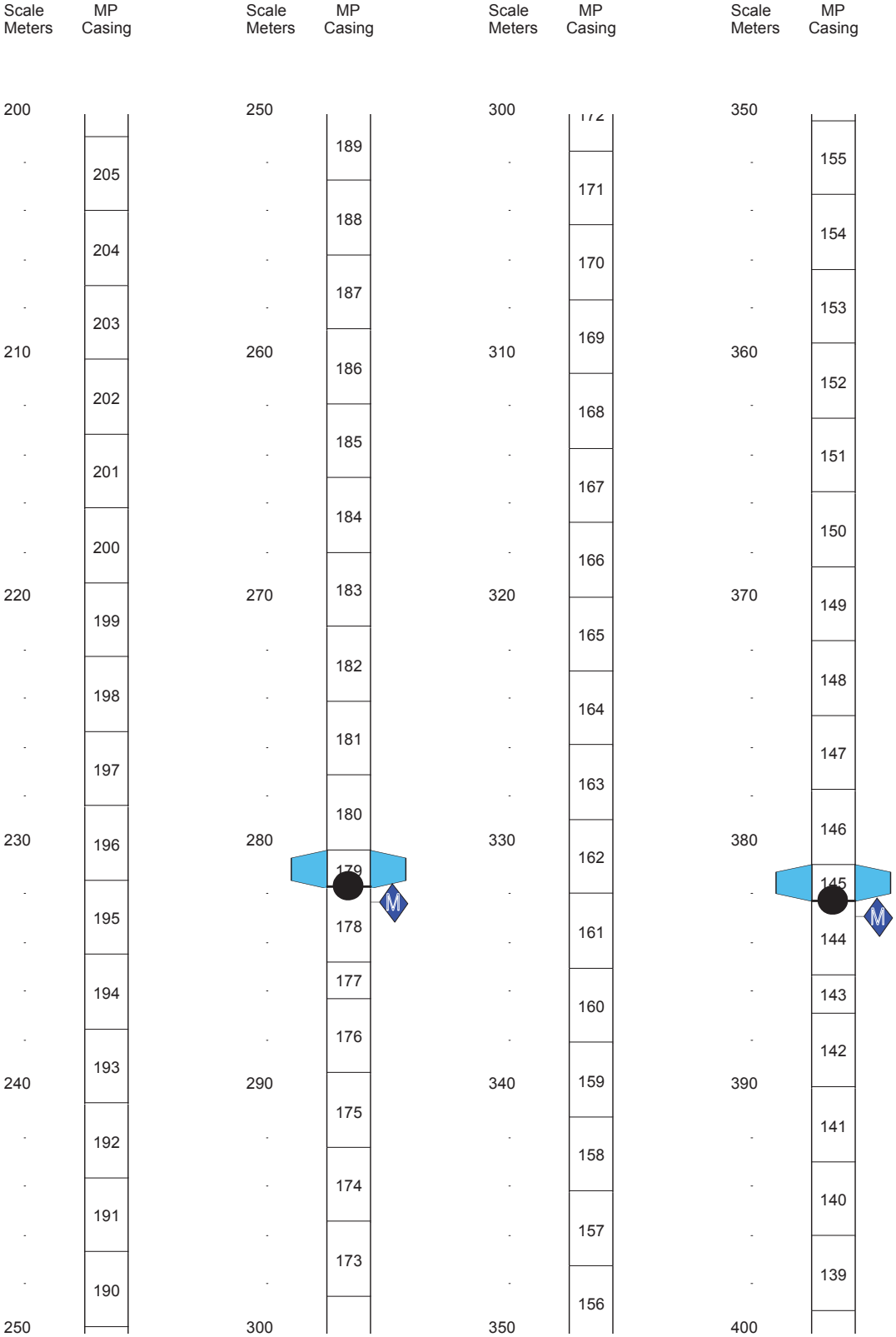
Summary Casing Log
Rescan

Job No: WB927
Well: 13-GSE-319



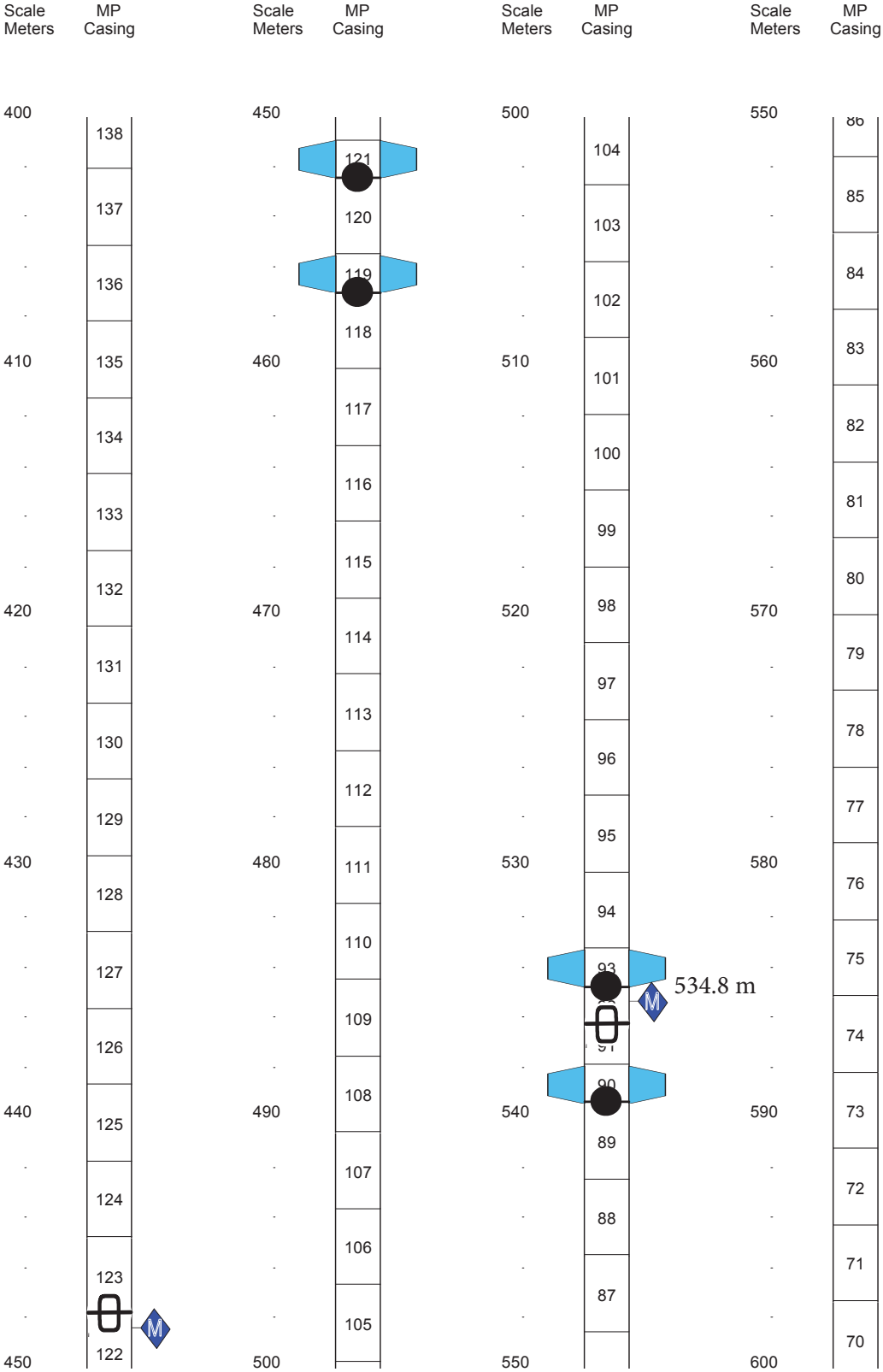
Summary Casing Log
Rescan

Job No: WB927
Well: 13-GSE-319



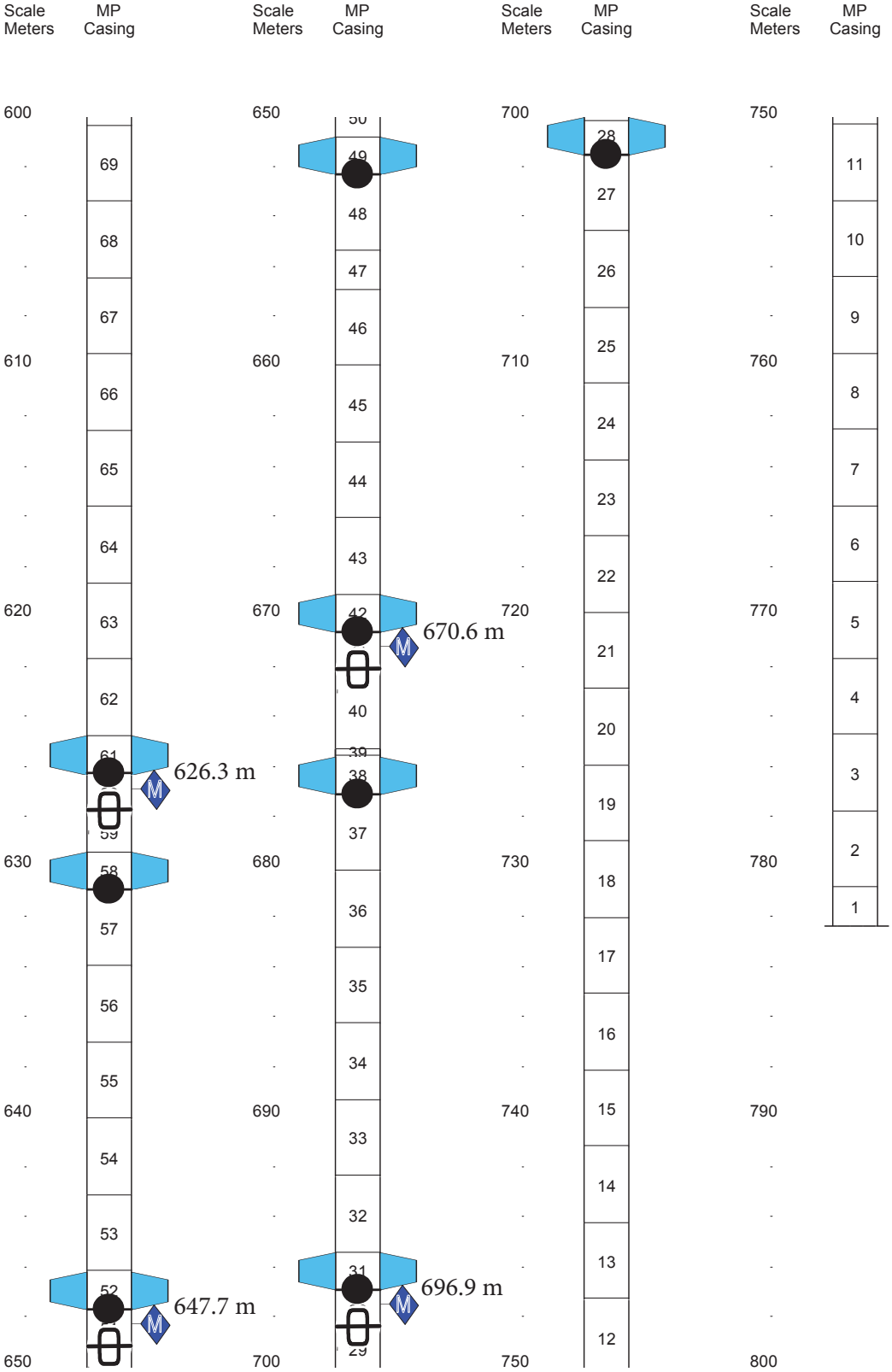
Summary Casing Log
Rescan

Job No: WB927
Well: 13-GSE-319



Summary Casing Log
Rescan

Job No: WB927
Well: 13-GSE-319



Post Inflation Profile

Schlumberger Water Services

Westbay Piezometric Pressures/Levels

Field Data and Calculation Sheet

Well No.: 13-GSE-319
Datum: Top of 4-in casing
Elev. G.S.: Ø
Height of Westbay above ~~G.S.~~ Zero: ≈ 41 in
Elev. top of Westbay Casing: Ø
Reference Elevation: Ø
Borehole angle: ≈ 77 Deg

Probe Type: Sampler o/c
Serial No.: EMS 4629
Probe Range: 2000 psi
Westbay Casing Type: MP38
Sampler Valve Position: Closed

Not adjust For borehole deviation.

Date: May 31/13
Client: RESCAN
Job No.: WB927
Location: Goose Lake
Weather: Warm - Clear
Operator: TG/RM/ML/DO

Note: "Port position" in angled boreholes refer to position along drillhole. True depth (Dp) needs to be calculated using borehole angle and deviation data to calculate zone piezometric level (Dz).

P_{atm} 14.20 psi

Ambient Reading (P_{atm}) (pressure, temperature, time)

	Start	Finish
Pressure	14.20	14.28
Temp	20.74°C	~1.40°C
Time	16:51	18:43

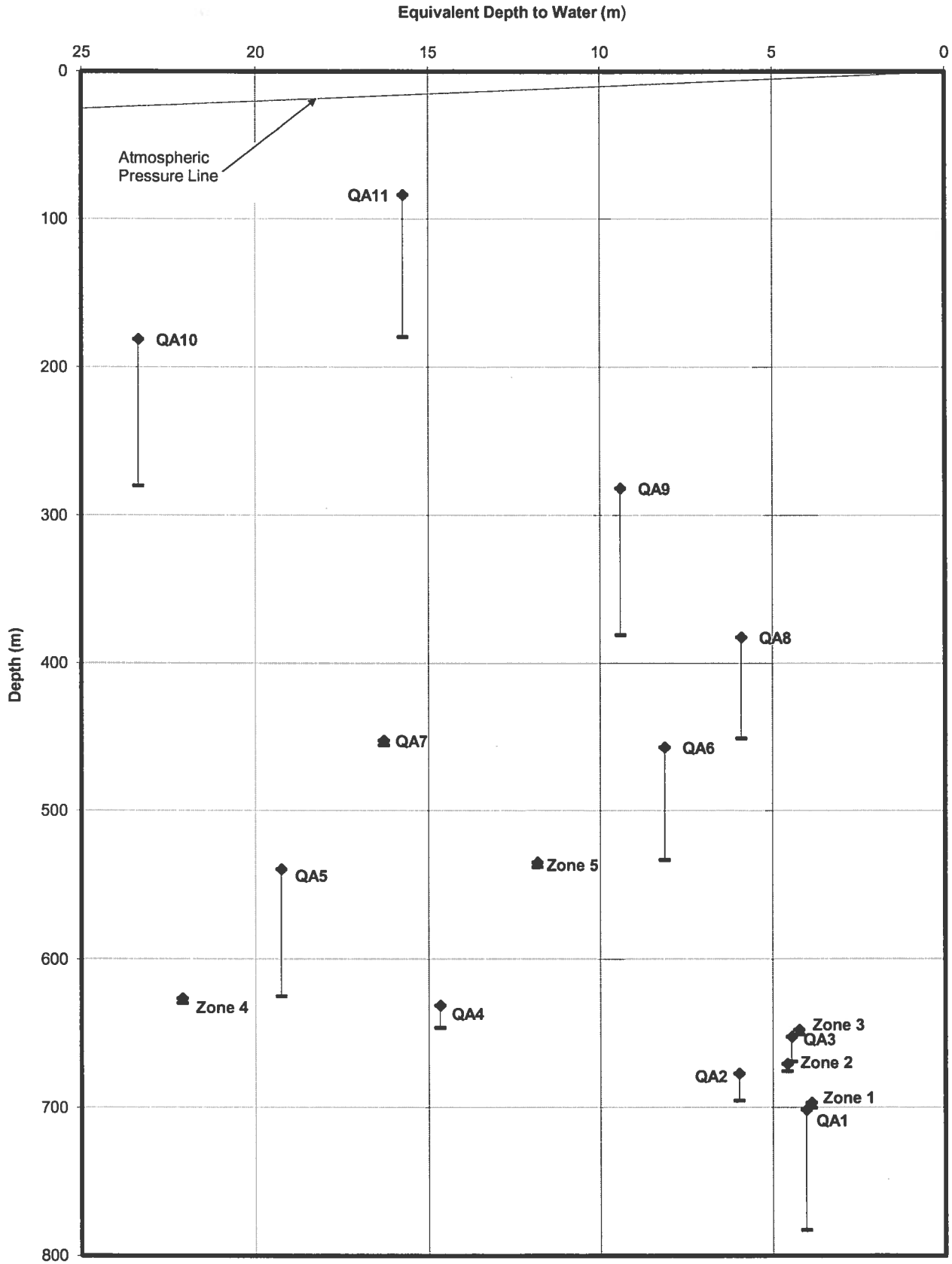
Port No.	Port Position From Log (ft/m)	Port Position From Cable (ft/m)	True Port Depth "Dp" (ft/m)	Fluid Pressure Readings: Inside Casing (P1)	Outside Casing (P2)	Time H:M:S	Probe Temp. (°C)	Inside Casing (P1)	Pressure Head Outside Port (ft/m) H = (P2-Patm)/w	Piez. Level Outside Port (ft/m) Dz = Dp - H	ZONE	Comments: counter offset	Comments: collar
1	701.57	696.7	-	981.70	1006.10	17:26	2.37	981.70	697.54	+4.03	QA1	4.87	692.5-m loop
2	696.92	692.4	-	974.80	999.70	17:31	2.70	974.84	693.0	3.9	Zone1		
3	677.11	672.4	-	946.05	968.55	17:35	2.68	946.04	671.1	6.0	QA2		
4	670.64	666.1	-	936.72	961.33	17:39	2.60	936.71	666.1	4.6	Zone2	4.54	
5	652.35	647.9	-	910.27	935.50	17:43	2.46	910.20	647.9	4.5	QA3		
6	647.70	643.3	-	903.61	929.20	17:48	2.36	903.59	643.5	4.2	Zone3	9.40	
7	630.94	626.6	-	879.27	890.53	17:51	2.25	879.31	616.3	14.7	QA4		
8	626.29	621.9	-	872.66	873.34	17:55	2.12	872.61	604.2	22.1	Zone4		
9	539.43	535.2	-	748.09	753.86	18:03	1.25	748.08	520.2	19.3	QA5		
10	534.78	530.7	-	741.49	757.83	18:06	1.09	741.47	522.9	11.8	Zone5		
11	457.06	453.2	-	630.24	652.57	18:15	0.15	630.22	448.9	8.1	QA6		
12	452.49	448.7	-	623.70	634.46	18:19	0.01	623.73	436.2	16.3	QA7		
13	382.31	378.8	-	523.32	549.45	18:22	-0.44	523.32	376.4	5.9	QA8		
14	281.73	278.9	-	379.10	401.44	18:29	-1.34	379.17	272.3	9.4	QA9		
15	181.15	178.8	-	233.94	238.57	18:34	-2.18	233.92	157.8	23.4	QA10		
	(P1)	(P2)		Time	Temp	(P1)							
16	83.62	81.9	-	92.82	110.73	18:38	-2.38	92.82	67.9	15.7	QA11		

Notes: w = 0.4335 psi/ft (1.422psi/m) of H_2O Dz = piezometric level in zone Patm = atmospheric pressure H = pressure head of water in zone Dp = true depth of measurement port

Piezometric Profile
Monitoring Well: 13-GSE-319

Not adjusted for borehole deviation.
Not adjusted for borehole water salinity.

Profile Date: May 31, 2013
Comments: Post-Inflation Profile



Client: Rescan
Site: Back River
Datum: 4-in surface casing

Figure 1

Plot By: ML Date: 6/6/13
Checked By: DL Date: Jun 7/2013
Westbay Project: WB927

Casing Installation Log

Company: Rescan
Well: 13-GSE-319
Site: Sabina
Project: Back River Project

Job No: WB927
Author: ML

Well Information

Reference Datum: Top of surface casing
Elevation of Datum: 0.00 m.
MP Casing Top: 0.00 m.
MP Casing Length: ~~777.82~~ 782.4 m, ML

Borehole Depth: 778.00 m. 782.6 m. ML
Borehole Inclination: 77 Degrees
Borehole Diameter: 96.00 mm

Well Description:
MP38
Other References:

File Information

File Name: WB-13D2.WWD
Report Date: Sat May 25 18:37:39 2013

File Date: May 25 18:36:05 2013

Comments

Zero reference is top of surface casing - ZS
Filter socks not to be used - ZS

Log Information

Borehole condition confirmed.	(method)_____	Date: _____
MP well design & preparation.	By: ML	Date: May 25/13
MP well design checked.	By: ML ZS	Date: May 27/13
MP well and borehole approved to install.	By: [signature]	Date: May 27/13

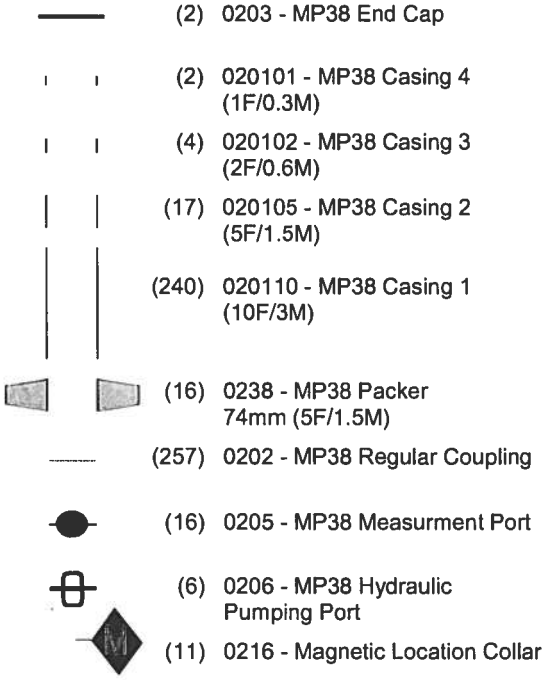
Zones lowered 0.6 m from original to offset core barrel.
ZS May 27/13

Legend

(Qty) MP Components (Library - WD Library 7/27/00)

Geology

Backfill/Casing



(2) 0203 - MP38 End Cap

(2) 020101 - MP38 Casing 4 (1F/0.3M)

(4) 020102 - MP38 Casing 3 (2F/0.6M)

(17) 020105 - MP38 Casing 2 (5F/1.5M)

(240) 020110 - MP38 Casing 1 (10F/3M)

(16) 0238 - MP38 Packer 74mm (5F/1.5M)

(257) 0202 - MP38 Regular Coupling

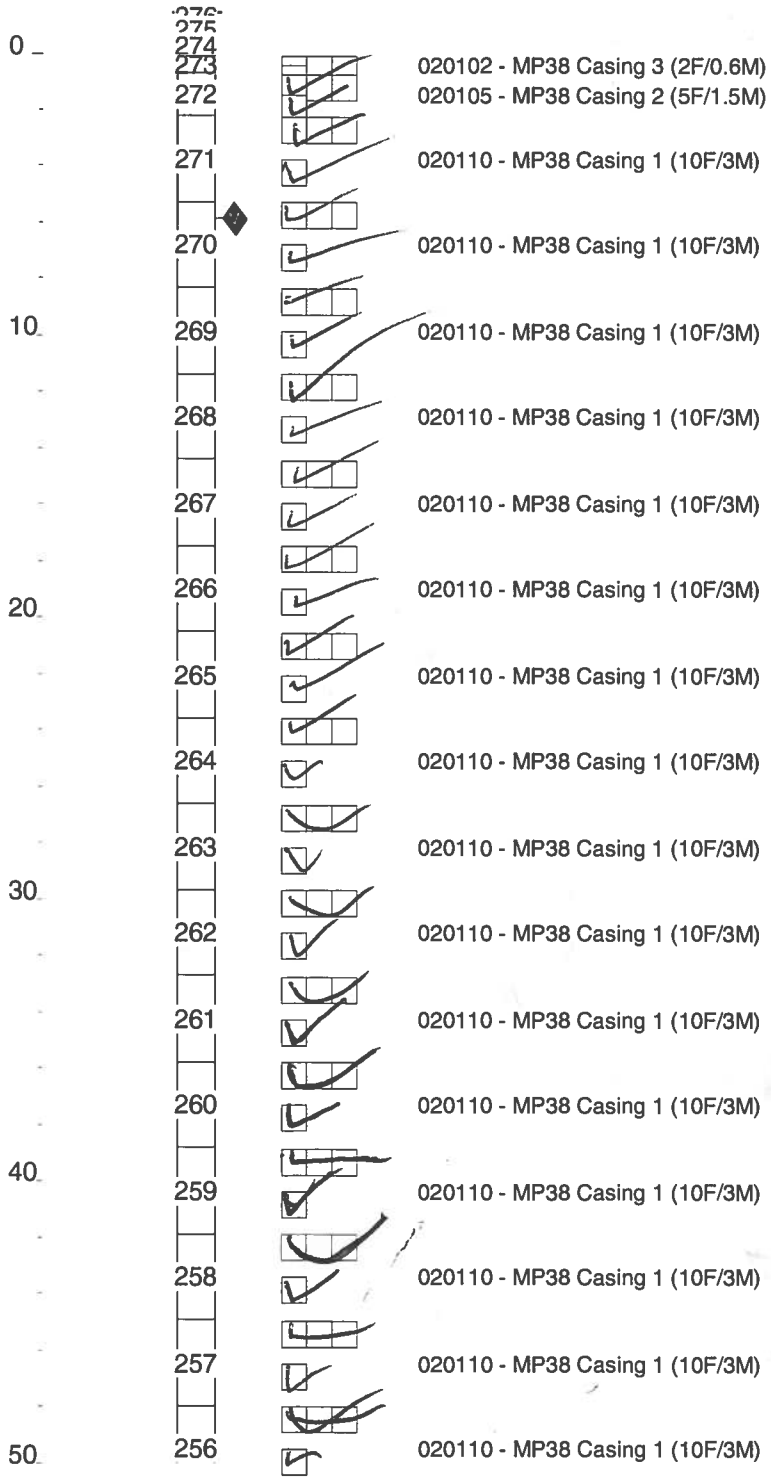
(16) 0205 - MP38 Measurment Port

(6) 0206 - MP38 Hydraulic Pumping Port

(11) 0216 - Magnetic Location Collar

Casing Installation Log
Rescan

Job No: WB927
Well: 13-GSE-319



Finish lowering Westbay Casing at 5:10 pm on May 28, 2013.

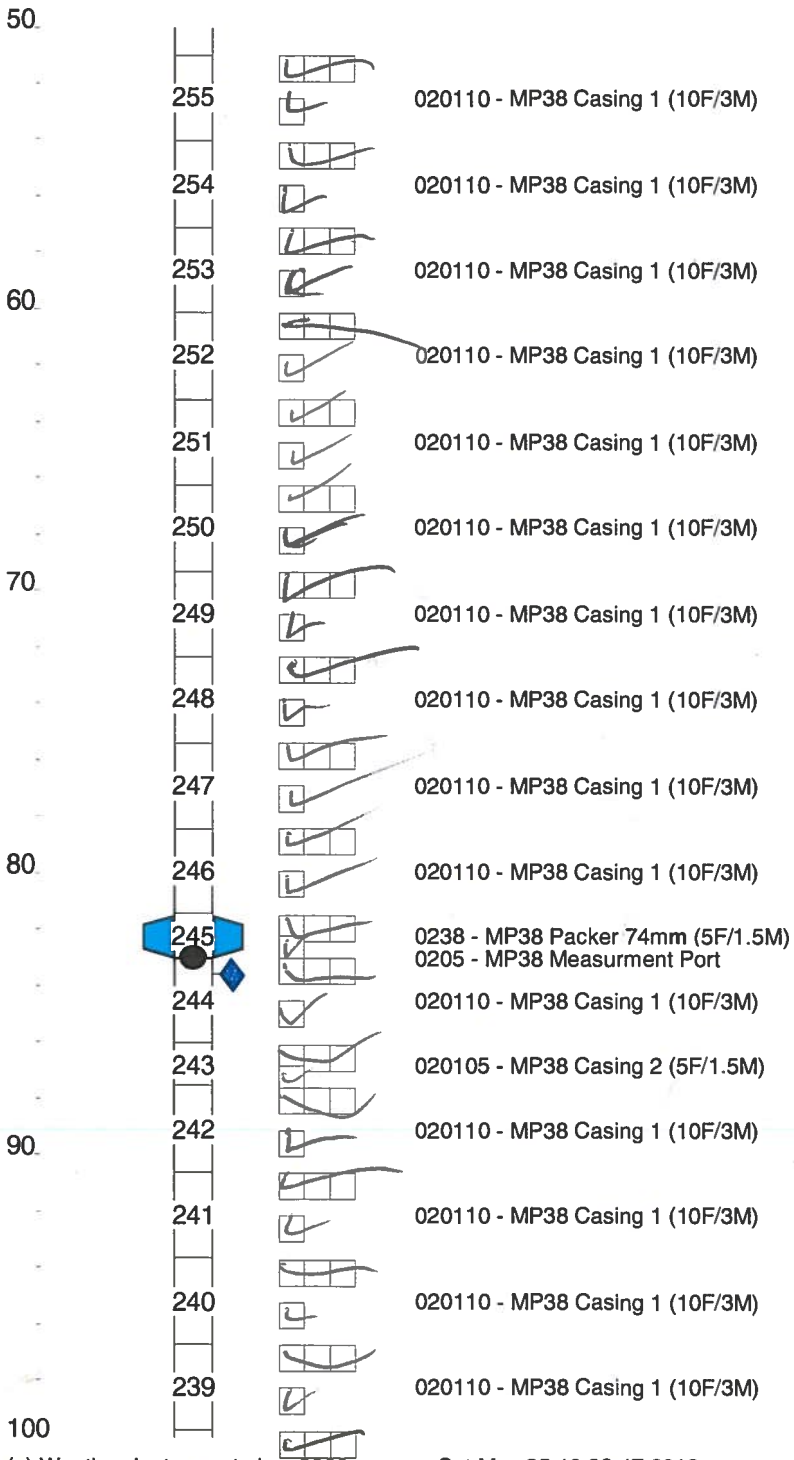
Westbay Casing about 200. lbs. + 20. L glycol/water mixture added to Westbay Casing before inflating packers.

(c) Westbay Instruments Inc. 2000

Sat May 25 18:38:47 2013

Casing Installation Log
Rescan

Job No: WB927
Well: 13-GSE-319



18314/145 ps:
7655

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Sat May 25 18:38:47 2013

Casing Installation Log
Rescan

Job No: WB927
Well: 13-GSE-319

Scale Meters	Westbay Casing	QA Tested OK	MP Casing Description	Serial Numbers
100				
	238	☑	020110 - MP38 Casing 1 (10F/3M)	
	237	☑	020110 - MP38 Casing 1 (10F/3M)	
	236	☑	020110 - MP38 Casing 1 (10F/3M)	
110	235	☑	020110 - MP38 Casing 1 (10F/3M)	
	234	☑	020110 - MP38 Casing 1 (10F/3M)	
	233	☑	020110 - MP38 Casing 1 (10F/3M)	
120	232	☑	020110 - MP38 Casing 1 (10F/3M)	
	231	☑	020110 - MP38 Casing 1 (10F/3M)	
	230	☑	020110 - MP38 Casing 1 (10F/3M)	
130	229	☑	020110 - MP38 Casing 1 (10F/3M)	
	228	☑	020110 - MP38 Casing 1 (10F/3M)	
	227	☑	020110 - MP38 Casing 1 (10F/3M)	
	226	☑	020110 - MP38 Casing 1 (10F/3M)	
140	225	☑	020110 - MP38 Casing 1 (10F/3M)	
	224	☑	020110 - MP38 Casing 1 (10F/3M)	
	223	☑	020110 - MP38 Casing 1 (10F/3M)	
150				

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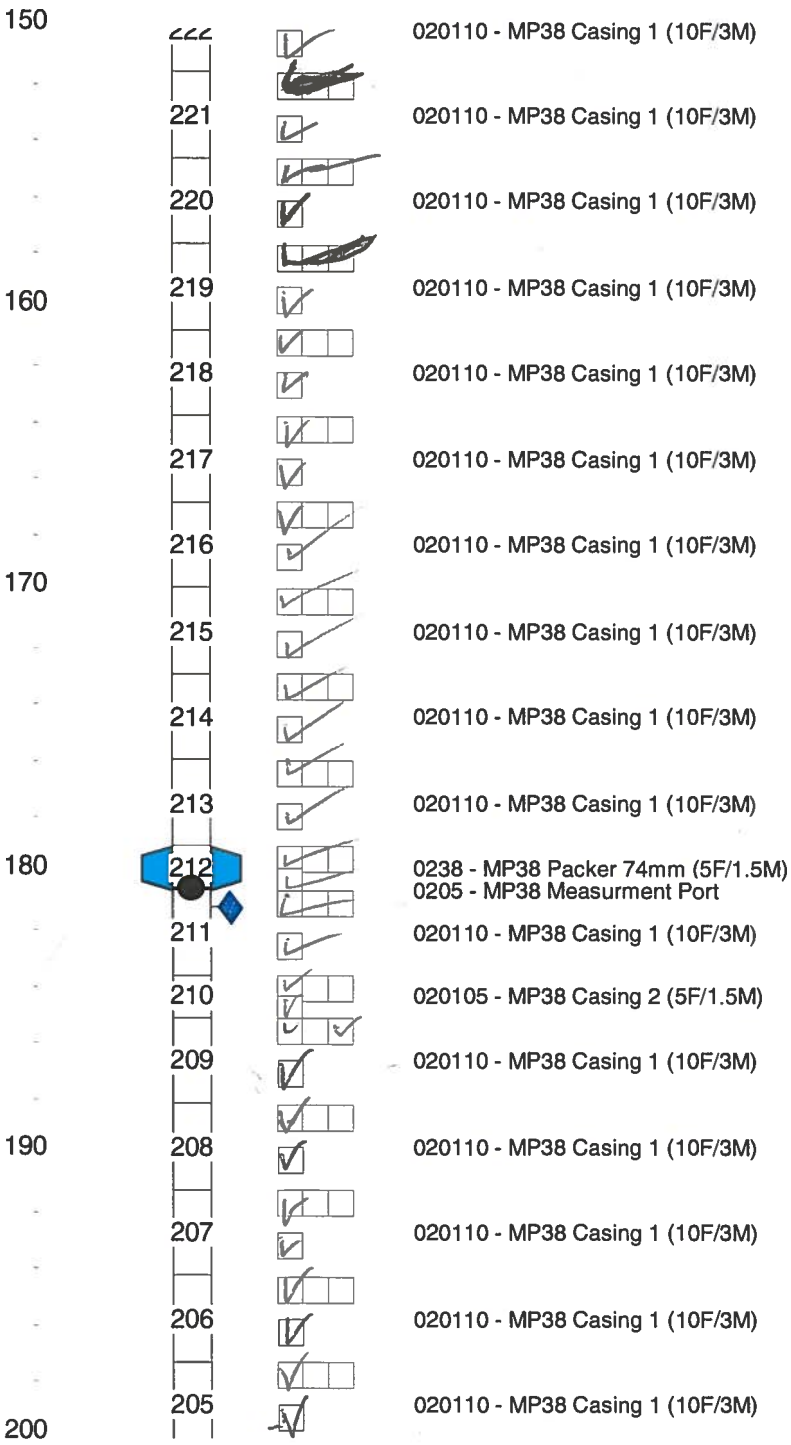
Casing Installation Log
Rescan

Job No: WB927
Well: 13-GSE-319



18313/140 ps:
7649

(c) Westbay Instruments Inc. 2000

Sat May 25 18:38:47 2013

Casing Installation Log
Rescan

Job No: WB927
Well: 13-GSE-319

Scale Meters	Westbay Casing	QA Tested OK	MP Casing Description	Serial Numbers
200				
	204		020110 - MP38 Casing 1 (10F/3M)	
	203		020110 - MP38 Casing 1 (10F/3M)	
	202		020110 - MP38 Casing 1 (10F/3M)	
210	201		020110 - MP38 Casing 1 (10F/3M)	
	200		020110 - MP38 Casing 1 (10F/3M)	
	199		020110 - MP38 Casing 1 (10F/3M)	
220	198		020110 - MP38 Casing 1 (10F/3M)	
	197		020110 - MP38 Casing 1 (10F/3M)	WBWL 40m
	196		020110 - MP38 Casing 1 (10F/3M)	
230	195		020110 - MP38 Casing 1 (10F/3M)	
	194		020110 - MP38 Casing 1 (10F/3M)	
	193		020110 - MP38 Casing 1 (10F/3M)	
	192		020110 - MP38 Casing 1 (10F/3M)	
240	191		020110 - MP38 Casing 1 (10F/3M)	
	190		020110 - MP38 Casing 1 (10F/3M)	
	189		020110 - MP38 Casing 1 (10F/3M)	
250				

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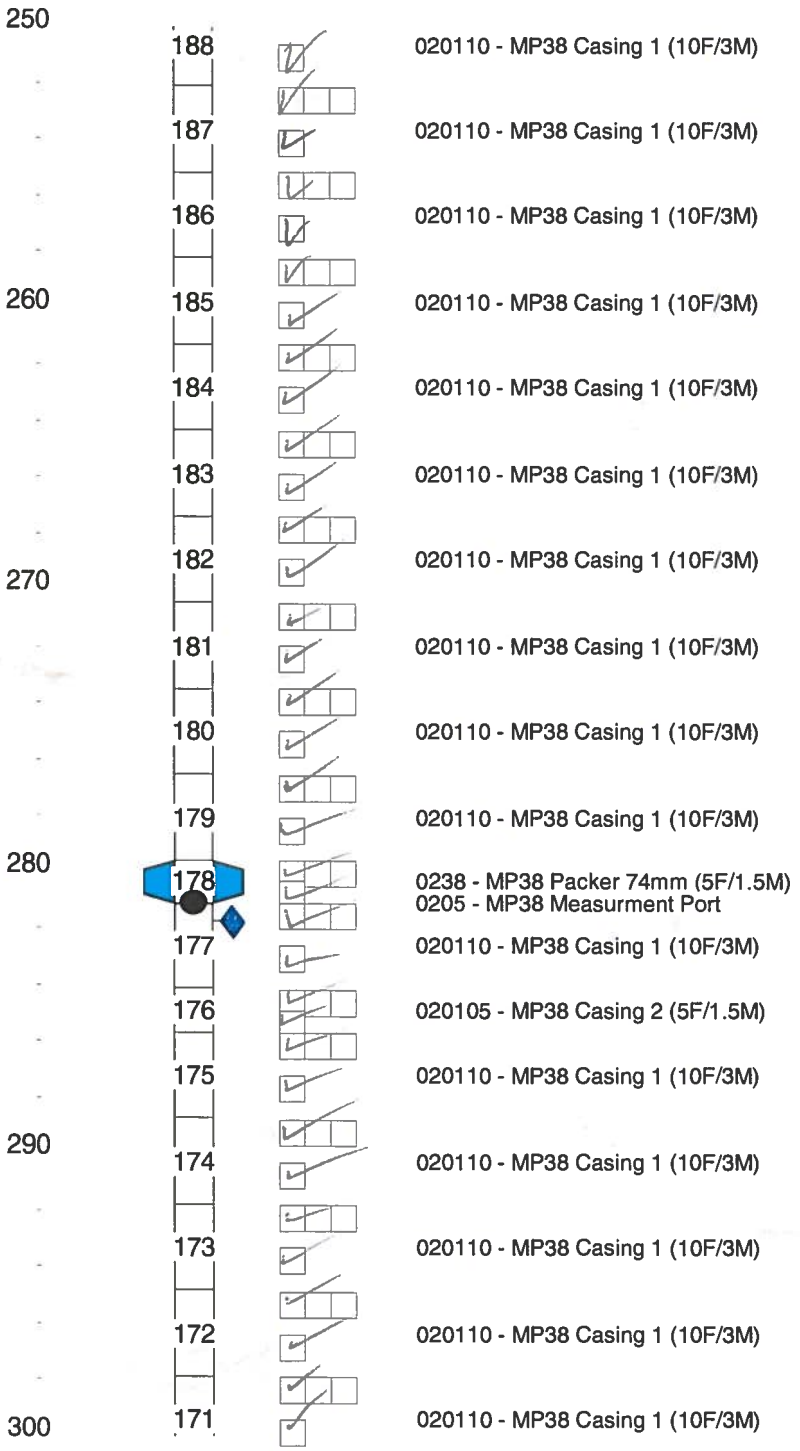
Casing Installation Log
Rescan

Job No: WB927
Well: 13-GSE-319



18312/140 ps:
7630

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Sat May 25 18:39:02 2013

Casing Installation Log
Rescan

Job No: WB927
Well: 13-GSE-319

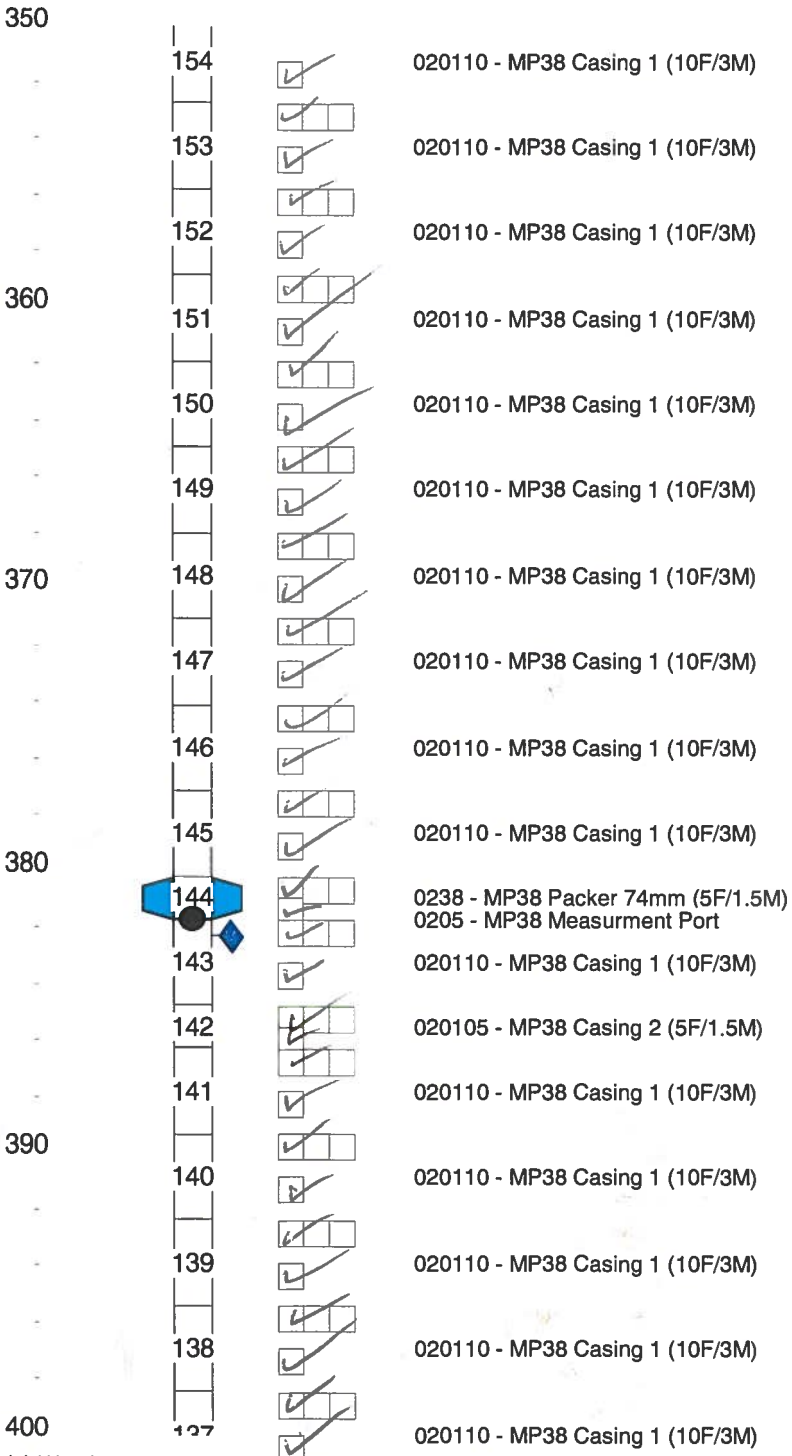
Scale Meters	Westbay Casing	QA Tested OK	MP Casing Description	Serial Numbers
300				
	170		020110 - MP38 Casing 1 (10F/3M)	
	169		020110 - MP38 Casing 1 (10F/3M)	
	168		020110 - MP38 Casing 1 (10F/3M)	
310	167		020110 - MP38 Casing 1 (10F/3M)	
	166		020110 - MP38 Casing 1 (10F/3M)	
	165		020110 - MP38 Casing 1 (10F/3M)	
320	164		020110 - MP38 Casing 1 (10F/3M)	
	163		020110 - MP38 Casing 1 (10F/3M)	
	162		020110 - MP38 Casing 1 (10F/3M)	
330	161		020110 - MP38 Casing 1 (10F/3M)	
	160		020110 - MP38 Casing 1 (10F/3M)	
	159		020110 - MP38 Casing 1 (10F/3M)	
340	158		020110 - MP38 Casing 1 (10F/3M)	
	157		020110 - MP38 Casing 1 (10F/3M)	
	156		020110 - MP38 Casing 1 (10F/3M)	
	155		020110 - MP38 Casing 1 (10F/3M)	
350				

(c) Westbay Instruments Inc. 2000

Sat May 25 18:39:02 2013

Casing Installation Log
Rescan

Job No: WB927
Well: 13-GSE-319



1831 | 145 psi
7653

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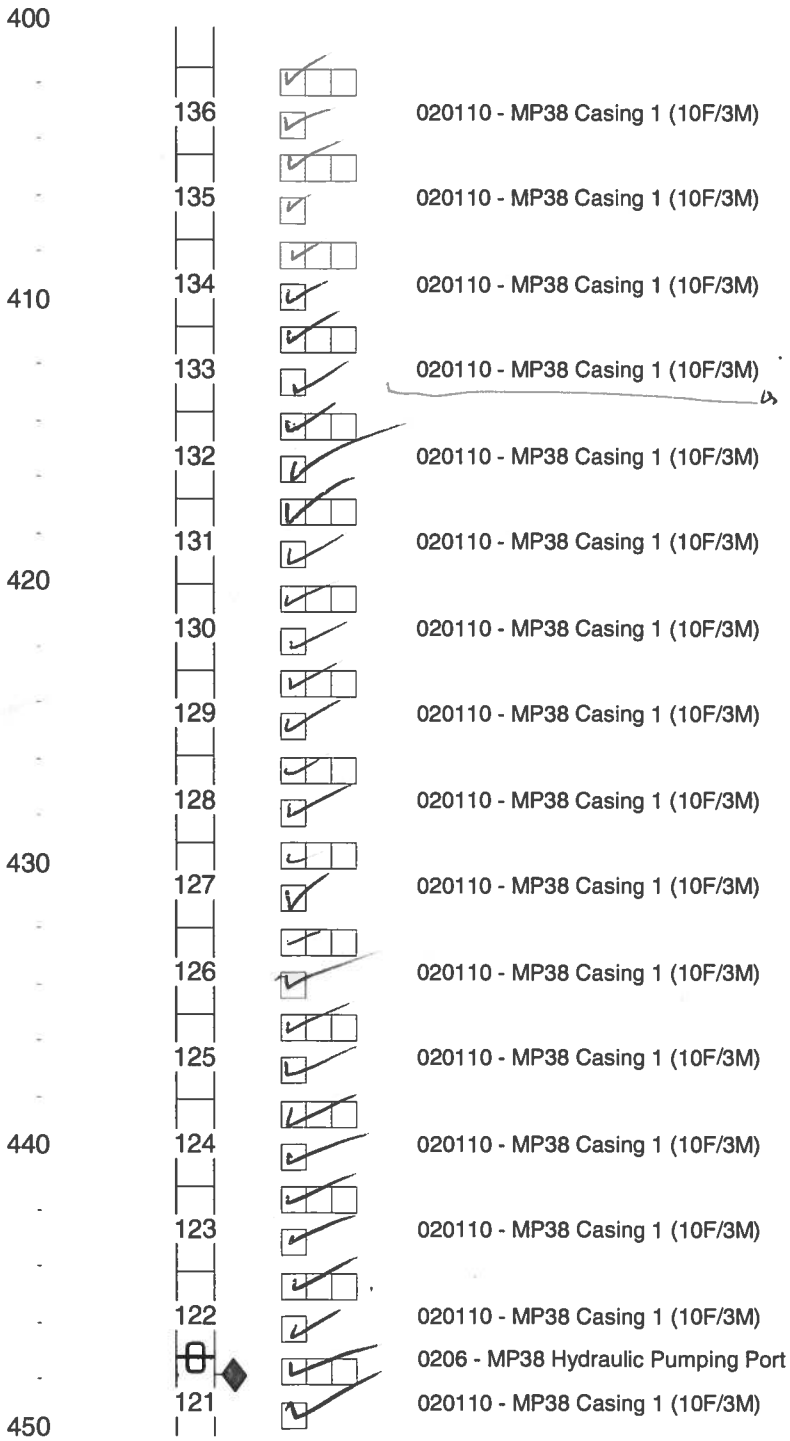
Sat May 25 18:39:02 2013

Casing Installation Log
Rescan

Job No: WB927
Well: 13-GSE-319



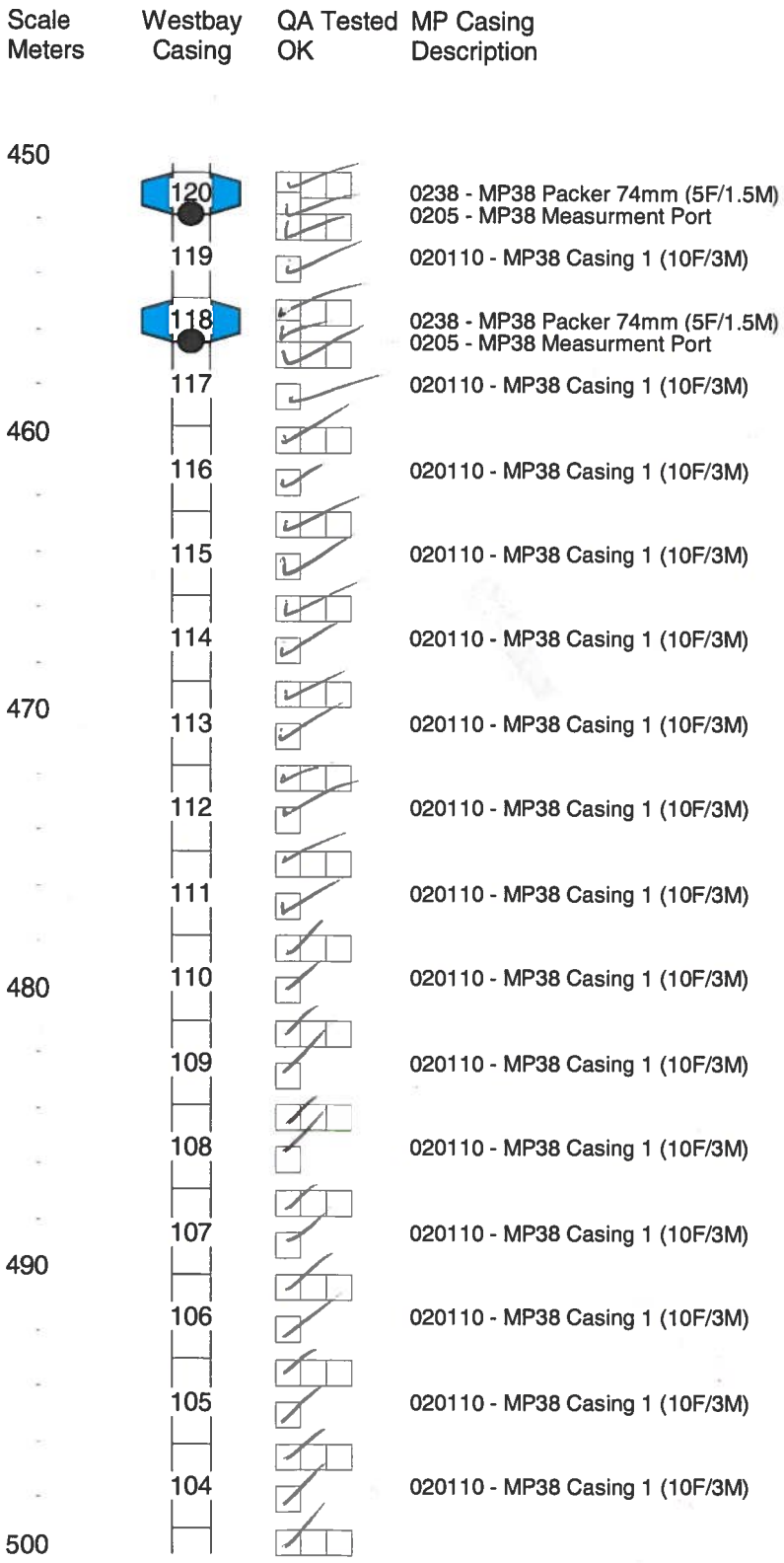
changed

10-ft casing exchanged due to deep scratches on face surface.

306

Casing Installation Log
Rescan

Job No: WB927
Well: 13-GSE-319



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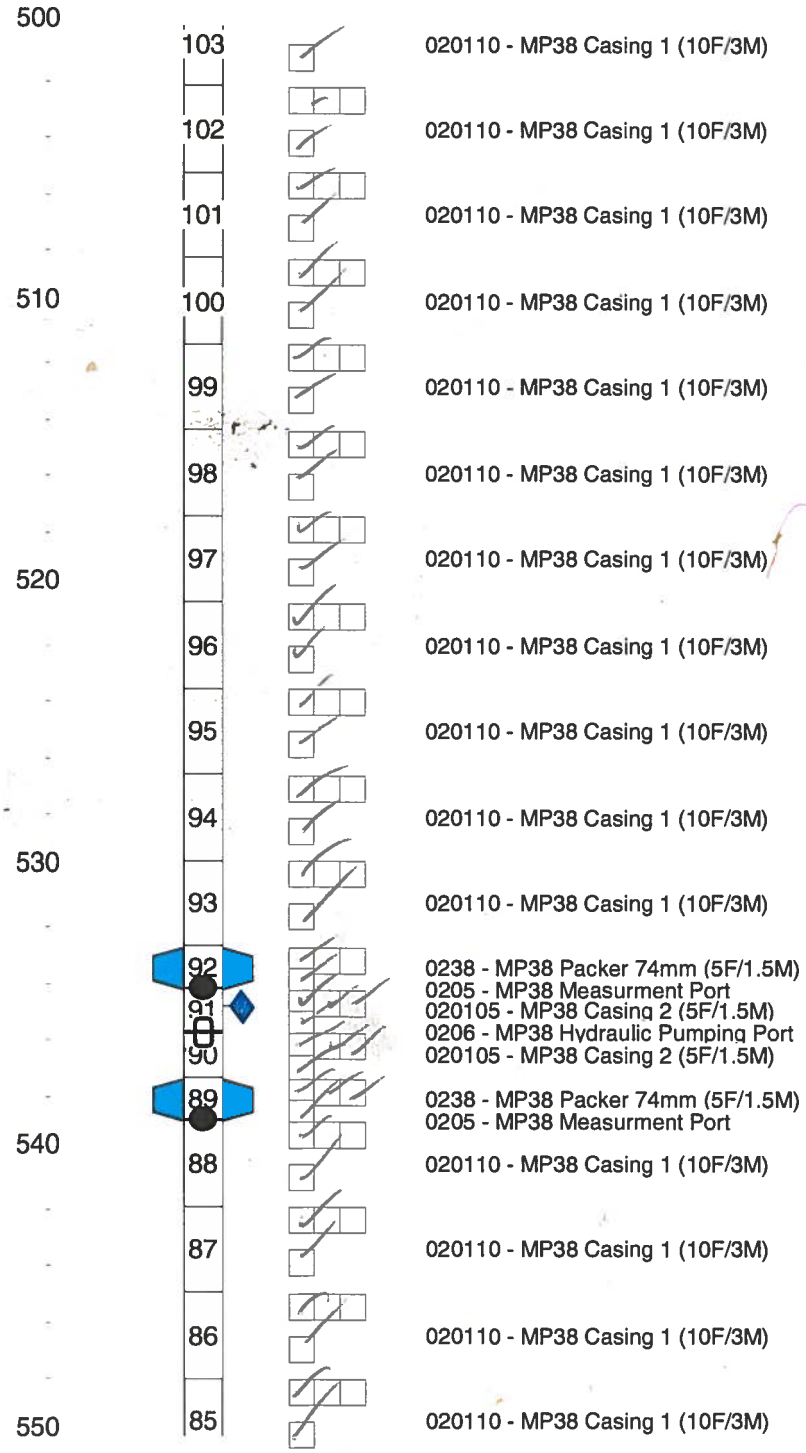
Sat May 25 18:39:19 2013

Casing Installation Log
Rescan

Job No: WB927
Well: 13-GSE-319



18287/145 ps: 7657 301

18288/145 ps: 7654

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Sat May 25 18:39:19 2013

Casing Installation Log
Rescan

Job No: WB927
Well: 13-GSE-319

Scale Meters	Westbay Casing	QA Tested OK	MP Casing Description	Serial Numbers
550				
	84		020110 - MP38 Casing 1 (10F/3M)	
	83		020110 - MP38 Casing 1 (10F/3M)	
	82		020110 - MP38 Casing 1 (10F/3M)	
560	81		020110 - MP38 Casing 1 (10F/3M)	
	80		020110 - MP38 Casing 1 (10F/3M)	
	79		020110 - MP38 Casing 1 (10F/3M)	
570	78		020110 - MP38 Casing 1 (10F/3M)	
	77		020110 - MP38 Casing 1 (10F/3M)	
	76		020110 - MP38 Casing 1 (10F/3M)	
580	75		020110 - MP38 Casing 1 (10F/3M)	
	74		020110 - MP38 Casing 1 (10F/3M)	
	73		020110 - MP38 Casing 1 (10F/3M)	
590	72		020110 - MP38 Casing 1 (10F/3M)	
	71		020110 - MP38 Casing 1 (10F/3M)	
	70		020110 - MP38 Casing 1 (10F/3M)	12/12
	69		020110 - MP38 Casing 1 (10F/3M)	
600				

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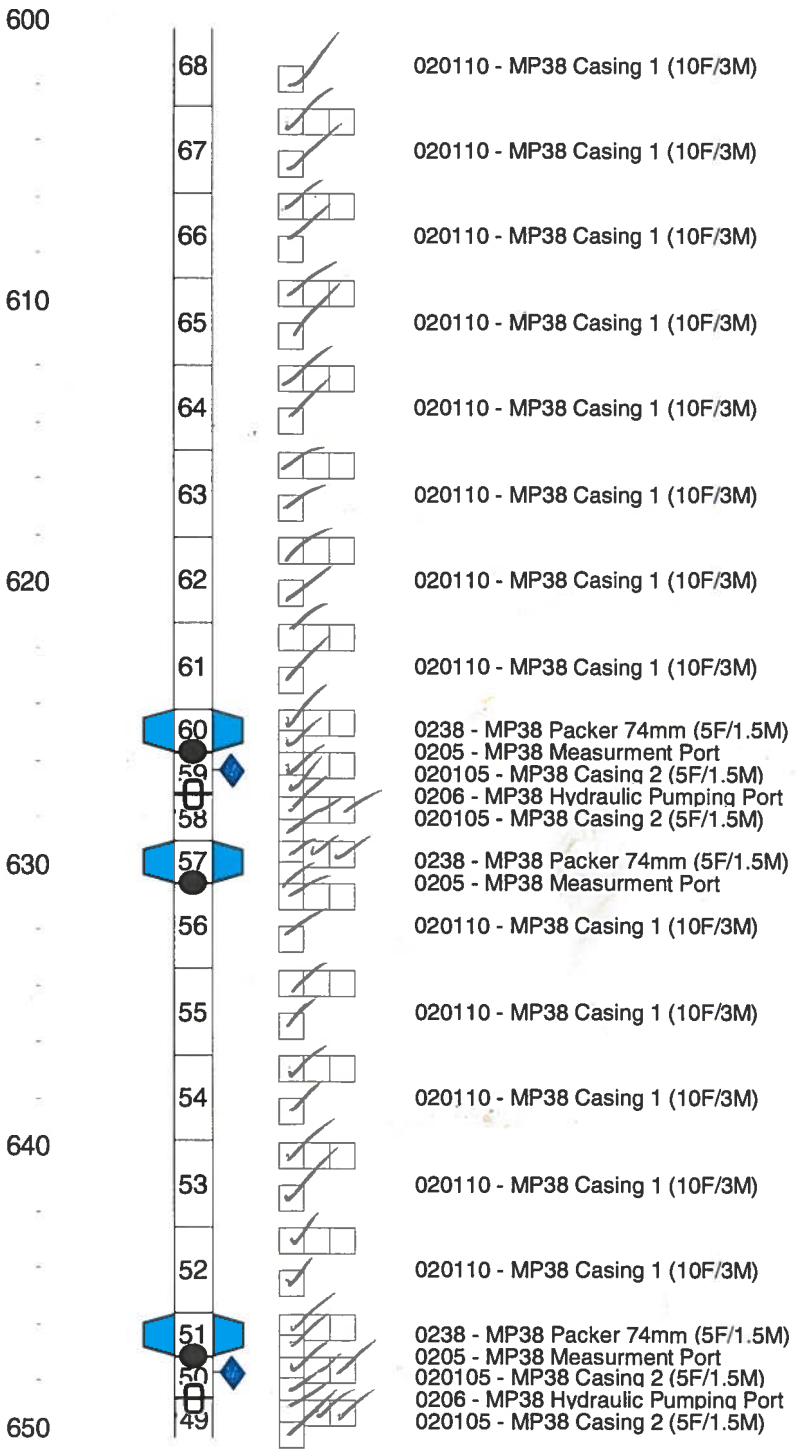
Sat May 25 18:39:19 2013

Casing Installation Log
Rescan

Job No: WB927
Well: 13-GSE-319



Serial Numbers

11.57

18285/145 ps:
7659
302

18286/145 ps:
7651

Add

10.43

18295/145 ps:
7660
~~7642~~
303

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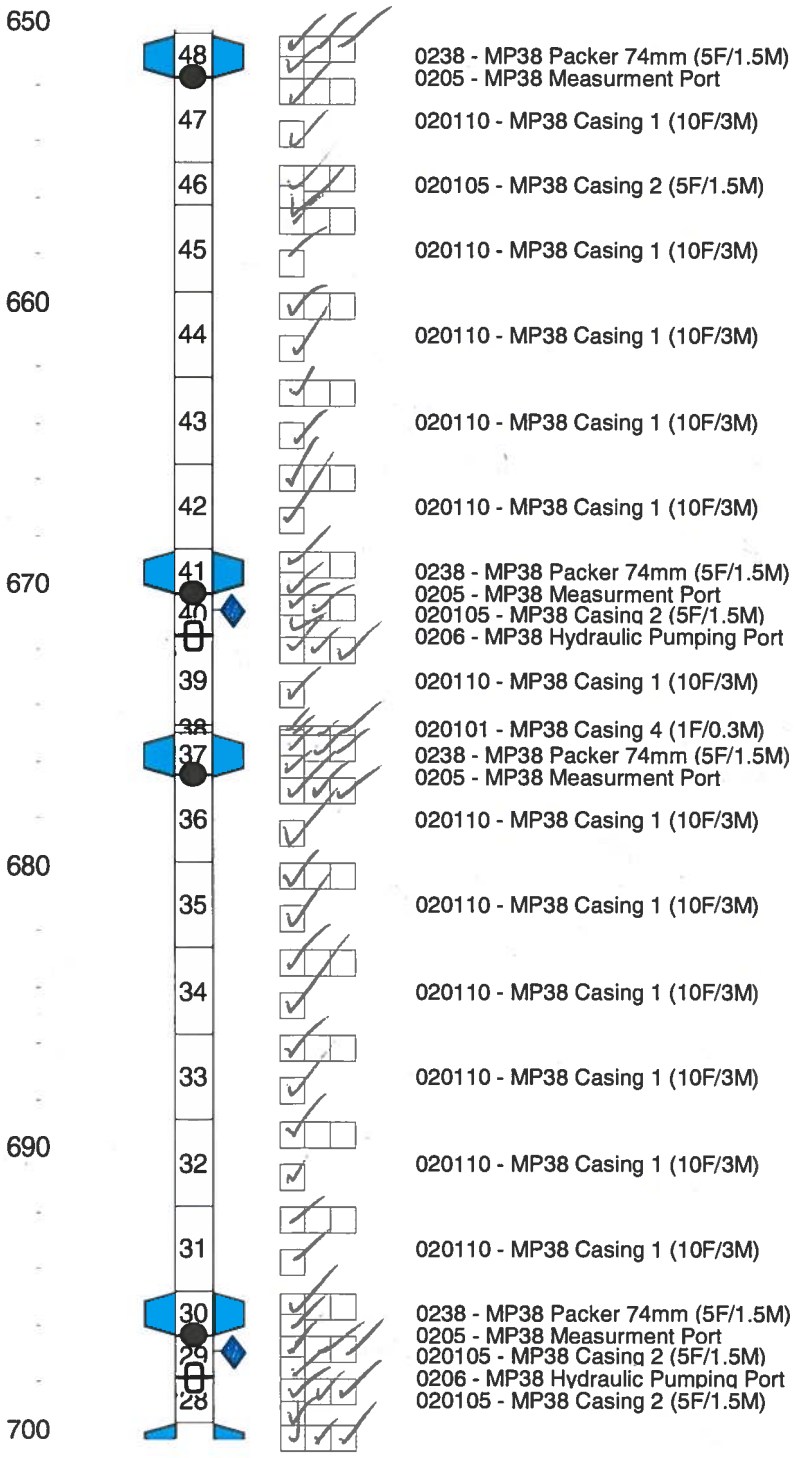
Sat May 25 18:39:33 2013

Casing Installation Log
Rescan

Job No: WB927
Well: 13-GSE-319



Serial Numbers

18294/145 psi
7652
Add

18292/150 psi
7656
Add 305

18293/145 psi
7650

Add

9:55 18291/145 psi
7658
Add
304

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Sat May 25 18:39:33 2013

Casing Installation Log
Rescan

Job No: WB927
Well: 13-GSE-319

Scale Meters	Westbay Casing	QA Tested OK	MP Casing Description	Serial Numbers
700		✓	0238 - MP38 Packer 74mm (5F/1.5M) 0205 - MP38 Measurment Port	18300/150 psi 7629
	26	✓	020110 - MP38 Casing 1 (10F/3M)	
	25	✓	020110 - MP38 Casing 1 (10F/3M)	
	24	✓	020110 - MP38 Casing 1 (10F/3M)	
710	23	✓	020110 - MP38 Casing 1 (10F/3M)	Add glycol/water
	22	✓	020110 - MP38 Casing 1 (10F/3M)	
	21	✓	020110 - MP38 Casing 1 (10F/3M)	
720	20	✓	020110 - MP38 Casing 1 (10F/3M)	Add glycol/water
	19	✓	020110 - MP38 Casing 1 (10F/3M)	
	18	✓	020110 - MP38 Casing 1 (10F/3M)	
730	17	✓	020110 - MP38 Casing 1 (10F/3M)	
	16	✓	020110 - MP38 Casing 1 (10F/3M)	
	15	✓	020110 - MP38 Casing 1 (10F/3M)	
740	14	✓	020110 - MP38 Casing 1 (10F/3M)	Add glycol/water
	13	✓	020110 - MP38 Casing 1 (10F/3M)	
	12	✓	020110 - MP38 Casing 1 (10F/3M)	
	11	✓	020110 - MP38 Casing 1 (10F/3M)	Add glycol/water to Westbay casing
750				

(c) Westbay Instruments Inc. 2000

Sat May 25 18:39:33 2013

Casing Installation Log
Rescan

Job No: WB927
Well: 13-GSE-319

Scale Meters	Westbay Casing	QA Tested OK	MP Casing Description	Serial Numbers
750				
	12	✓	020110 - MP38 Casing 1 (10F/3M)	9.00 am
	11	✓	020110 - MP38 Casing 1 (10F/3M)	
	10	✓	020110 - MP38 Casing 1 (10F/3M)	
760	9	✓	020110 - MP38 Casing 1 (10F/3M)	
	8	✓	020110 - MP38 Casing 1 (10F/3M)	
	7	✓	020110 - MP38 Casing 1 (10F/3M)	
	6	✓	020110 - MP38 Casing 1 (10F/3M)	
770	5	✓	020110 - MP38 Casing 1 (10F/3M)	
	4	✓	020110 - MP38 Casing 1 (10F/3M)	
	3	✓	020110 - MP38 Casing 1 (10F/3M)	
	2	✓	020110 - MP38 Casing 1 (10F/3M)	
	1	✓	020110 - MP38 Casing 1 (10F/3M)	
780	19 removed	✓	020105 - MP38 Casing 2 (5F/1.5M)	Bottom 1-ft casing removed from string.
		✓	0203 - MP38 End Cap 4 (1F/0.3M)	

8:30 - start lowering casing, May 28, 2013.
Joint test tool: 230 psi.

790 Bore hole water level ≈5 m below zero before lowering Westbay casing. Guide tube in well.

800 Add: added glycol/water mixture to Westbay Casing.

Schlumberger
Water Services

Sheet 1 of 17

Westbay Packer Inflation Record

Project: Rescan | Project No.: WB927 | Well No.: 13-GSE-319

Location: Goose Lake | Completed by: ML / DO | Date Inflated: May 27/13

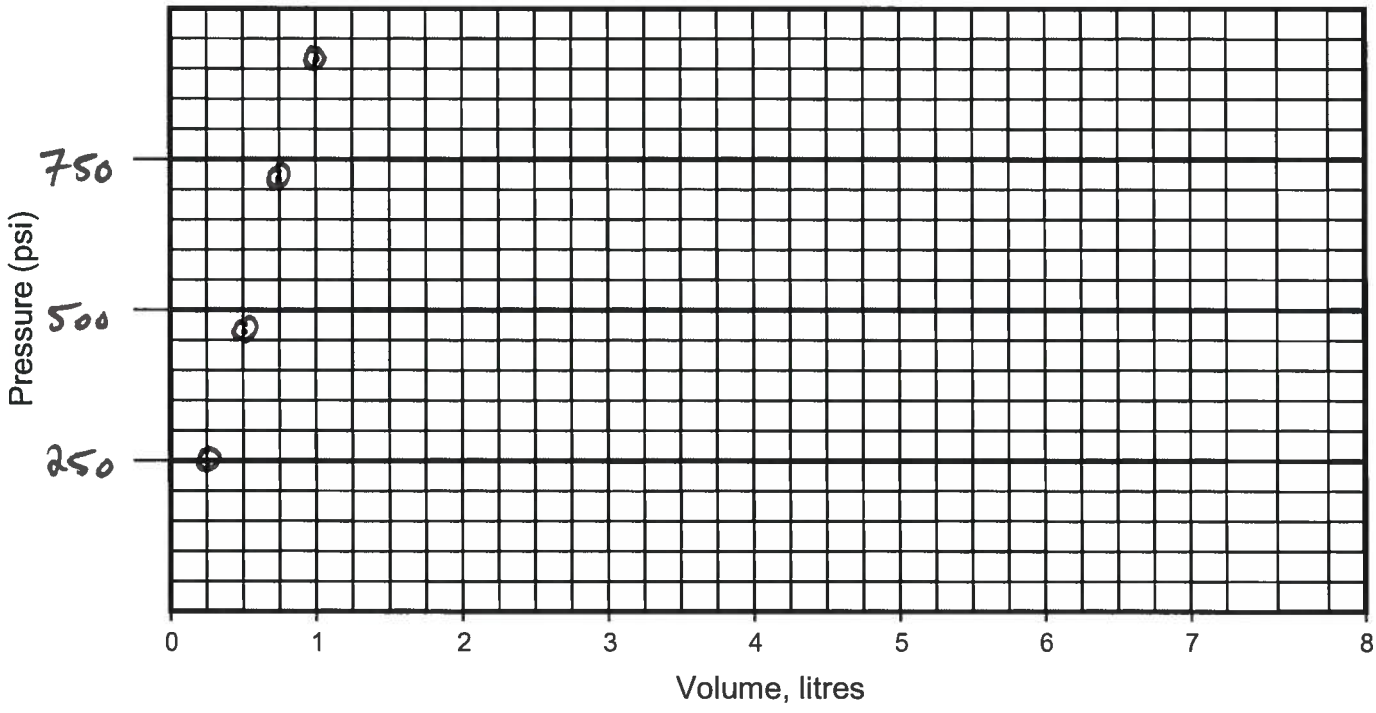
Packer No. BWT | Depth (ft / m): ~ 465 | Inflation Tool No.: TFW852

Packer Valve Pressure, P_V: n/a psi | Final Line Pressure, P_L: 910 psi | Tool Pressure, P_T: 450 psi

Borehole Water Level: 3 (ft / m) = 0 psi (P_W)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = n/a psi

Volume, litres	0.25	0.5	0.75	1.0						
Pressure, psi	250	470	720	910						
Volume, litres										
Pressure, psi										



Comments: Blank wall test | Time - 10:31 am

Schlumberger
Water Services

Westbay Packer Inflation Record

Project: Rescan | Project No.: WB927 | Well No.: 13-GSE-319

Location: Goose Lake | Completed by: ML/DO | Date Inflated: May 30/13

Packer No. 1, comp. #27 | Depth (~~ft~~/ m): 700.0 | Inflation Tool No.: TIW 852

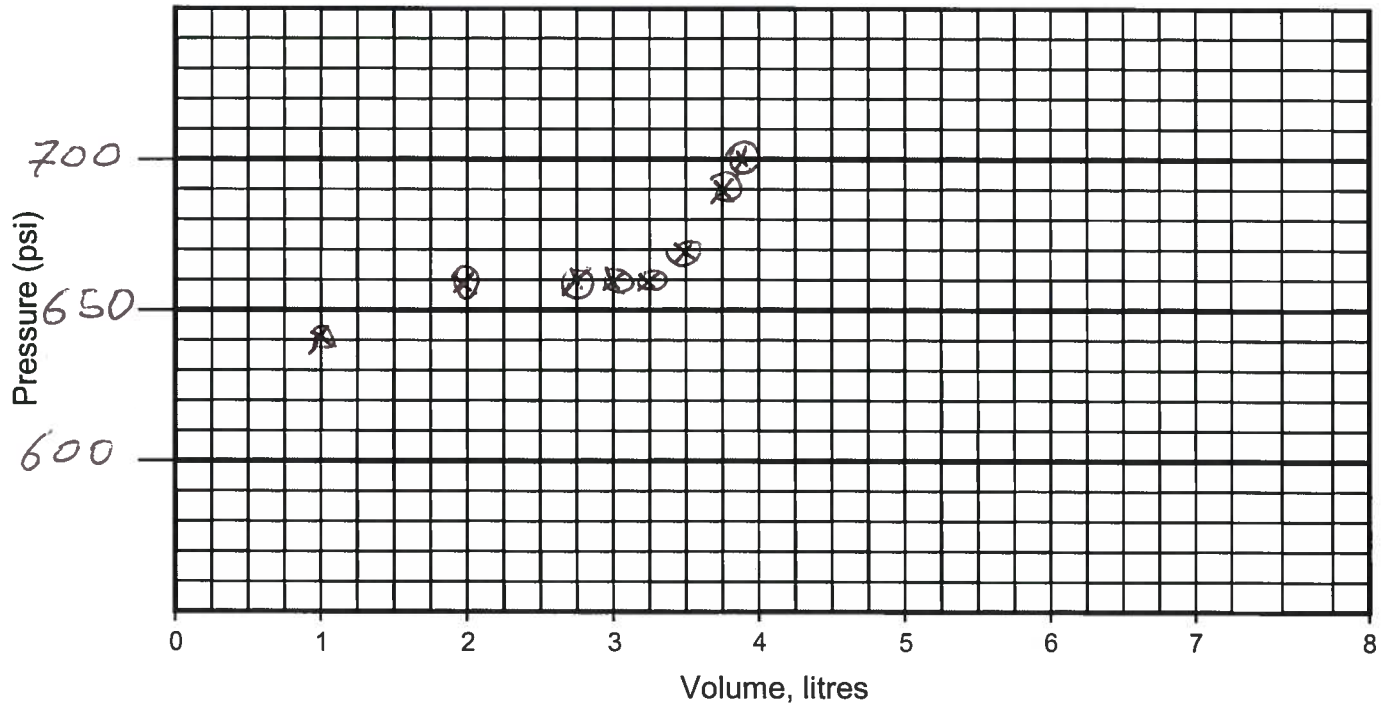
Packer Valve Pressure, P_V: 150 psi | Final Line Pressure, P_L: 700 psi | Tool Pressure, P_T: 430 psi

Borehole Water Level: 3 (~~ft~~/ m) = 0 psi (P_W)

Packer SN# 18300

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = 120 psi

Volume, litres	1.0	2.0	2.75	3.0	3.25	3.5	3.75	/	/	4.0
Pressure, psi	640	660	660	660	660	670	690	/	0	700
Volume, litres	/	3.5								
Pressure, psi	/	0								



Comments: Packer #1 | Time - 16 15

Schlumberger
Water Services

Westbay Packer Inflation Record

Project: Rescan | Project No.: WB927 | Well No.: 13-GSE-319

Location: Goose Lake | Completed by: ML/DO | Date Inflated: May 30/13

Packer No. 2, comp. # 30 | Depth (~~ft~~ / m): 695.4 | Inflation Tool No.: TIW 852

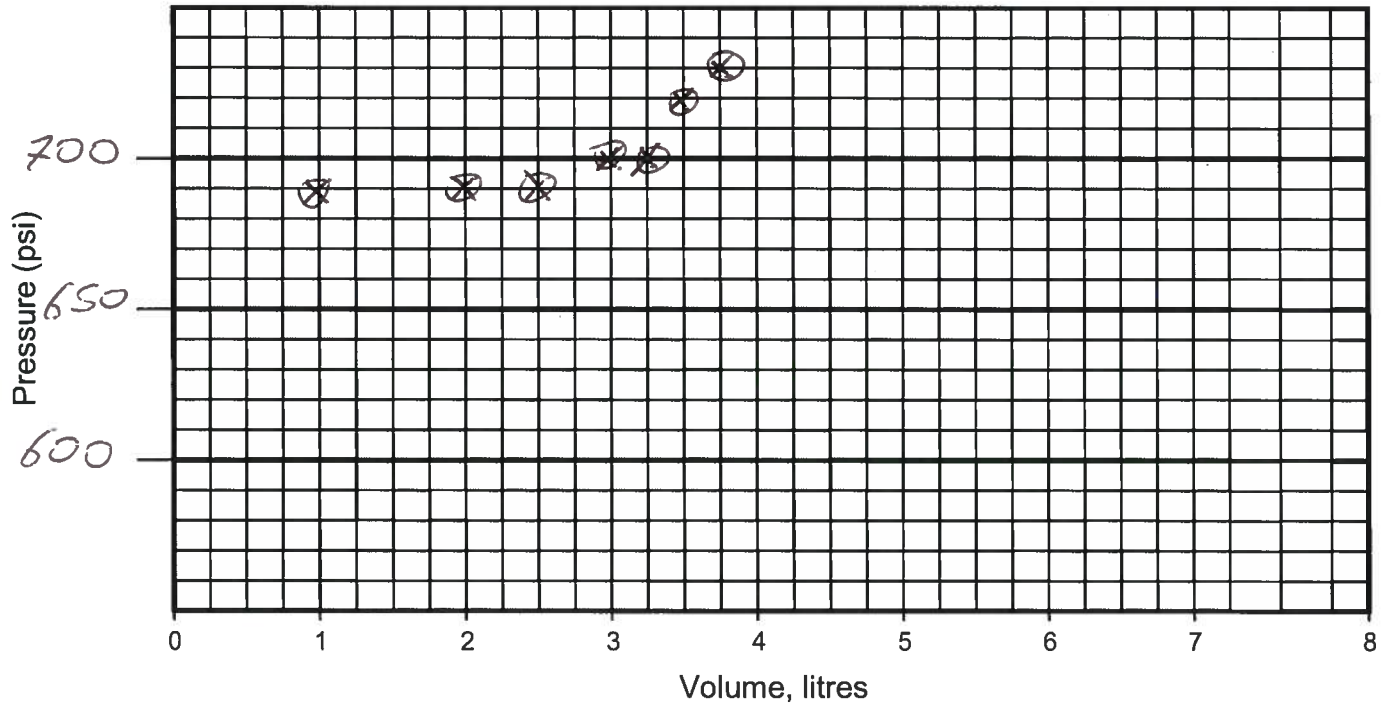
Packer Valve Pressure, P_V: 145 psi | Final Line Pressure, P_L: 730 psi | Tool Pressure, P_T: 430 psi

Borehole Water Level: 3 (~~ft~~ / m) = 0 psi (P_W)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = 155 psi

Packer SN# 18291

Volume, litres	1.0	2.0	2.5	3.0	3.25	3.5	3.75	/	3.2	
Pressure, psi	690	690	690	700	700	720	730	/	0	
Volume, litres										
Pressure, psi										



Comments: Packer #2

Time - 16 42

Schlumberger Water Services

Westbay Packer Inflation Record

Project: Rescan | Project No.: WB 927 | Well No.: 13-GSE-319

Location: Goose Lake | Completed by: ML/OO | Date Inflated: May 30/13

Packer No. 3, comp 37 | Depth (~~ft~~ m): 675.6 | Inflation Tool No.: TFW 852

Packer Valve Pressure, P_V: 145 psi | Final Line Pressure, P_L: 740 psi | Tool Pressure, P_T: 430 psi

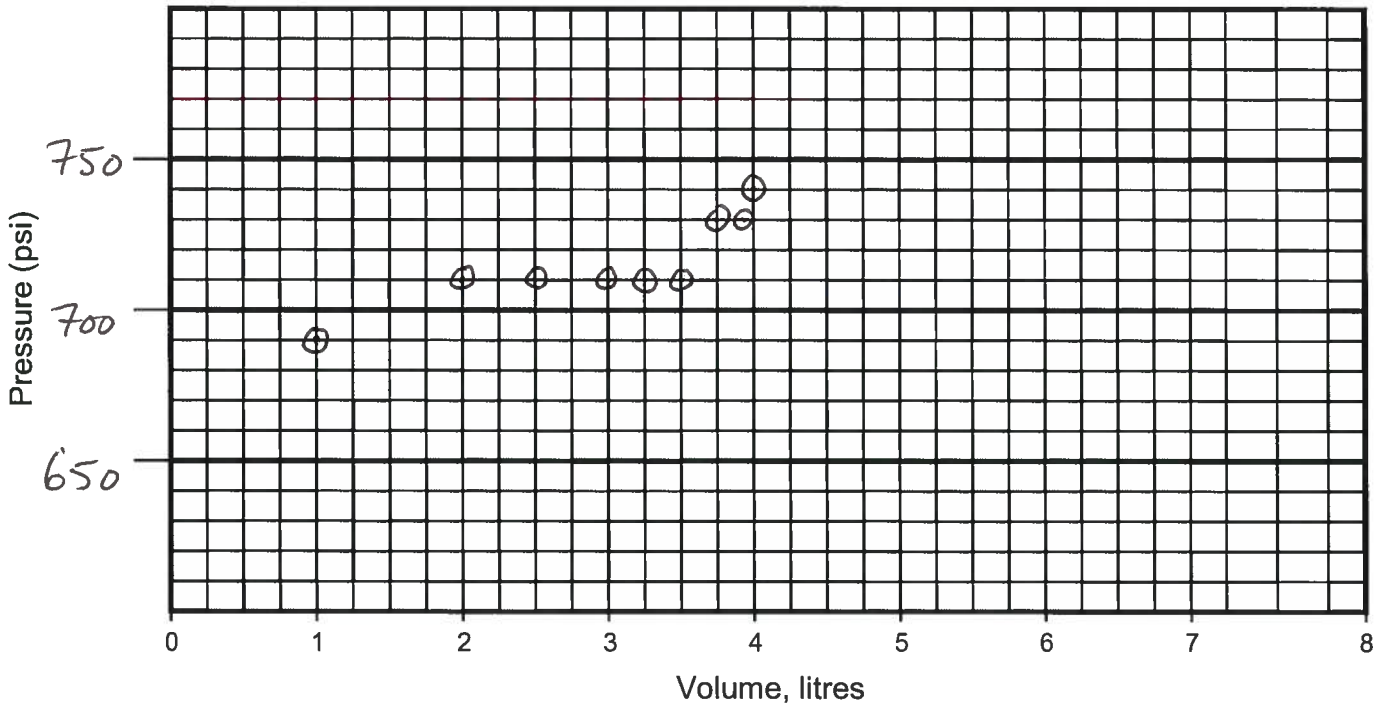
Borehole Water Level: 3 (~~ft~~ m) = 0 psi (P_W)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = 165 psi

Packer SN# 18293

1:50

Volume, litres	1	2.0	2.5	3.0	3.25	3.5	3.75	3.9	4.0	/
Pressure, psi	690	710	710	710	710	710	730	730	740	/
Volume, litres	3.5									
Pressure, psi	ø									



Comments: Packer #3 Time - 17:14

Schlumberger
Water Services

Westbay Packer Inflation Record

Project: Rescan | Project No.: WB927 | Well No.: 13-GSE-319

Location: Goose Lake | Completed by: ML/DO | Date Inflated: May 30/13

Packer No. 4, comp. #41 | Depth (~~ft~~/m): 669.1 | Inflation Tool No.: TW852

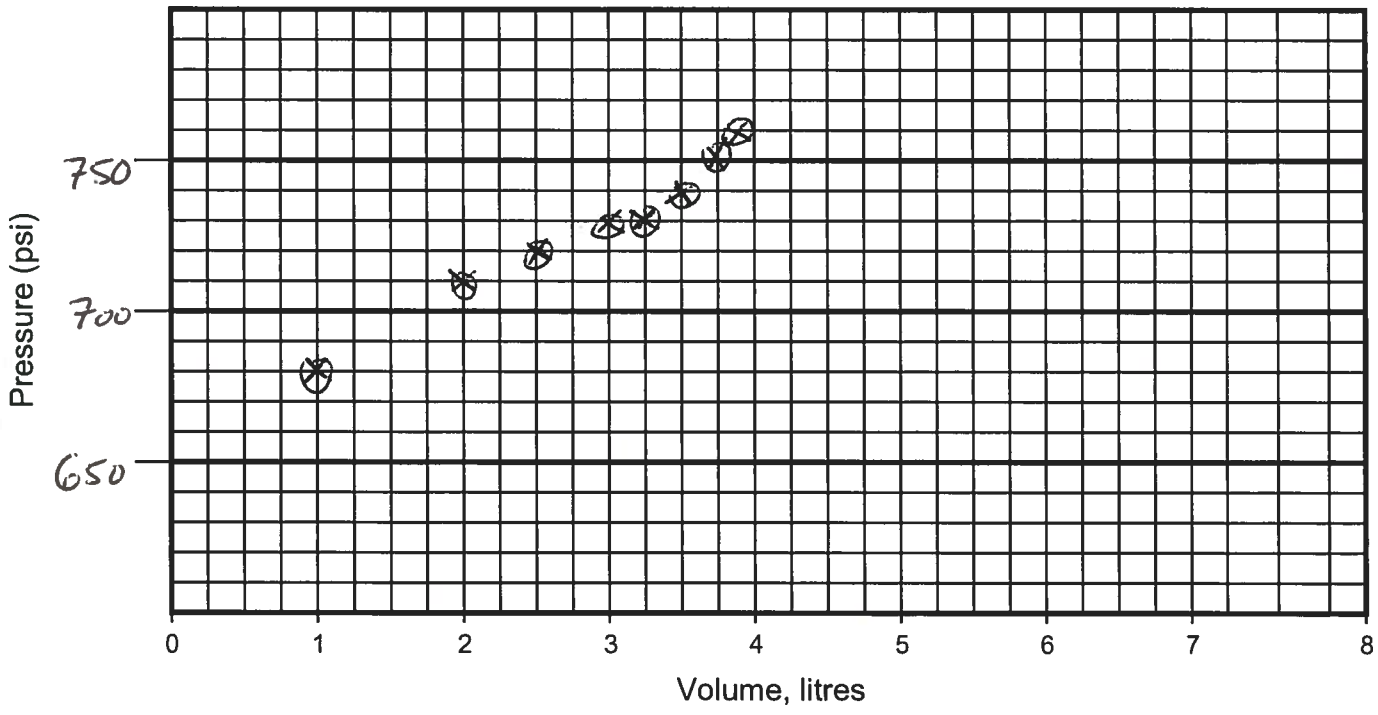
Packer Valve Pressure, P_V: 150 psi | Final Line Pressure, P_L: 760 psi | Tool Pressure, P_T: 430 psi

Borehole Water Level: 3 (~~ft~~/m) = 0 psi (P_W)

Packer SN# 18292 @ 1:50 min

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = 180 psi

Volume, litres	1.0	2.0	2.5	3	3.25	3.5	3.75	3.9	/	3.4
Pressure, psi	680	710	720	730	730	740	750	760	/	0
Volume, litres										
Pressure, psi										



Comments: Packer #4 | Time - 17 52

Schlumberger
Water Services

Sheet 6 of 17

Westbay Packer Inflation Record

Project: Rescan Project No.: WB927 Well No.: 13-GSE-319

Location: Goose Lake Completed by: ML/DO Date Inflated: May 30/2013

Packer No. 5, comp. # 48 Depth (~~ft~~ m): 650.8 Inflation Tool No.: TIW852

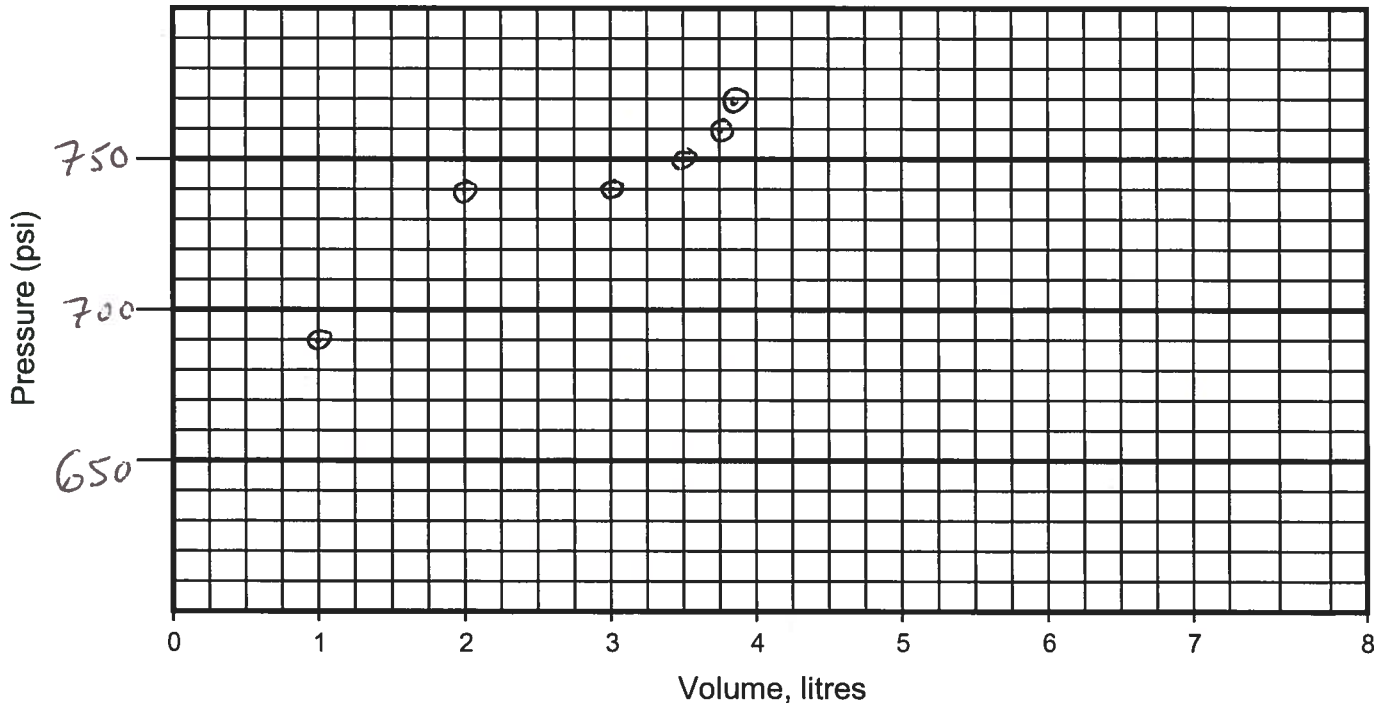
Packer Valve Pressure, P_V: 145 psi Final Line Pressure, P_L: 770 psi Tool Pressure, P_T: 430 psi

Borehole Water Level: 3 (~~ft~~ m) = 0 psi (P_W)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = 195 psi

Packer SN# 18294

Volume, litres	1.0	2.0	3.0	3.5	3.75	3.85	/	3.3		
Pressure, psi	690	740	740	750	760	770	/	Ø		
Volume, litres										
Pressure, psi										



Comments: Packer #5 Time - 18:20

Schlumberger
Water Services

Sheet 7 of 17

Westbay Packer Inflation Record

Project: Rescan | Project No.: WB927 | Well No.: 13-GSE-319

Location: Goose Lake | Completed by: ML/DO | Date Inflated: May 31, 2013

Packer No. 6, comp. # 51 | Depth (ft / m): 646.2 | Inflation Tool No.: TW 852

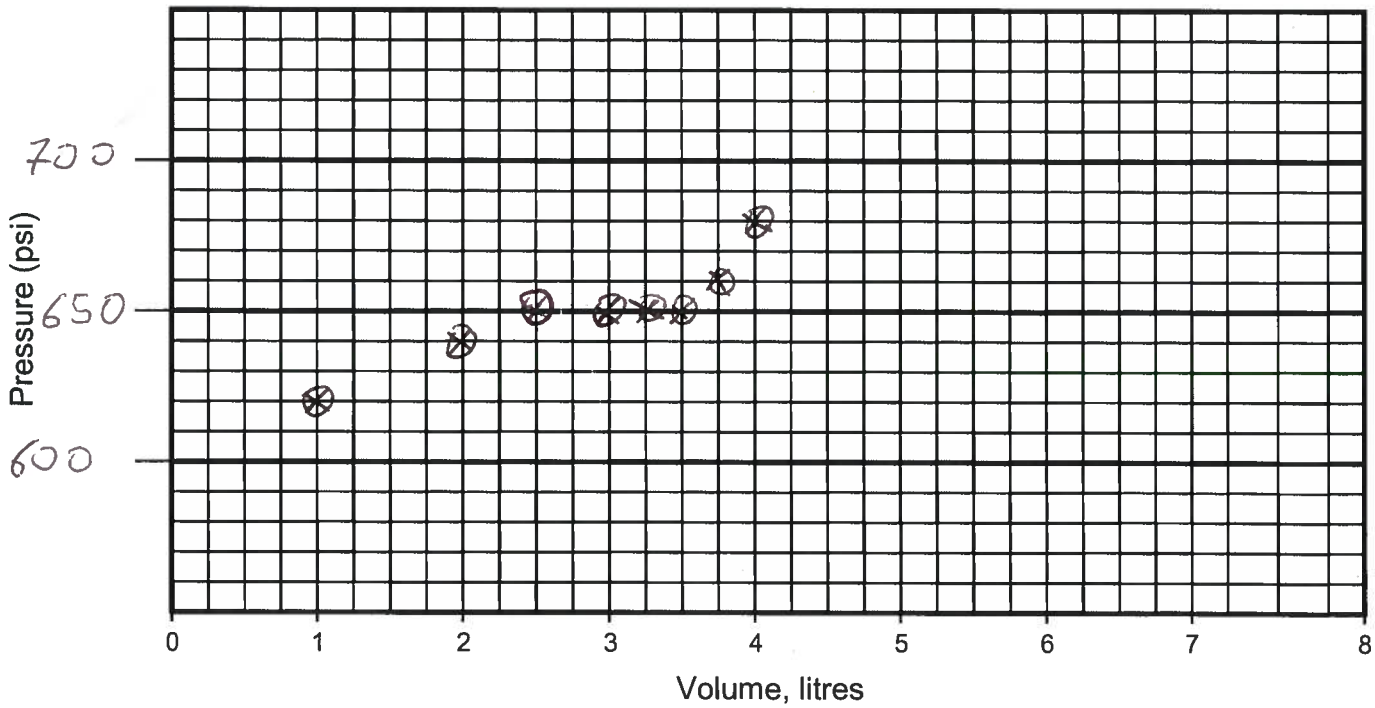
Packer Valve Pressure, P_V: 145 psi | Final Line Pressure, P_L: 680 psi | Tool Pressure, P_T: 430 psi

Borehole Water Level: 3 (ft / m) = 0 psi (P_W)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = 105 psi

Packer SN# 18295

Volume, litres	1	2	2.5	3	3.25	3.5	3.75	4.0	/	3.5
Pressure, psi	620	640	650	650	650	650	660	680	/	0
Volume, litres										
Pressure, psi										



Comments: Packer #6 | Time - 10:42

Schlumberger
Water Services

Westbay Packer Inflation Record

Project: Rescan Project No.: WB927 Well No.: 13-GSE-319

Location: Goose Lake Completed by: ML/DO Date Inflated: May 31/2013

Packer No. 7, comp. # 57 Depth (~~ft~~ / m): 629.4 Inflation Tool No.: TW852

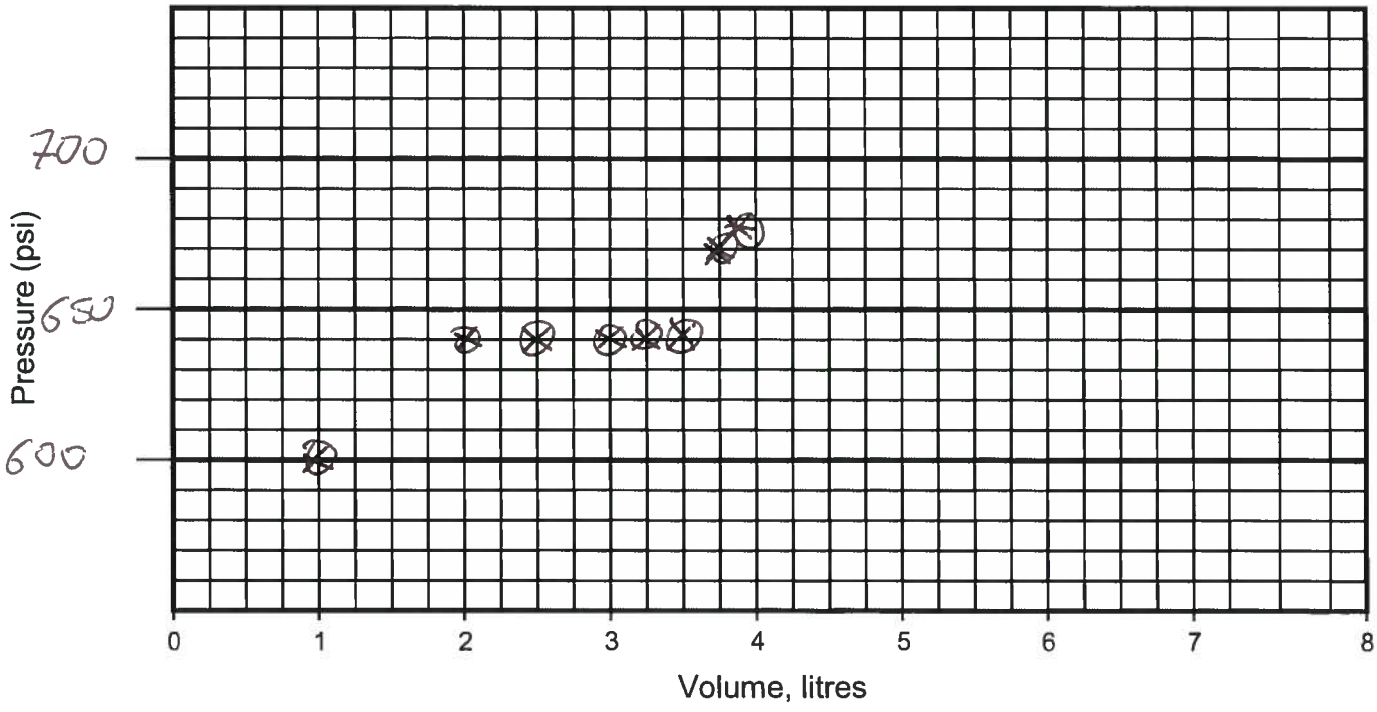
Packer Valve Pressure, P_V: 145 psi Final Line Pressure, P_L: 680 psi Tool Pressure, P_T: 430 psi

Borehole Water Level: 3 (~~ft~~ / m) = 0 psi (P_W)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = 105 psi

Packer SN# 18286

Volume, litres	1.0	2.0	2.5	3	3.25	3.5	3.75	3.85	/	3.4
Pressure, psi	600	640	640	640	640	640	670	680	/	0
Volume, litres										
Pressure, psi										



Comments: Packer #7 Time -

Schlumberger
Water Services

Sheet 9 of 17

Westbay Packer Inflation Record

Project: Rescan | Project No.: WB927 | Well No.: 13-GSE-319

Location: Goose Lake | Completed by: ML/DO | Date Inflated: May 31/2013

Packer No. 8, comp. # 60 | Depth (~~ft~~/m): 624.8 | Inflation Tool No.: TW 852

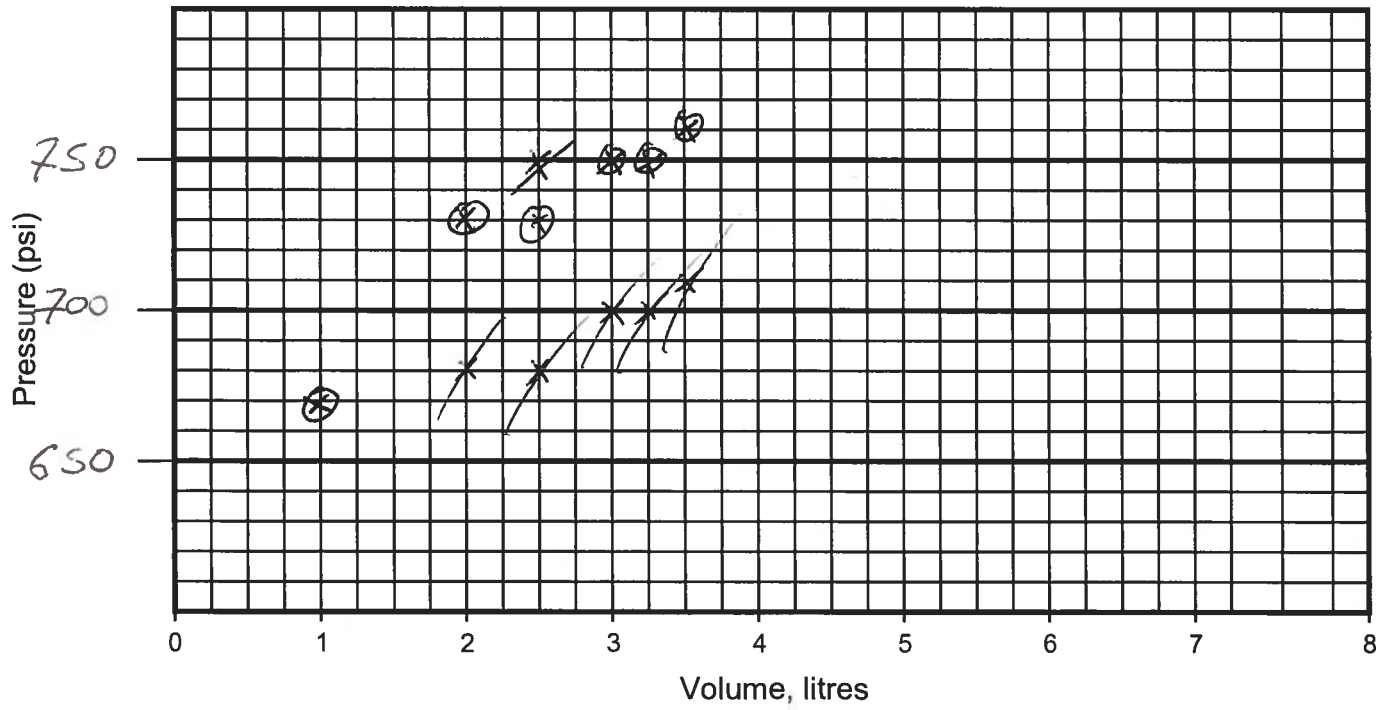
Packer Valve Pressure, P_V: 145 psi | Final Line Pressure, P_L: 850 psi | Tool Pressure, P_T: 430 psi

Borehole Water Level: 3 (~~ft~~/m) = 0 psi (P_W)

Packer SN# 19285

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = 275 ⊛ psi

		2 min						Wait 5 min		
Volume, litres	1.0	2.0	2.5	3.0	3.25	3.5	3.75	/	3.25	
Pressure, psi	670	730	730	750	750	760	850	/	⊘	
Volume, litres										
Pressure, psi										



Comments: Packer #8 | Time - 11:40 am

⊛ Higher pressures due to dirty 90 micron filter.

Schlumberger Water Services

Sheet 10 of 17

Westbay Packer Inflation Record

Project: Rescan Project No.: WB927 Well No.: 13-GSE-319

Location: Goose Lake Completed by: ML/DO Date Inflated: May 31/2013

Packer No. 9, comp. # 89 Depth (~~ft~~/ m): 537.9 Inflation Tool No.: #IW852

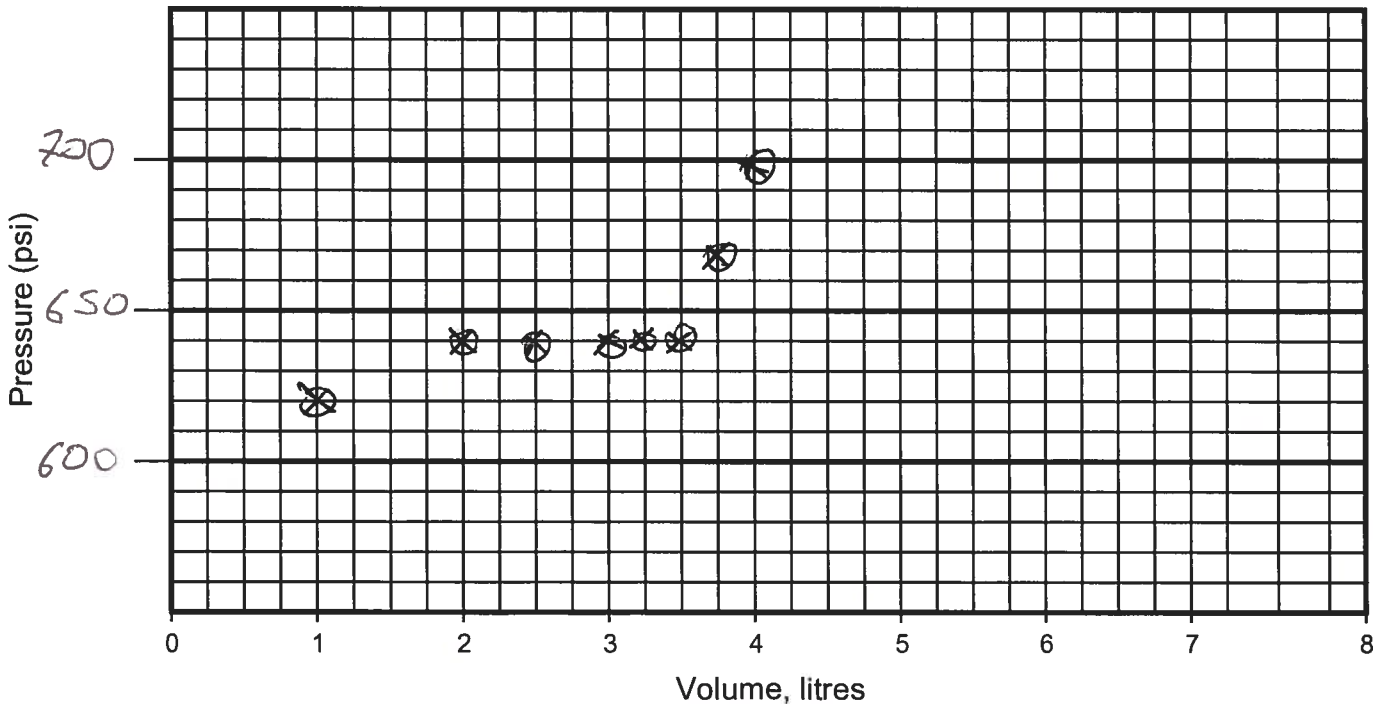
Packer Valve Pressure, P_V: 125 psi Final Line Pressure, P_L: 700 psi Tool Pressure, P_T: 420 psi

Borehole Water Level: 3 (~~ft~~/ m) = 0 psi (P_W)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = 135 psi

Packer SN# 18288

Volume, litres	1	2	2.5	3.0	3.25	3.5	3.75	3.9	/	3.3
Pressure, psi	620	640	640	640	640	640	670	700	/	0
Volume, litres										
Pressure, psi										



Comments: Packer # 9 Time -

Schlumberger Water Services

Sheet 11 of 17

Westbay Packer Inflation Record

Project: Rescan Project No.: WB927 Well No.: 13-GSE-319

Location: Goose Lake Completed by: ML/DO Date Inflated: May 31/2013

Packer No. 10, comp. # 92 Depth (~~ft~~ m): 533.3 Inflation Tool No.: TIw 852

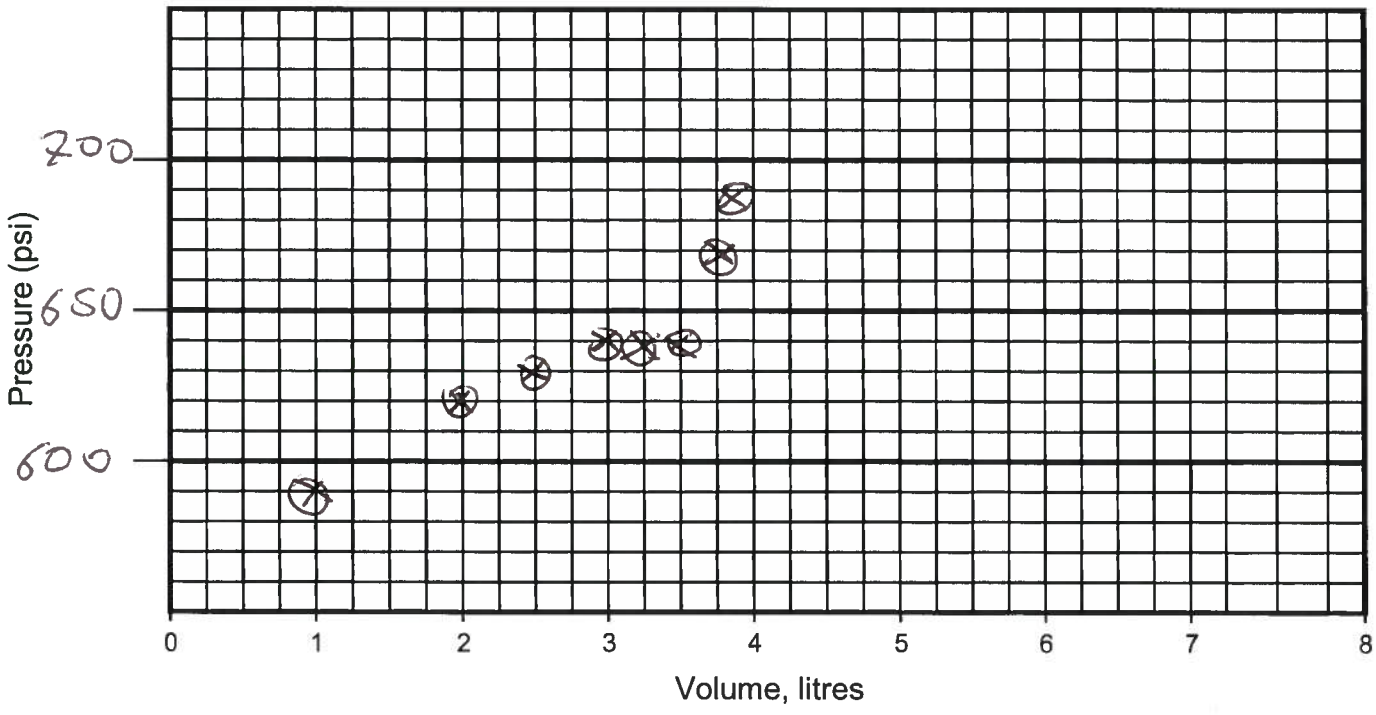
Packer Valve Pressure, P_V: 145 psi Final Line Pressure, P_L: 690 psi Tool Pressure, P_T: 420 psi

Borehole Water Level: 3 (~~ft~~ / m) = 0 psi (P_W)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = 125 psi

Packer SN# 18287

Volume, litres	1.0	2.0	2.5	3.0	3.25	3.5	3.75	3.9	/	3.3
Pressure, psi	590	620	630	640	640	640	670	690	/	0
Volume, litres										
Pressure, psi										



Comments: Packer #10 Time -

Schlumberger
Water Services

Sheet 12 of 17

Westbay Packer Inflation Record

Project: Rescan Project No.: WB927 Well No.: 13-GSE-319

Location: Goose Lake Completed by: ML/DO Date Inflated: May 27/13

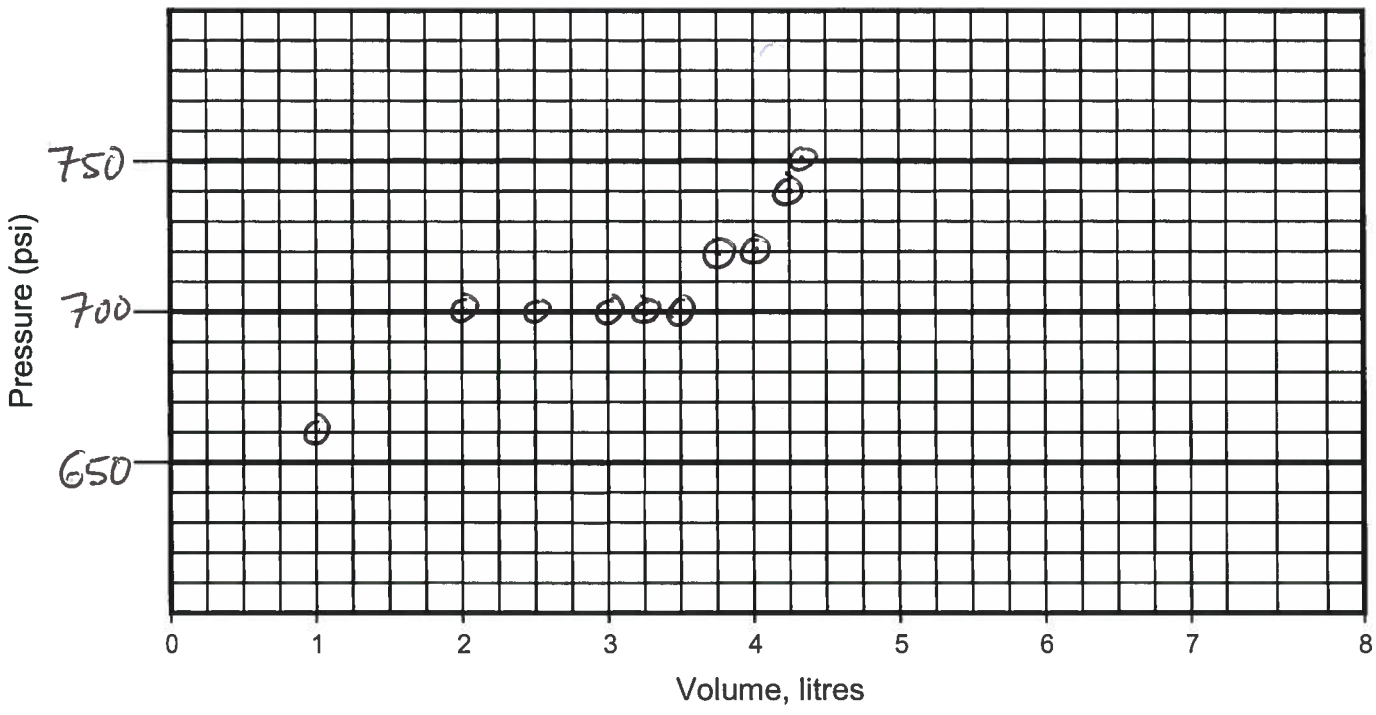
Packer No. 11, comp 118 SN# 18289 Depth (ft / m): 455.5 Inflation Tool No.: IW852

Packer Valve Pressure, P_V: 145 psi Final Line Pressure, P_L: 750 psi Tool Pressure, P_T: 450 psi

Borehole Water Level: 3 (ft / m) = 0 psi (P_W)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = 155 psi

Volume, litres	1.0	2.0	2.5	3.0	3.25	3.5	3.75	4.0	4.25	4.35
Pressure, psi	660	700	700	700	700	700	720	720	740	750
Volume, litres	/	3.75								
Pressure, psi	/	Ø								



Comments: Packer inflated properly, Packer at 454.3 m on counter. Time - 11:02 pm

Schlumberger
Water Services

Westbay Packer Inflation Record

Project: Rescan | Project No.: WB927 | Well No.: 13-GSE-319

Location: Goose Lake | Completed by: ML/DO | Date Inflated: May 27/2013

Packer No. 12, comp. # 120 | Depth (ft/ m): 451.0 | Inflation Tool No.: TIW 852

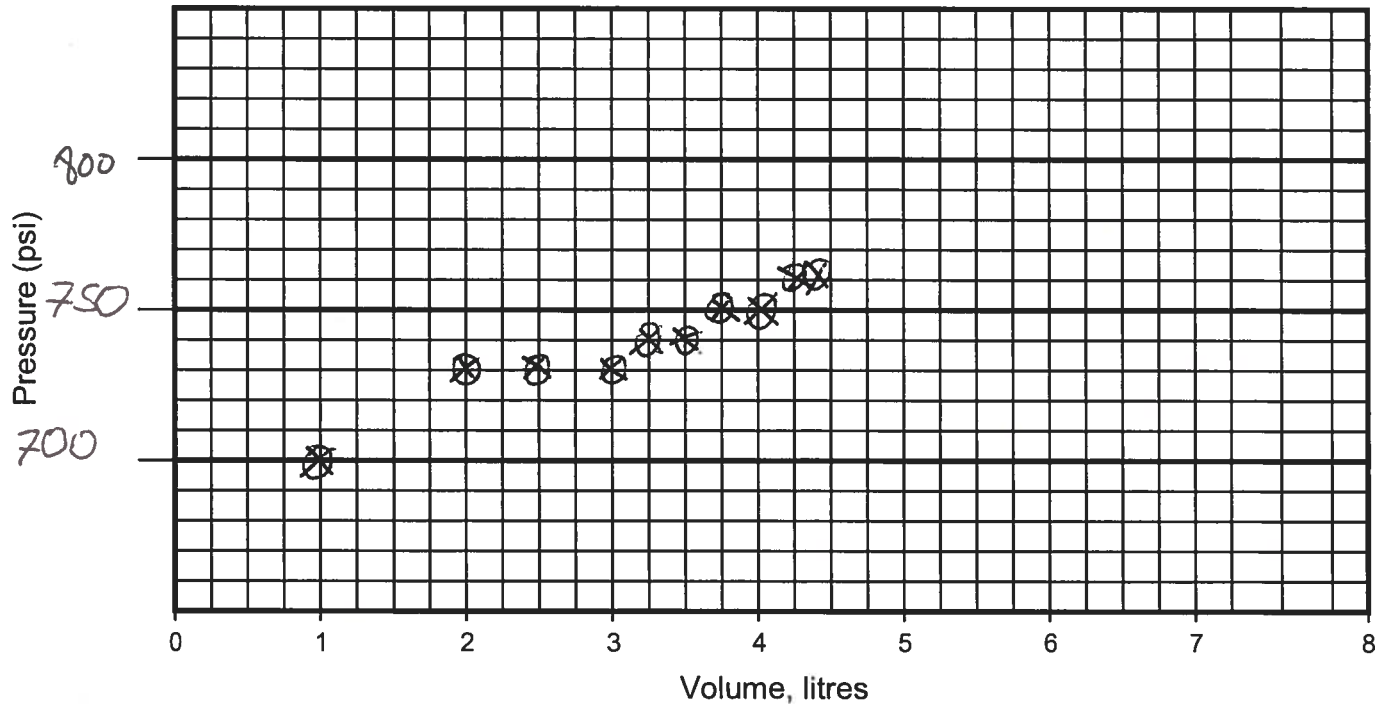
Packer Valve Pressure, P_V: 150 psi | Final Line Pressure, P_L: 760 psi | Tool Pressure, P_T: 450 psi

Borehole Water Level: 3 (ft/ m) = 0 psi (P_W)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = 160 psi

Packer SN# 18290

Volume, litres	1	2	2.5	3	3.25	3.5	3.75	4	4.25	4.35
Pressure, psi	700	730	730	730	740	740	750	750	760	760
Volume, litres	1	3.8								
Pressure, psi	1	0								



Comments: Packr Inflated properly | Time - 11 38 PM

Schlumberger
Water Services

Westbay Packer Inflation Record

Project: Rescan Project No.: WB927 Well No.: 13-GSE-319

Location: Goose Lake Completed by: ML/DO Date Inflated: May 29/13

Packer No. 13, comp.# 144 Depth (~~ft~~/ m): 380.8 Inflation Tool No.: TIW 852

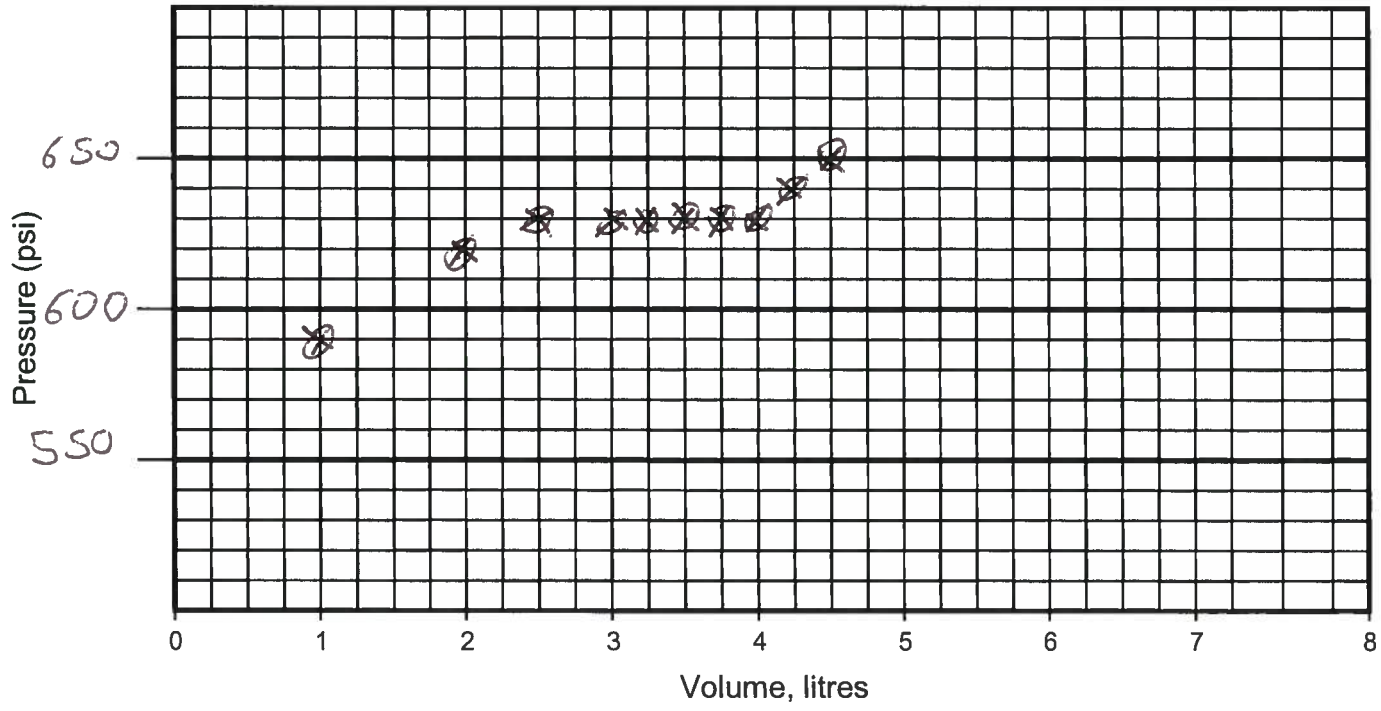
Packer Valve Pressure, P_V: 145 psi Final Line Pressure, P_L: 650 psi Tool Pressure, P_T: 400 psi

Borehole Water Level: 3 (~~ft~~/ m) = 0 psi (P_W)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = 105 psi

Packer SN# 18311

Volume, litres	1	2	2.5	3	3.25	3.5	3.75	4.0	4.25	4.5
Pressure, psi	590	620	630	630	630	630	630	630	640	650
Volume, litres	/	3.8								
Pressure, psi	/	0								



Comments: Packer #13 Time - 1955

Schlumberger
Water Services

Sheet 15 of 17

Westbay Packer Inflation Record

Project: Rescan Project No.: WB927 Well No.: 13-GSE-319

Location: Goose Lake Completed by: ML/DO Date Inflated: May 29/2013

Packer No. 14, comp. # 178 Depth (~~ft~~ / m): 280.2 Inflation Tool No.: FIW 852

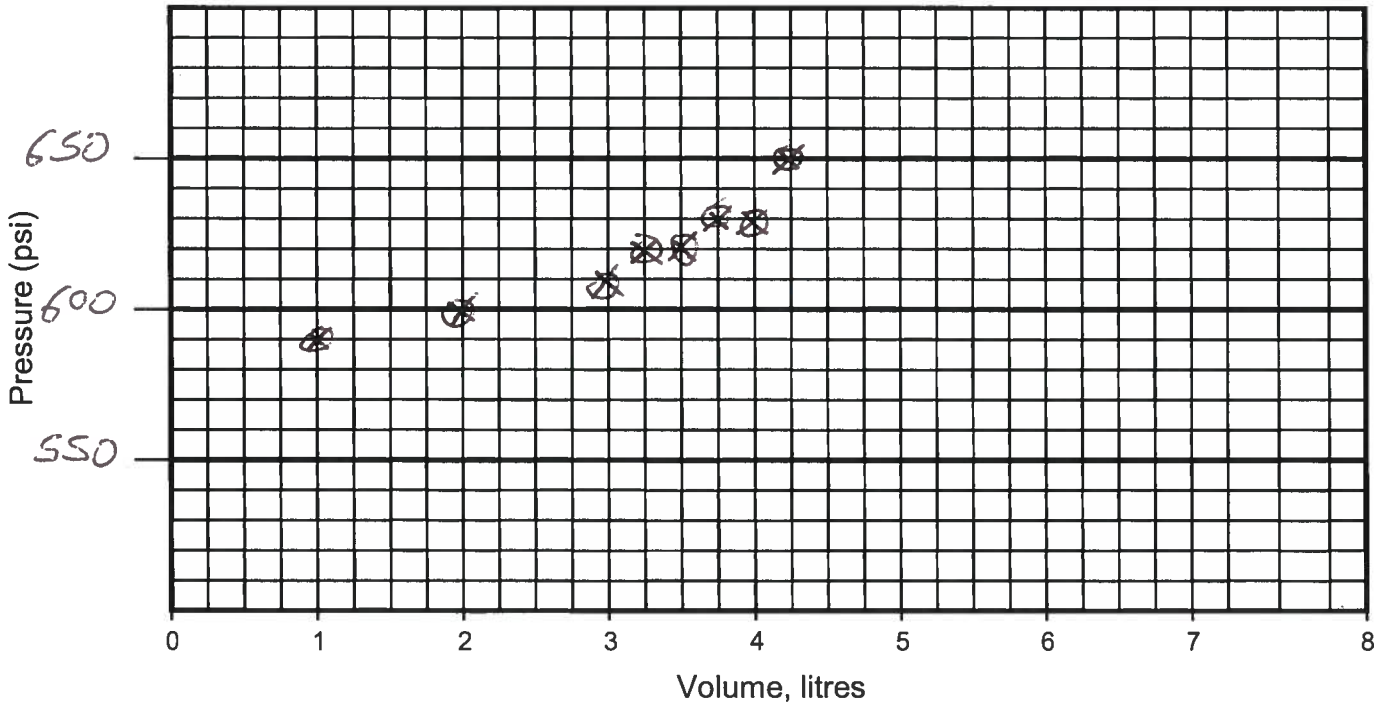
Packer Valve Pressure, P_V: 140 psi Final Line Pressure, P_L: 650 psi Tool Pressure, P_T: 400 psi

Borehole Water Level: 3 (~~ft~~ / m) = 0 psi (P_W)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = 110 psi

Packer SN# 18312

Volume, litres	1	2	3	3.25	3.5	3.75	4.0	4.25	/	3.8
Pressure, psi	590	600	610	620	620	630	630	650	/	0
Volume, litres										
Pressure, psi										



Comments: Packer #14 Time - 8:30 PM

Schlumberger Water Services

Westbay Packer Inflation Record

Project: Rescan | Project No.: WB927 | Well No.: 13-GSE-319

Location: Goose Lake | Completed by: ML/DO | Date Inflated: May 31/13

Packer No. 15, comp. # 212 | Depth (~~ft~~ m): 179.6 | Inflation Tool No.: TIW 852

Packer Valve Pressure, P_V: 140 psi | Final Line Pressure, P_L: 680 psi | Tool Pressure, P_T: 420 psi

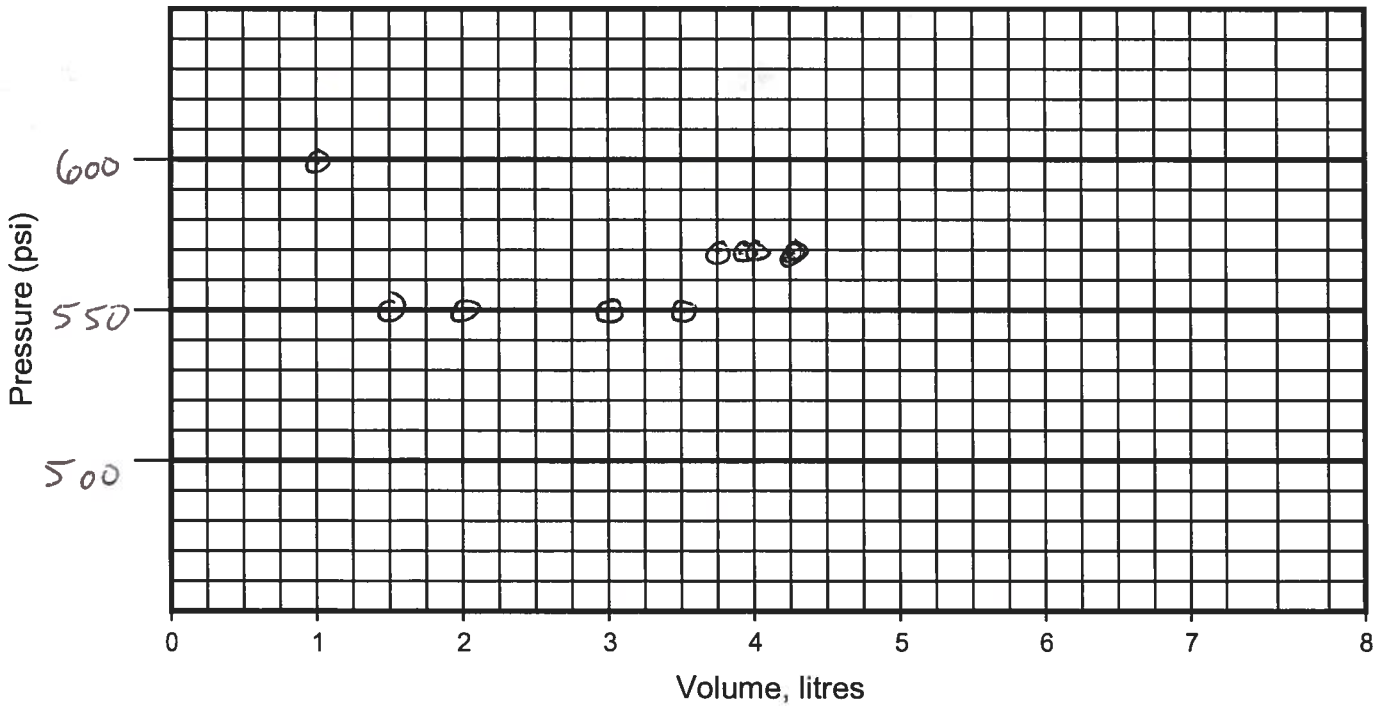
Borehole Water Level: 3 (~~ft~~ m) = 0 psi (P_W)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = 120 psi

Packer SN# 18313

Volume, litres	1.0	1.5	2.0	3.0	3.5	3.75	3.9	4.0	4.25	4.5
Pressure, psi	600	550	550	550	550	570	570	570	570	680
Volume, litres	/	4.0							550	
Pressure, psi	/	0							@ 80 sec	

4.5-L pressure at 650 psi after 3-min.



Comments: Packer #15 | Time -

	PSF	Time	PSF	Time
2-L mark	750 @	20 sec	550 @	70 sec
	650 @	40 sec		
	600 @	50 sec		

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Water Services

Sheet 17 of 17

Westbay Packer Inflation Record

Project: Rescan Project No.: CJB927 Well No.: 13-GSE-319

Location: Goose Gak Completed by: ML/DO Date Inflated: May 31/2013

Packer No. 16, comp.# 245 Depth (~~ft~~/ m): 82.1 Inflation Tool No.: TW852

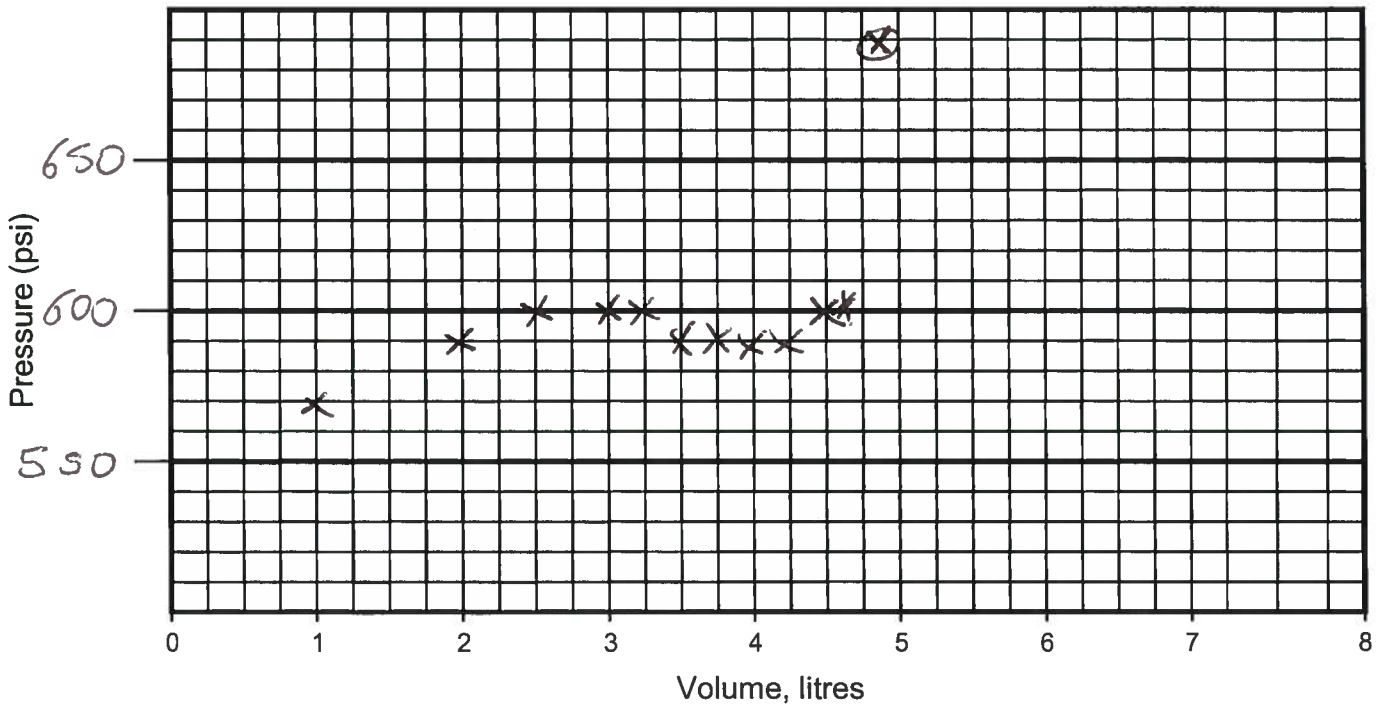
Packer Valve Pressure, P_V: 145 psi Final Line Pressure, P_L: 690 psi Tool Pressure, P_T: 420 psi

Borehole Water Level: 3 (~~ft~~/ m) = 0 psi (P_W)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = 125 psi

Packer SN# 18314

Volume, litres	1.0	2.0	2.5	3	3.25	3.5	3.8	4.0	4.25	4.5
Pressure, psi	570	590	600	600	600	590	590	590	590	606
Volume, litres	4.7	4.9	/	4.2						
Pressure, psi	600	690	/	0						



Comments: Packer #16 Time - 16 45

Appendix V6-2C

2012 Geotechnical and Hydrogeological Drilling Program Factual Data Report

Sabina
GOLD & SILVER CORP.

Back River 2012 Geotechnical and Hydrogeological Drilling Program

Factual Data Report

Report Prepared for

Sabina Gold & Silver Corporation

Report Prepared by

SRK Consulting (Canada) Inc.
2CS031.002
November 2012

Back River 2012 Geotechnical and Hydrogeological Drilling Program

Factual Data Report

Sabina Gold & Silver Corporation

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SRK Project Number 2CS031.002

November 2012

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Appendices

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- Appendix A.2: Air Photos (digital and physical copies)
- Appendix A.3: Air Photo Interpretation
- Appendix A.4: Electronic Geotechnical Database
- Appendix A.5: SRK Geotechnical Logging Manual
- Appendix A.6: Laboratory Sampling and Testing
- Appendix A.7: Core Photos

Appendix B: Hydrogeology Data

- Appendix B1: Injection Test Theory & Analysis
- Appendix B2: 2012 Packer Test Field Data Sheets
- Appendix B3: 2012 Vibrating Wire / Thermistor Documentation
- Appendix B4: Summary Temperature Results and Pore Pressure
- Appendix B5: Thermistor and Vibrating Wire Data (Electronic)

1 Introduction and Scope of Report

SRK Consulting (Canada) Inc. ("SRK") was selected by Sabina Gold & Silver Corporation ("Sabina") to undertake a geotechnical and hydrogeological site investigation program to support feasibility level design of the proposed open pits and underground operations at the Back River Gold Project ("Back River project") in Nunavut, Canada. This factual report details the data collected from SRK's geotechnical site investigation program carried out from June to September 2012. The program consisted of a field program comprising geotechnical drilling and testing, installations of thermistor strings, and limited laboratory testing.

The mine plan in the Preliminary Economic Assessment ("PEA") (SRK, 2012)) was used as the basis for the geotechnical and hydrogeological study. Both underground and open pit options were considered for the Umwelt and Goose deposits, with open pit mining for the Llama deposit.

This data report does not contain interpretive statements.

1.1 Project Description

The Back River Project site ("site") is located approximately 520 km northeast of Yellowknife, Northwest Territories, and 50 km southeast of the Hackett River Project in the southwestern part of Nunavut, Canada. The site consists of the Llama, Umwelt, and Goose Main deposits (collectively referred to as the Goose Property). The locations of the deposits are seen in Figure 1.

1.1.1 Data Outline

The data presented in this report includes historical data and data collected during the 2011 SRK site investigation program. All data is included as appendices in this report, subdivided into appendices: Appendix A - Geotechnical Data and Appendix B - Hydrogeological Data. An outline of the appendix layout is summarized below:

- Appendix A: Geotechnical Data
  - Appendix A.1: Wireframe Structures (DXF)
  - Appendix A.2: Digital and Physical Air Photos
  - Appendix A.3: Air Photo Interpretation
  - Appendix A.4: Electronic Geotechnical Database
  - Appendix A.5: SRK Logging Manual
  - Appendix A.6: Laboratory Sampling and Testing
  - Appendix A.7: Core Photos

- Appendix B: Hydrogeology Data
  - Appendix B1: Injection Test Theory & Analysis
  - Appendix B2: 2012 Packer Test Field Data Sheets
  - Appendix B3: 2012 Vibrating Wire / Thermistor Documentation
  - Appendix B4: Summary Temperature Results and Pore Pressure
  - Appendix B5 (Electronic Only): Thermistor and Vibrating Wire Data

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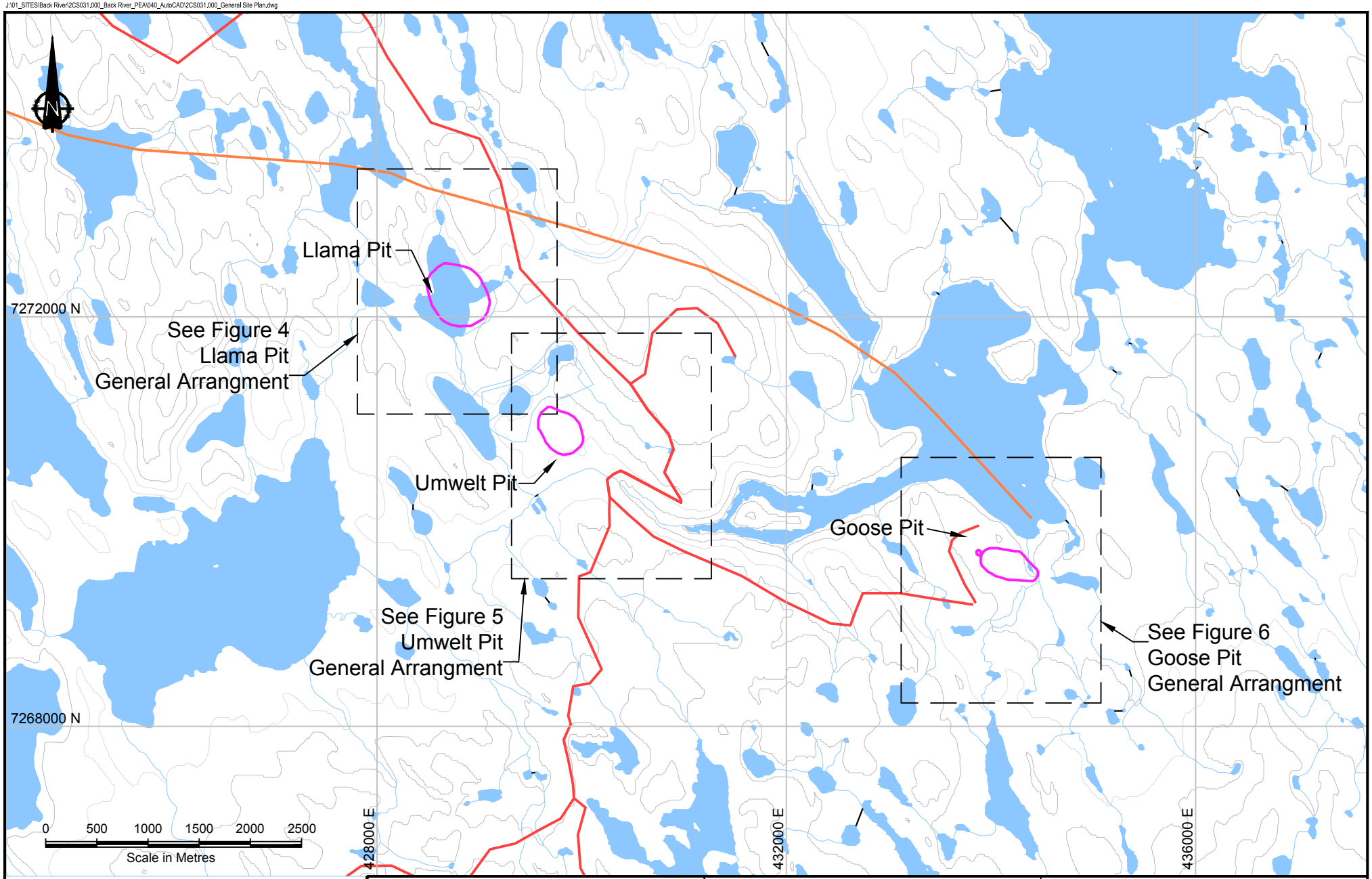


LEGEND

- Proposed All-Weathered Road
- Proposed Winter Road
- Pits
- Lakes and Rivers

srk consulting

SRK JOB NO.: 2CS031.000

FILE NAME: 2CS031.000_General Site Plan.dwg

Sabina GOLD & SILVER CORP.

Sabina Gold and Silver Corporation

Back River PEA

Site Wide General Arrangement

DATE:	APPROVED:	FIGURE:
November 2012	BG	1.1

2 Geotechnical Study

SRK was requested by Sabina to complete a geotechnical investigation to bring the various underground and open pit mining areas at Umwelt, Llama Lake, and Goose deposits up to a PFS level of study. The deposits are currently considered to be at a Preliminary Economic Assessment level of study.

SRK's planned geotechnical program considered the pit shells and underground mining shells as detailed in the 2012 PEA issued to Sabina. On-going conversations with Sabina indicated that the geology and mine plans could change from what was understood at the time of proposal. It was noted in SRK's proposal to Sabina that if the geotechnical drill program outlined could not be completed, or if the mine plan changes such that the investigations do not cover all mining areas, SRK could not guarantee that a PFS-level conclusion would be reached for all mining areas.

2.1 Geotechnical Objectives

To enable open pit and underground PFS level design, the geotechnical objectives of the SRK 2012 program include:

- Improved understanding of the rock mass units, particularly related to the presence and spatial location of mudstone and graphitic mudstone units;
- Develop a preliminary structural model and attempt to determine the characteristics of mine scale structures;
- Identify discontinuity characteristics and orientations; and
- Conduct laboratory test work designed to provide baseline estimates of intact rock strength.

2.2 Structural Review

A structural review of the Back River project was undertaken to define brittle structural trends in the Goose, Umwelt, and Llama zones. The structural review consisted of a three day site visit by SRK Consultants Blair Hrabi and Tessa Scott, fault interpretation based on available structural data from Sabina's Gems database, and stereo air photo interpretation.

The site visit allowed the SRK team to review various faults and structures in the drill core as well as Sabina's Gemcom Gems structural data from current and historic holes. Several drillholes from each deposit were reviewed and compared to the Gems database and the geological logs to understand how structures had been identified and described by Sabina's geologists. Overall the structural data in the Gems database was mostly complete and no major discrepancies were found. In some cases structural data was recorded in the lithology codes and in the detailed comments, however in most instances this data was duplicated in the structural tables. Some of the minor structures and sub-parallel structures were not included in the Gems database.

A structural interpretation was completed using Leap Frog 3D geological modelling software. Using the structural data from the Gems database, brittle structures identified from drill core in each mining area have been modeled. The structures were created from a combination of RQD, core recovery, fracture frequency, and structural and lithological tables. Each structure was modeled by snapping to brittle structure data points along a trend. A selection of potential fault intercepts were reviewed in core photos to determine the confidence and characteristics of each fault (Table 2.1, Figure 2.1, 2.2, 2.3). The wireframe models are included electronically in Appendix A1.

Most of the interpreted structural trends are directly related to geological units and folding, and several of the interpreted structures run along axial planes of the folds as well as along fold hinges. Few cross-cutting structures were able to be identified from the drilling as the majority of the drillholes are oriented perpendicular to the fold axis. This creates a bias which does not allow for cross-cutting faults to be defined well enough to model and as a result the faults being modeled are almost exclusively parallel to the trend of the folds. It should be noted that there is a high potential for additional faults which cross-cut the fold trend.

The air photo study was undertaken to delineate structures expressed on the surface to tie into faults modeled from drill core data, and attempt to verify the presence of cross-cutting structures. Air photos at 1:30,000 scale were utilized during the interpretation. The resulting interpretations have been scanned and geo-referenced in ArcGIS and subsequently digitized on the deposits (Figure 2.4) and are included electronically in Appendix A2. Electronic and original copies of the air photos are included in Appendix A3.

Many of the interpreted trends from the air photo study support the known geometry of the deposits and modeled structures. There are numerous cross trend structures that could warrant ground verification. Ideally each deposit would have several geotechnical oriented drillholes at different azimuths to obtain a better understanding of the faults.

Table 2.1: Summary of interpreted fault characteristics and level of confidence

Deposit	Name	Interp. by	Orientation			Description	Confidence			Comments
			Strike	Dip	Dip Dir.		Good	Medium	Low	
Goose	Fault_Goose_1	SRK	120	-39	SW	Fault gouge with broken core	•			This fault cross cuts the geology. The fault shows fault gouge, broken core and low angle fractures. There is no shearing or deformation around the fault.
	Fault_Goose_3	SRK	302	-86	NE	Broken core, shallow fractures, fault gouge		•		Medium to low confidence fault. This fault follows the northern limb of a fold and is following the geological structure. Fault consists of broken core with rubble and gouge.
	Fault_Goose_Sabina	Sabina	323	-77	NE, E	Broken core from low angle fractures			•	Low to medium confidence fault. The fault consists of small zones of broken core with low angle fractures and possible clay gouge. This fault makes sense geologically and should be explored further.
Umwelt	Fault_Umwelt_1	SRK	321	-66	NE	Cohesive thin fault gouge and breccia with graphite and disking	•			High to medium confidence fault. This fault appears thin and compact showing thin 2-10cm cohesive fault gouges and breccias. Faults and surrounding joints are often graphitic. The fault is roughly parallel the granodiorite dyke and follows the overall structural direction.
	Fault_Umwelt_2	SRK	325	-61	NE	Small zones of broken core, disking, and thin fault gouge. Possible graphite on fractures		•		Medium confidence fault. The fault generally consists of small zones of broken core and thin 1 to 5cm fault gouges. Possible graphite on fractures. There could be several small faults instead of one large one. The fault is roughly parallel the granodiorite dyke and follows the overall structural direction.
	Fault_Umwelt_3	SRK	326	-63	NE	Disked core with rubble and fault gouge and graphite		•		Medium confidence fault. The fault consists of disked core to broken core with thin fault gouges. Graphite is visible on several joints. The fault is roughly parallel the granodiorite dyke and follows the overall structural direction.
	Fault_Umwelt_4	SRK	343	-71	NE	Disked core with rubble and fault gouge	•			High confidence fault. The fault consists of disked core and rubble and fault gouge. One hole has 40cm of cohesive fault gouge. The fault is likely offsetting the deposit. There is a lot of faulting activity in this area, likely from several faults. This fault should have further exploration.
	Fault_Umwelt_5	SRK	330	-62	NE	Disked core with rubble and fault gouge. Possible graphite	•			High confidence fault of disked and broken core with rubble and fault gouge. Possible graphite on fractures. The fault is roughly parallel the granodiorite dyke and follows the overall structural direction.
	Fault_Umwelt_6	SRK	357	-57	E	Disked core, rubble, fault gouge, and graphitic fractures	•			High confidence fault. Disked core with broken core, rubble, fault gouge, and graphite on some fractures. The fault crosses geological trend, and passes through two dykes. The trend is similar to Fault_Umwelt_5.
Llama	Fault_Llama_1	SRK	341	-49	NE, E	Disked core, rubble, fault gouge, and graphitic fractures	•			High confidence fault with rubble, disked core, rubble, and graphitic fractures. The fault crosscuts the geological trends and several other Llama faults.
	Fault_Llama_4	SRK	322	-89	NE	Broken core, rubble, with gouge and possible graphitic fractures		•		Medium confidence fault with broken core and rubble with some fault gouge and possible graphitic fractures. The fault is roughly parallel the granodiorite dyke and follows the overall geological trend.
	Fault_Llama_5	SRK	319	-88	NE	Small zones of rubble with possible graphitic fractures			•	Low to medium confidence. This fault consists of mostly solid core with small 5-20cm zones of rubble with possible graphite on several fractures. There may be several small faults running through this since there are many structural intersects. The fault is roughly parallel the granodiorite dyke and follows the geological trend.

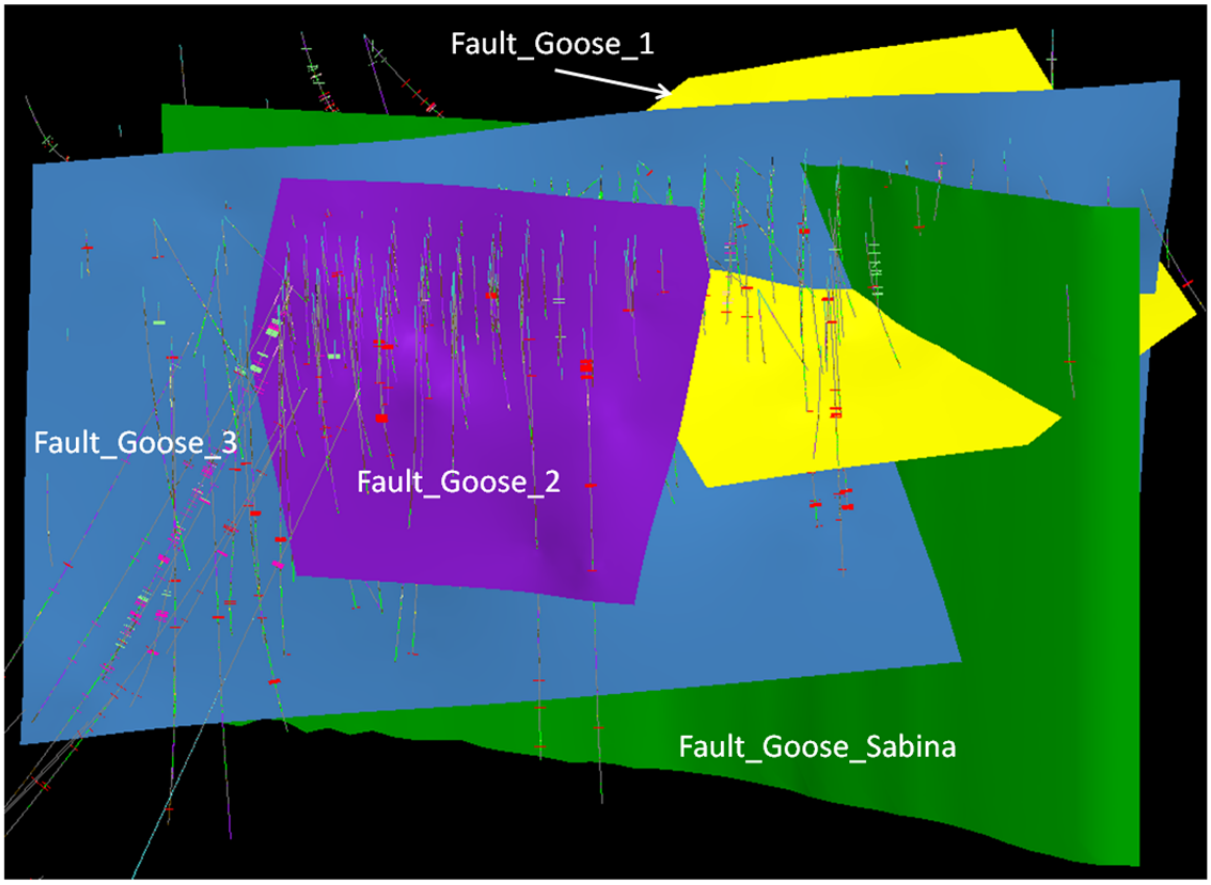


Figure 2.1: Goose deposit fault interpretation

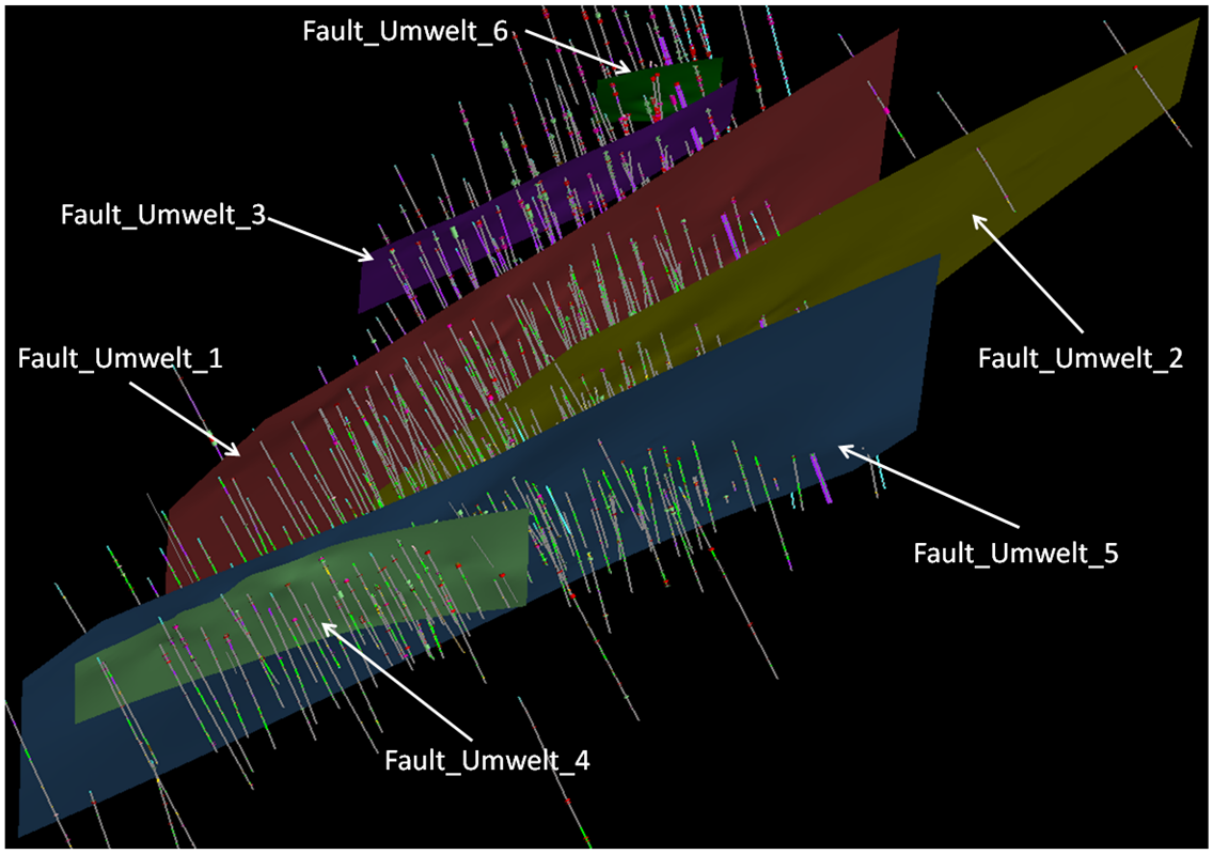


Figure 2.2: Umwelt deposit fault interpretation

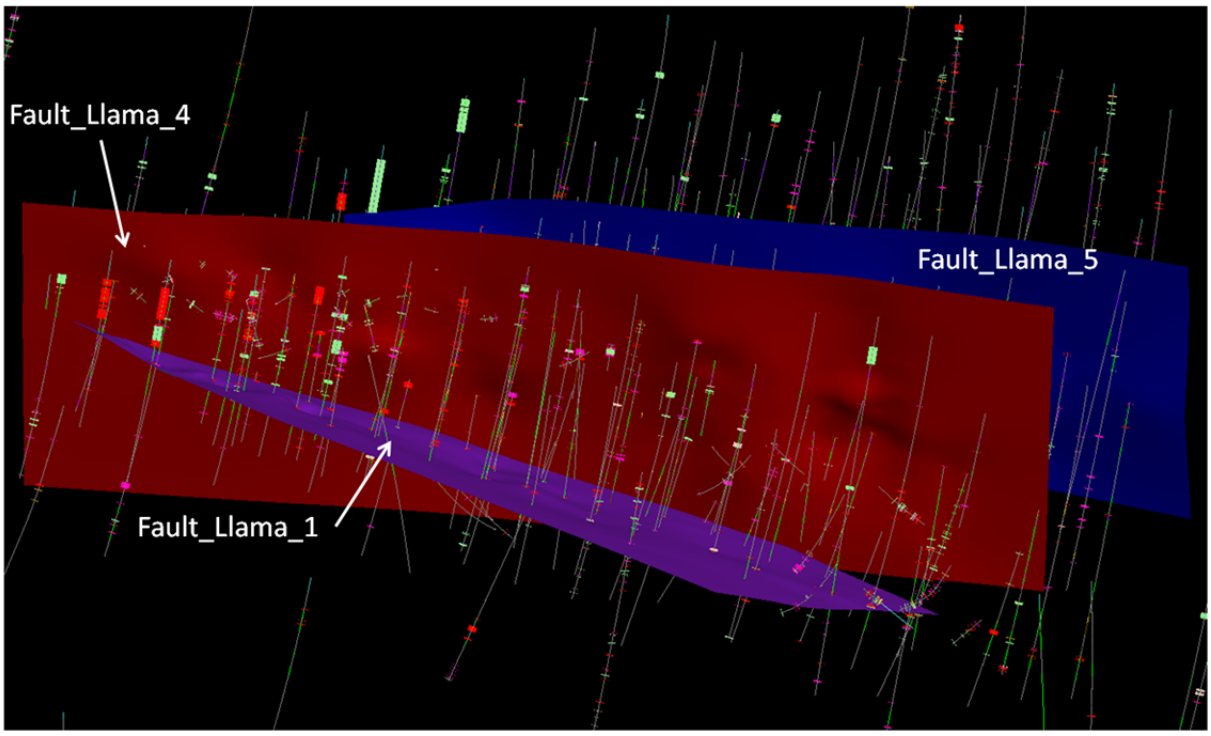


Figure 2.3: Llama deposit fault interpretation

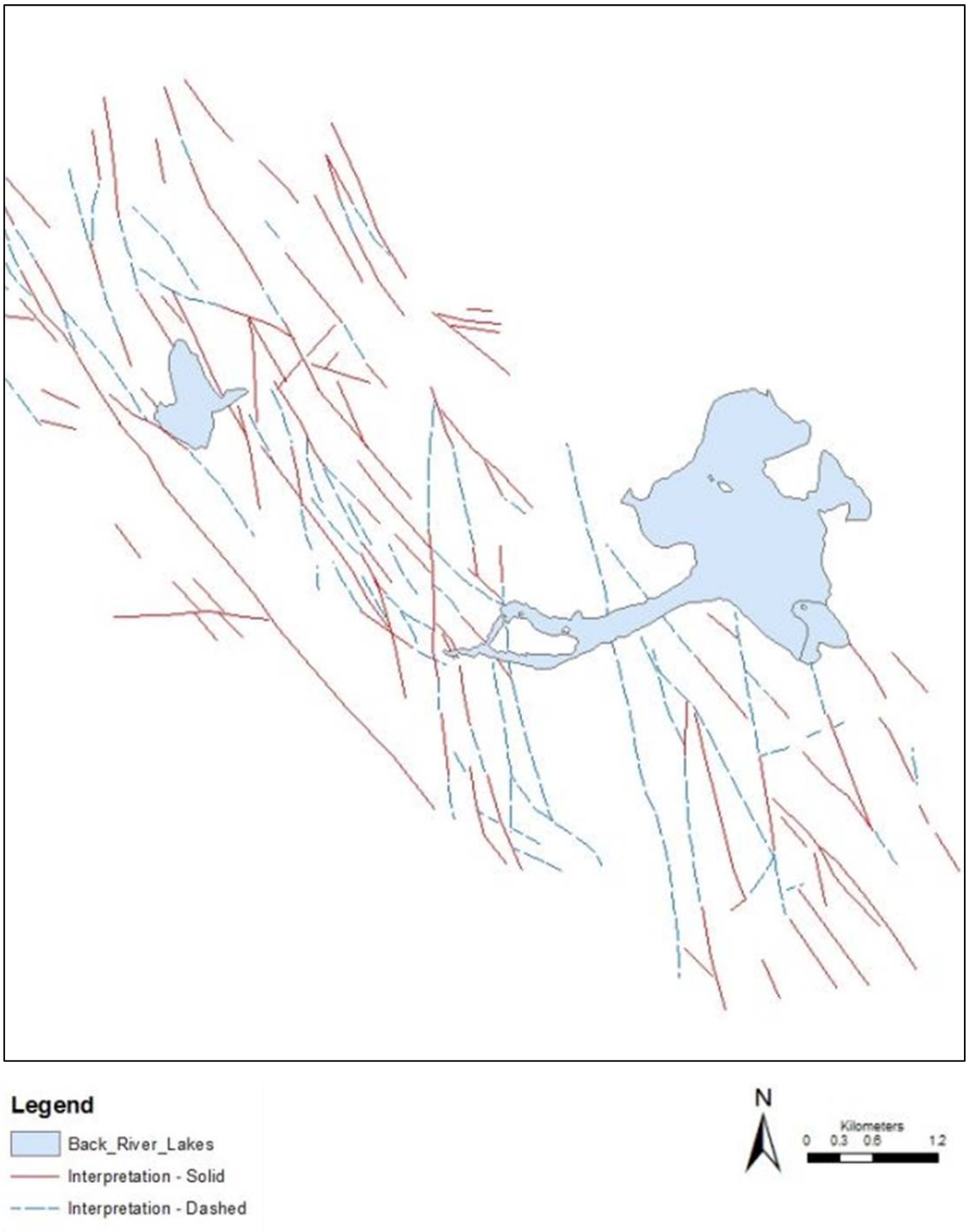


Figure 2.4: Digitized structures from air photo interpretation. High confidence structures indicated by solid red, lower confidence in blue dash.

2.3 2012 Geotechnical Program Summary

The 2012 geotechnical site investigation field work consisted of the following:

- 22 geotechnical drillholes (seventeen piggybacked with resource drilling, five geotechnical specific holes);
- 'On-rig' geotechnical logging of rock mass parameters and collection of oriented discontinuity data by Sabina staff and supervised by SRK's site senior;
- Collect representative drill core samples for the purposes of strength properties laboratory testing;
- Limited laboratory strength testing of selected rock samples;
- Review of available exploration drill core by SRK structural geologists; and
- Structural review to determine potential brittle structures intersecting the various mining areas.

2.4 2012 Geotechnical Drilling Program

Preliminary drill planning was laid out in SRK's proposal to Sabina (April 2011) based around 'piggy-backing' geotechnical data collection on exploration drill holes. Adjustment and planning of additional geotechnical drill holes was completed as the project advanced. Table 2.2 summarizes the estimated and actual drill hole meterage completed per deposit.

Table 2.2: Summary of estimated and actual drill hole coverage per deposit

Deposit	Number of Exploration Holes Selected ('Likely' as Indicated by Sabina)	Number of Additional Geotechnical Specific Holes (Estimated)	Estimated Total Meters	Actual Total Meters
Goose	5 (5)	3	1600	319.0
Llama Lake	11 (11)	3	3000	2655.5
Umwelt	13 (5)	2	1800	3359.6
Total	**29 (21)**	**8**	**6400**	**6334.1**

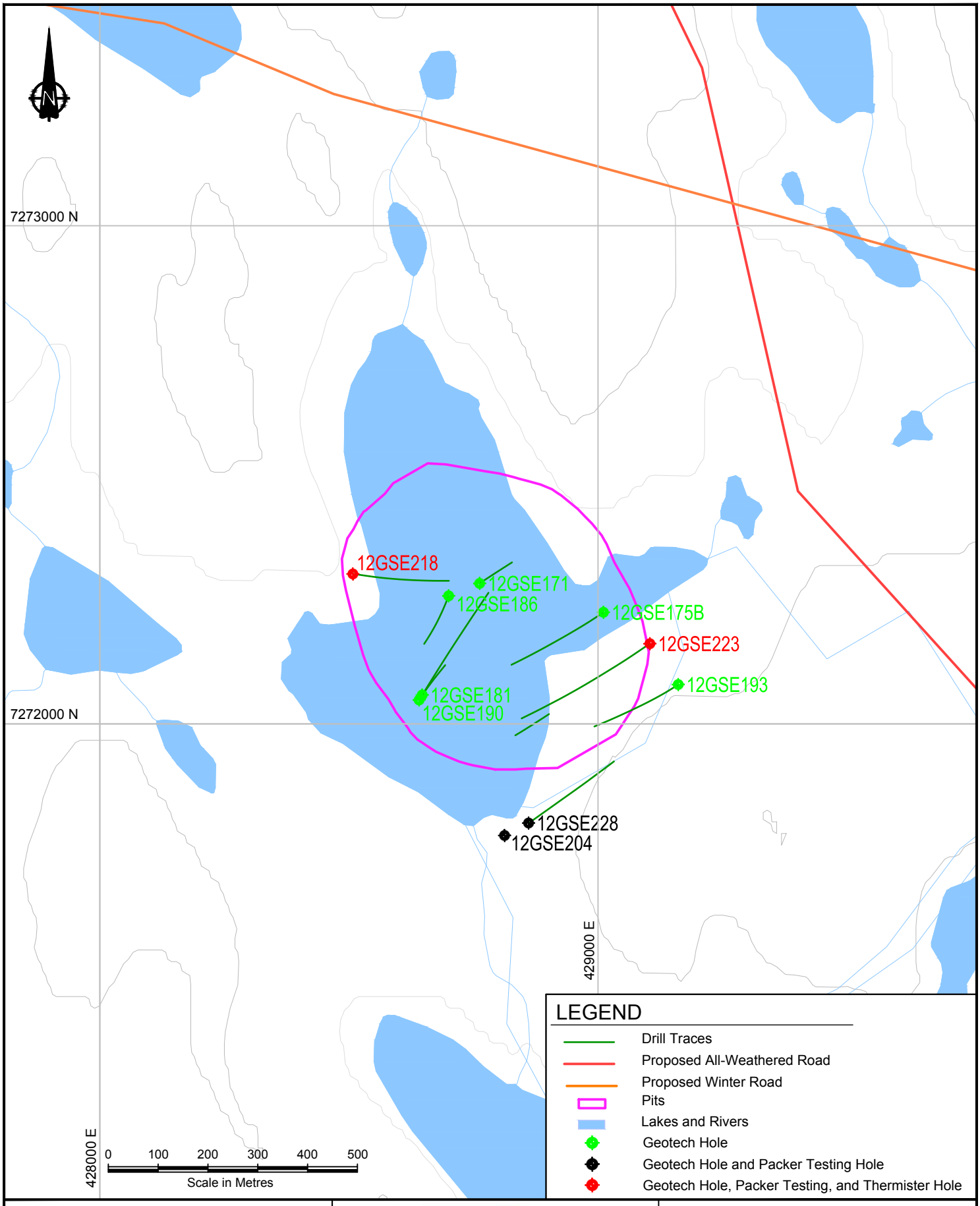
As indicated in Table 2.2, the actual meters completed varied significantly from the estimated.

- At Umwelt, deep holes that Sabina had originally indicated were not likely to be completed were completed toward the end of the program. A number of the holes originally selected by SRK were not completed in the deep underground mining areas based on directives from Sabina's senior management.
- At Goose, due to the significant historical geological drilling coverage there was not significant drilling planned for the 2012 season. As only one drill was available for geotechnical drilling, Umwelt and Llama geotechnical drilling was given priority over data collection at Goose. Historic oriented core data from 2008 drilling is available for Goose to supplement the 2012 data. Note that 8 additional historic holes with core orientation exist at the Goose deposit.

Locations of each drill hole from the 2012 program are shown in Figures 2.5 through 2.7. The location details and purpose for each drill hole is summarized in Table 2.3.

Drilling was undertaken by Major Drilling Group Limited ("Major") over a 24 hour period per day under the supervision of Sabina staff. NQ3 triple tube holes were drilled where possible, however in some cases to control hole deviation NQ2 double tube drilling was employed over the upper portions of the hole. During the program, SRK observed a drilling practice of only using one split tube during drilling. SRK was unable to determine if this was an isolated incident or recurring practice, but resulted in decreasing the confidence of the orientation line due to core spinning in the core barrel.

Drill holes were located on site by Sabina staff, with a ‘heads and tails’ survey completed to confirm dip and azimuth of the drill hole prior to the commencement of diamond coring (typically after casing was set in bedrock). Down hole deviation was surveyed during drilling using a Reflex Ezy-Shot down hole tool, with a Reflex Gyro tool utilized for final down hole survey. The Ezy-Shot is not considered reliable for monitoring of drill hole azimuth due to magnetic interference in the bedrock and is only used to monitor changes in drill hole dip.



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Back River PEA

Llama Pit
General Arrangement

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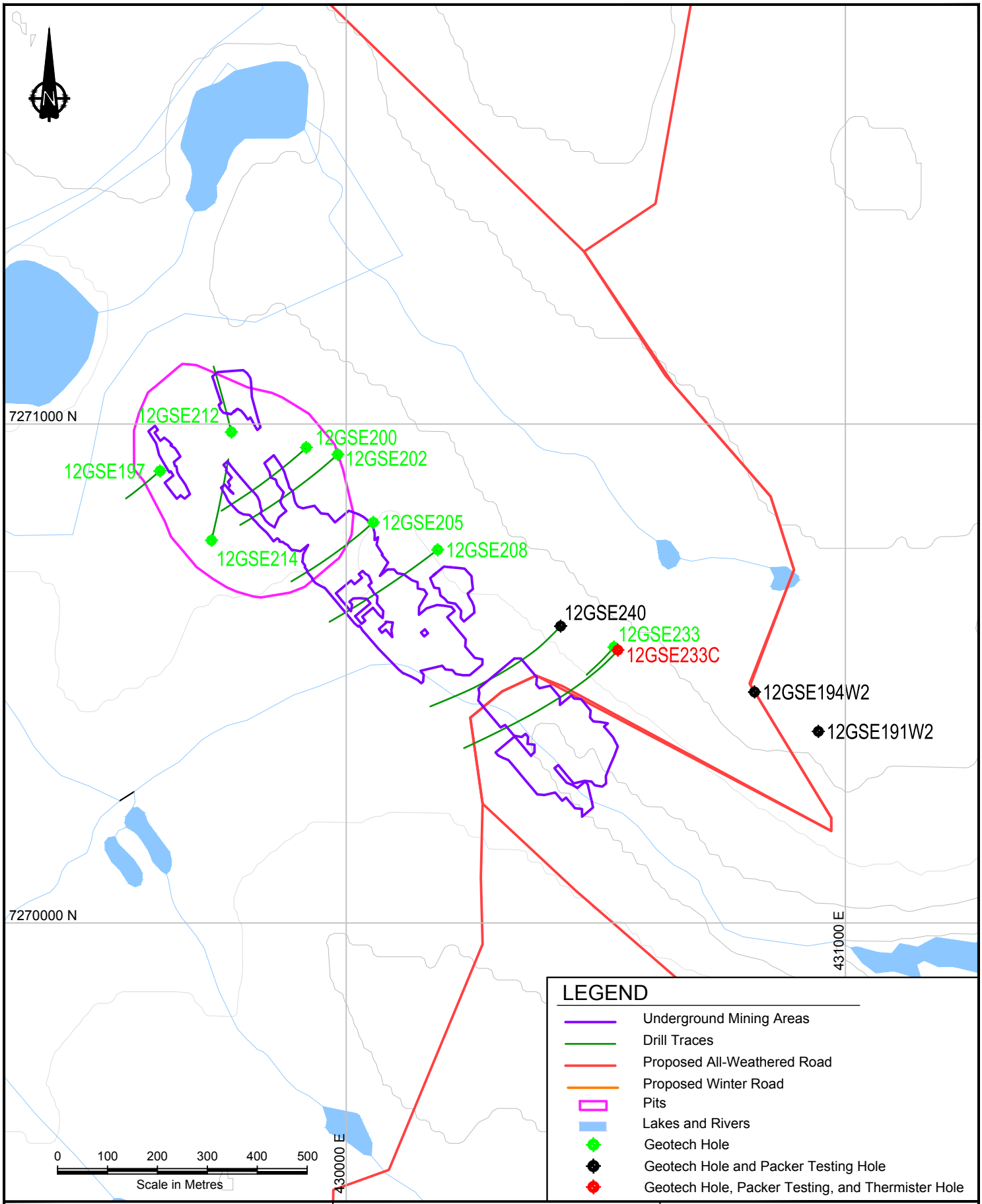

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Back River PEA

Umwelt Pit
General Arrangement

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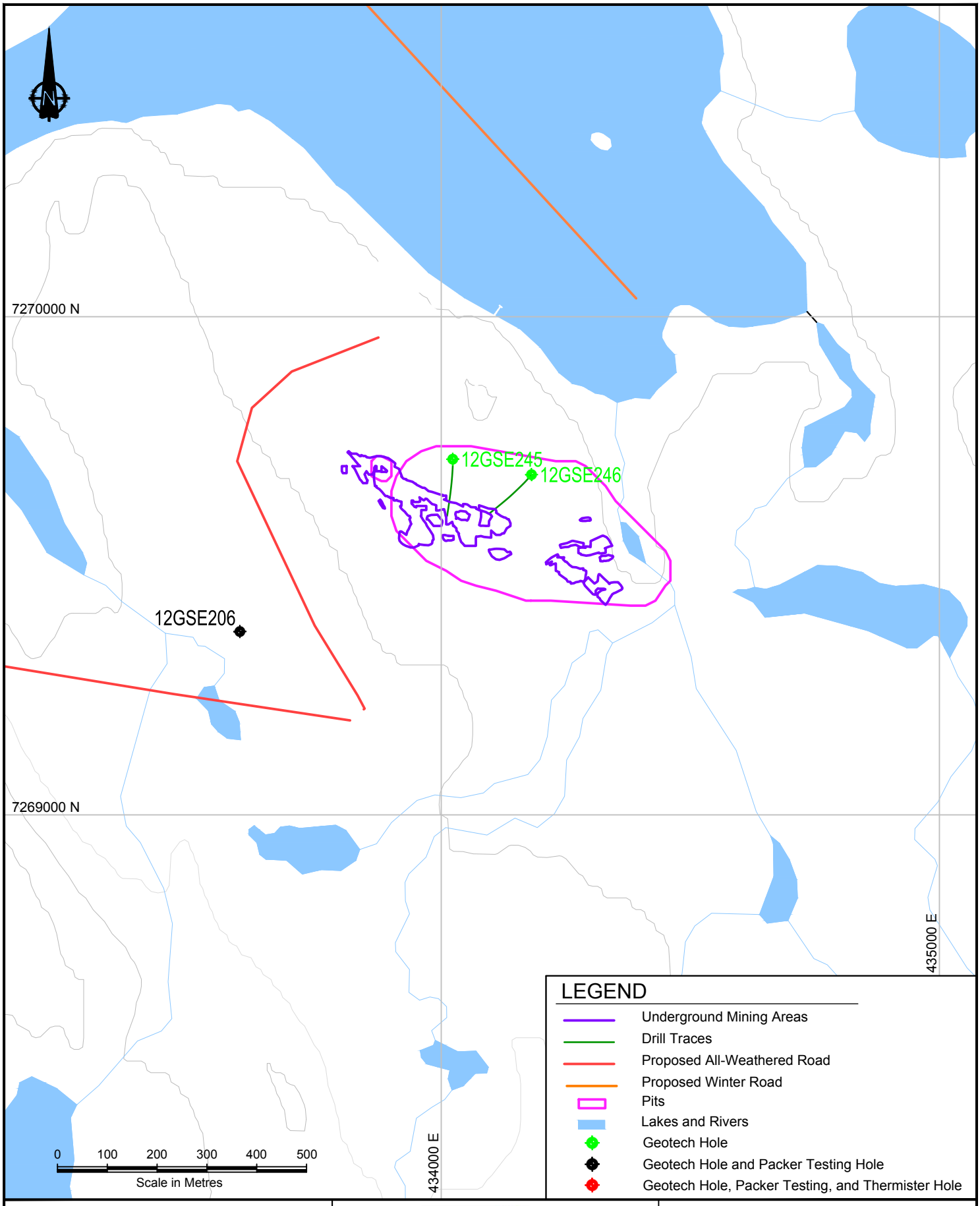

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Back River PEA

Goose Pit
General Arrangement

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Table 2.3: Details of SRK 2012 geotechnical drill holes

Hole-ID	Easting	Northing	Elevation	Length (m)	Azimuth (°)	Dip (°)	Deposit	Core Orientation	Comment/Purpose
12GSE171	428762	7272282	303	122.0	58	-51	Llama	N	Drilled double tube; not logged at drill; structure targeted
12GSE175B	429011	7272224	303	338.0	236	-57	Llama	Y	Open pit rock mass characterization
12GSE181	428647	7272058	303	104.0	34	-47	Llama	Y	Open pit rock mass characterization
12GSE183	428834	7271977	301	153.5	59	-60	Llama	Y	Open pit rock mass characterization
12GSE186	428700	7272257	303	206.0	202	-61	Llama	Y	Open pit rock mass characterization
12GSE190	428641	7272048	303	356.0	33	-46	Llama	Y	Open pit west wall off-axis hole to understand orientation bias
12GSE193	429161	7272079	308	293.0	236	-56	Llama	Y	Open pit rock mass characterization
12GSE197	429627	7270906	303	122.0	229	-47	Umwelt	Y	Open pit structure targeted
12GSE200	429920	7270952	305	305.0	226	-52	Umwelt	Y	Open pit rock mass characterization; shallow underground areas
12GSE202	429983	7270939	304	341.0	228	-50	Umwelt	Y	Open pit rock mass characterization; shallow underground areas
12GSE205	430054	7270803	300	311.0	227	-54	Umwelt	Y	Deep underground mining areas
12GSE208	430183	7270748	305	380.0	232	-50	Umwelt	Y	Deep underground mining areas
12GSE212	429770	7270984	304	230.0	346	-54	Umwelt	Y	Open pit east wall off-axis hole to understand orientation bias; shallow underground areas
12GSE214	429730	7270767	303	254.0	13	-51	Umwelt	Y	Open pit west wall off-axis hole to understand orientation bias
12GSE218	428508	7272301	307	302.0	100	-50	Llama	Y	Open pit west wall off-axis hole to understand orientation bias
12GSE223	429104	7272161	306	401.0	233	-48	Llama	Y	Open pit rock mass characterization
12GSE228	428861	7271801	305	380.0	55	-58	Llama	Y	Open pit potential extension south
12GSE233	430536	7270553	311	161.0	224	-65	Umwelt	Y	Abandoned due to hole deviation
12GSE233C	430544	7270547	311	679.0	224	-68	Umwelt	Y	Deep underground mining areas
12GSE240	430429	7270595	308	576.6	220	-68	Umwelt	Y	Deep underground mining areas
12GSE245	434023	7269714	284	158.0	178	-49	Goose	Y	Open pit north wall characterization
12GSE246	434181	7269683	283	161.0	220	-50	Goose	Y	Targeted major fault structure

2.4.1 Geotechnical Core Logging

Training of four Sabina staff was completed by SRK at the outset of the drilling program, and these staff were on a consistent rotation throughout the duration of the geotechnical program. Core was logged and photographed in the splits by Sabina staff on a run by run basis. A Sabina staff member was at the drill 24 hours per day to supervise drilling and log core prior to placing it in the core boxes.

A site specific geotechnical core logging manual was produced by SRK which details the core logging procedure. This manual is presented in Appendix A5. Data was recorded at the drill digitally in an SRK's proprietary Microsoft Access geotechnical database. The following geotechnical information was recorded for each run where possible:

- Run Length; From, To (m);
- Total Core Recovery (TCR);
- Rock Quality Designation (RQD);
- Fracture Frequency (FF/m);
- Number of discontinuity sets;
- Discontinuity characteristics including discontinuity type; infilling type, infilling properties, roughness, aperture, and wall alteration; and
- Alpha and (where possible) beta angle for each discontinuity.

Lithology data was recorded by Sabina geologists and has not been provided to SRK.

Core Orientation

Core orientation was completed for all geotechnical holes (excluding 12GSE171) using the Reflex ACT II tool. The tool was operated by Major's drillers, who marked the low side of hole location on the core. The purpose of orienting the core is to characterize the orientation of discontinuities in the proposed pit walls and underground mining areas. The following parameters are recorded as part of the oriented core procedures:

- Depth of feature (m);
- Alpha and beta angles (°);
- Discontinuity characteristics including roughness, wall alteration, fill, and aperture.

Only structural features considered to be open in the ground are recorded in the orientation sheet, which includes joints, and joints along foliation. The orientation of veins and features opened during the drilling and handling process are not recorded.

In areas of highly fractured or weak rock, core orientation was rarely possible due to poor recovery, grinding of the core within the core catcher, and also spinning of the rock within the core barrel. If orientation was not possible, then the orientation line would be brought down from the previous run by matching core from the end of the previous run with core from the top of the current run, and where possible utilizing the regionally consistent foliation.

Sabina's staff would note the orientation line offset between each run. This can allow corrections to be made to beta angle measurements along runs with erroneous orientation lines. However as noted previously, the use of only one split tube has affected the confidence of the orientation line due to increased line offsets from core spinning in the core barrel.

Core Photographs

Each core run was photographed in the split tube at the drilling station. Full core box photographs were taken by Sabina at camp and provided to SRK. Both sets of photographs are included in Appendix A7.

2.4.2 Data Quality Assurance and Quality Control

Two stages of quality assurance and quality control ("QA/QC") have been completed for the raw data contained in Appendix A4. The first stage was completed at the project site through the checking of drillhole logs against drilled core by the SRK Site Senior. This process consists of general reviews of the core drilled and the geotechnical log, plus detailed checks on specific runs chosen at random intervals. The purpose of this procedure was to ensure data consistency between loggers and to minimize errors. Alterations to the geotechnical log would then be made as necessary by the Site Senior.

The second stage was completed at SRK's Vancouver office through the review of graphical logs and broad data statistics. Following these checks, the data is considered to be clean of errors and is ready in preparation for data engineering and computation of RMR_{90} or RMR_{89} values. Additional engineering of the data should consider:

- Adjustment of fracture frequency taking into consideration core loss (based on RMR_{90});
- Adjustment of IRS strong values based on UCS results;
- Computation of IRS (measured in MPa) based on RMR_{90};
- Correction for deviation of the orientation line; and
- Correction of alpha and beta measurements to dip and dip direction.

2.4.3 Laboratory Testing Program

A total of 96 core samples were collected for potential laboratory testing from the 2012 geotechnical drillholes. All samples collected were plotted in 3D to understand the spatial distribution of the samples and detailed photos of the samples were reviewed prior to the final selection for testing. UCS samples were chosen based on lithology type, taking into consideration veining intensity, micro-defects, and alteration intensity. 20 selected samples were tested for:

- Basic UCS testing to determine intact rock strength only; and
- UCS with strain gauges to determine intact rock strength, Poisson's ratio (v) and Young's Modulus (E).

At the request of Sabina, the testing program was cancelled and all samples were held awaiting further instruction.

Testing was undertaken by MDH Solutions in Saskatoon. A complete list of all the samples collected is given in Appendix A6. A summary of the UCS testing completed by SRK is presented in Table 2.4, and the laboratory test results as received from MDH Solutions are presented in Appendix A6.

Table 2.4: Summary of UCS testing completed as part of SRK 2012 site investigation

Hole-ID	Sample-ID	From (m)	To (m)	Lithology	Requested Test	UCS (MPa)	Young's Modulus (GPa)
12GSE175B	12GSE175B_UCS-003	176.18	176.37	Interbedded greywacke; siltstone; mudstone	UCS modulus	45.6	9.9
12GSE175B	12GSE175B_UCS-006	261.39	261.64	Felsic dyke	UCS modulus	145.1	14.37
12GSE175B	12GSE175B_UCS-007	296.00	296.30	Oxide Iron formation	UCS modulus	167.1	14.7
12GSE175B	12GSE175B_UCS-008	323.26	323.56	Oxide Iron formation	UCS	221.2	
12GSE186	12GSE186_UCS-001	108.13	108.5	Oxide Iron formation	UCS modulus	213.1	17.1
12GSE186	12GSE186_UCS-002	124.43	124.65	Interbedded greywacke; siltstone; mudstone	UCS	11.1	—
12GSE190	12GSE190_UCS-009	346.20	346.38	Interbedded greywacke; siltstone; mudstone	UCS modulus	12.3	—
12GSE200	12GSE200_UCS_002	120.74	120.97	Greywacke	UCS	156.4	—
12GSE200	12GSE200_UCS_004	170.10	170.28	Sulfide bearing oxide iron formation	UCS modulus	121.12	16.08
12GSE200	12GSE200_UCS_007	255.20	255.45	Massive mudstone; argillite	UCS	56.2	11.8
12GSE200	12GSE200_UCS_008	288.57	288.8	Greywacke	UCS	86.3	—
12GSE202	12GSE202_UCS_001	100.11	100.3	Greywacke	UCS	57.2	—
12GSE202	12GSE202_UCS_004	197.00	197.21	Oxide Iron formation	UCS	315.63	—
12GSE205	12GSE205_UCS_002	127.14	127.32	Interbedded greywacke; siltstone; mudstone	UCS	126.4	—
12GSE205	12GSE205_UCS_003	155.00	155.17	Greywacke	UCS	101.7	—
12GSE205	12GSE205_UCS_005	209.54	209.71	Greywacke	UCS	106.5	—
12GSE208	12GSE208_UCS_001	109.23	109.41	Greywacke	UCS modulus	99.5	9.8
12GSE208	12GSE208_UCS_002	129.01	129.18	Greywacke	UCS	85.9	—
12GSE208	12GSE208_UCS_003	161.43	161.59	Greywacke	UCS	79.5	—
12GSE208	12GSE208_UCS_006	265.20	265.36	Greywacke	UCS modulus	61.7	11.8

3 Hydrogeology Study

3.1 Hydrogeological Objectives

Following SRK's work on the PEA for the Back River deposits (SRK, 2012), a number of hydrogeological uncertainties and associated risks, became apparent. These key areas for consideration are summarized below:

- Thermal characteristics and geothermal gradients for the proposed mining areas.
- Hydraulic conductivity ("K") of the different geologic units and structures.
- Pore pressure at depths of underground development.
- Quality of deep or talik groundwater.

These uncertainties correspond to the following potential risks:

- *Ground temperature and groundwater inflow*. Where mining intersects, connected taliks, or where mining occurs below the base of frozen ground, inflow to the mine workings can be anticipated. Inflowing waters will need to be pumped to the surface or to other storage/management facilities and will be exposed to cold temperatures, requiring consideration for pipeline or storage facility design.
- *Pore pressure*. At depth, below frozen ground, pore pressure may correspond to a potentiometric surface close to the ground surface. Geotechnical assessments will need to take into account the potential for elevated pore pressure, which could affect the design of the openings.
- *Groundwater quality*. Quality of inflowing groundwater and inflow or drilling water that comes into contact with ore or mine developments in ore zones, may not be suitable for discharge without treatment. For the mining areas below the base of the frozen ground, inflowing water should be assumed to be saline. Water treatment may be required and, if so, plans will need to be considered on how the treatment plant waste is managed.

The key objectives for SRK's hydrogeological field data collection studies at Back River corresponded directly to the PEA hydrogeological uncertainties, as described in the above section. SRK proposed a phased approach to the field data collection program.

The initial phase of data collection was to better understand the distribution of permafrost, with respect to depth, temperature and talik characterization. With a better hold on the permafrost, characterisation of hydraulic conductivity (K) of bedrock below the permafrost zone and within taliks could be undertaken.

The second phase was to use the K data to estimate the inflows to open pit or underground workings, as well as pore pressure simulations. A third phase was also discussed with Sabina concerning the collection of groundwater quality samples. The scope of this report covers the first phase of the data collection. The second and third phases of the approach were not undertaken.

3.1.1 Previous Work

SRK carried out a review of the hydrogeology at Back River for the PEA. This report (SRK, 2012) included a conceptualization of the groundwater regime at Back River.

In 2008, a thermistor string was installed in borehole 08-GSE- to the east of the Goose deposit. The data for this thermistor is referenced in the PEA report.

3.2 2011 Hydrogeology Program

Hydrogeological investigations during the SRK 2011 field program comprised of:

- Hydraulic (packer injection) testing in the combined hydrogeological/geotechnical drillholes. Sixteen constant head packer tests were successfully completed within the talik below the permafrost; and
- Installation of multi-bead thermistor strings with integrated vibrating wire piezometer (vibe wire) in three of the geotechnical drillholes.

This section describes the methods used to collect hydrogeological data during the 2012 drilling program. The packer injection testing system is described followed by a description of the quality assurance/quality control ("QA/QC") methods and calculations to obtain hydraulic conductivity. This is followed by a summary of the installation methods used for equipping the drillholes with thermistors and vibe wires. Table 1 summarizes the drillhole details for the hydrogeological testing and installations for the 2012 field data collection work. The locations of these drillholes are presented in Figure 3.1. Thermistor traces are shown in Figures 2.5, 2.6 and 2.7.

Table 3.1: Summary of drillholes used for hydrogeological testing and installations

Hole ID	Northing	Easting	Elev.	DIP	LENGTH	AREA	TARGET
12GSE240	430429.47	7270595.33	307.84	56.0	576.6	Umwelt	SRK geotechnical hole
12GSE233C	430544.15	7270546.54	311.02	56.0	679	Umwelt	SRK geotechnical hole-Thermistor Install
12GSE228	428860.58	7271800.54	304.83	55.0	380	Llama	SRK geotechnical hole
12GSE223	429104.06	7272161.44	305.93		401	Llama	SRK geotechnical hole-Thermistor Install
12GSE218	428507.89	7272301.46	307.40	49.7	302	Llama	Geotech hole targeting the NW pit wall rock. Thermistor installation in lake talik
12GSE206	433595.84	7269367.59	291.74	66.7	581	Goose	SRK geotechnical hole
12GSE204	428812.39	7271776.20	303.69	56.7	473	Llama	SRK geotechnical hole
12GSE194W2	430817.94	7270463.34	314.84	75.1	824	Umwelt	SRK geotechnical hole (wedge hole)
12GSE191W2	430945.80	7270383.80	315.56	75.0	905	Umwelt	SRK geotechnical hole (wedge hole)

Source: \\van-svr0.van.na.srk.ad\Projects\01_SITES\Back River\2CS031.002_Geotech & Hydro PFS\!080_Deliverables\081_DataReport\040_tables
Coordinate Datum: NAD83 UTM Zone 13N

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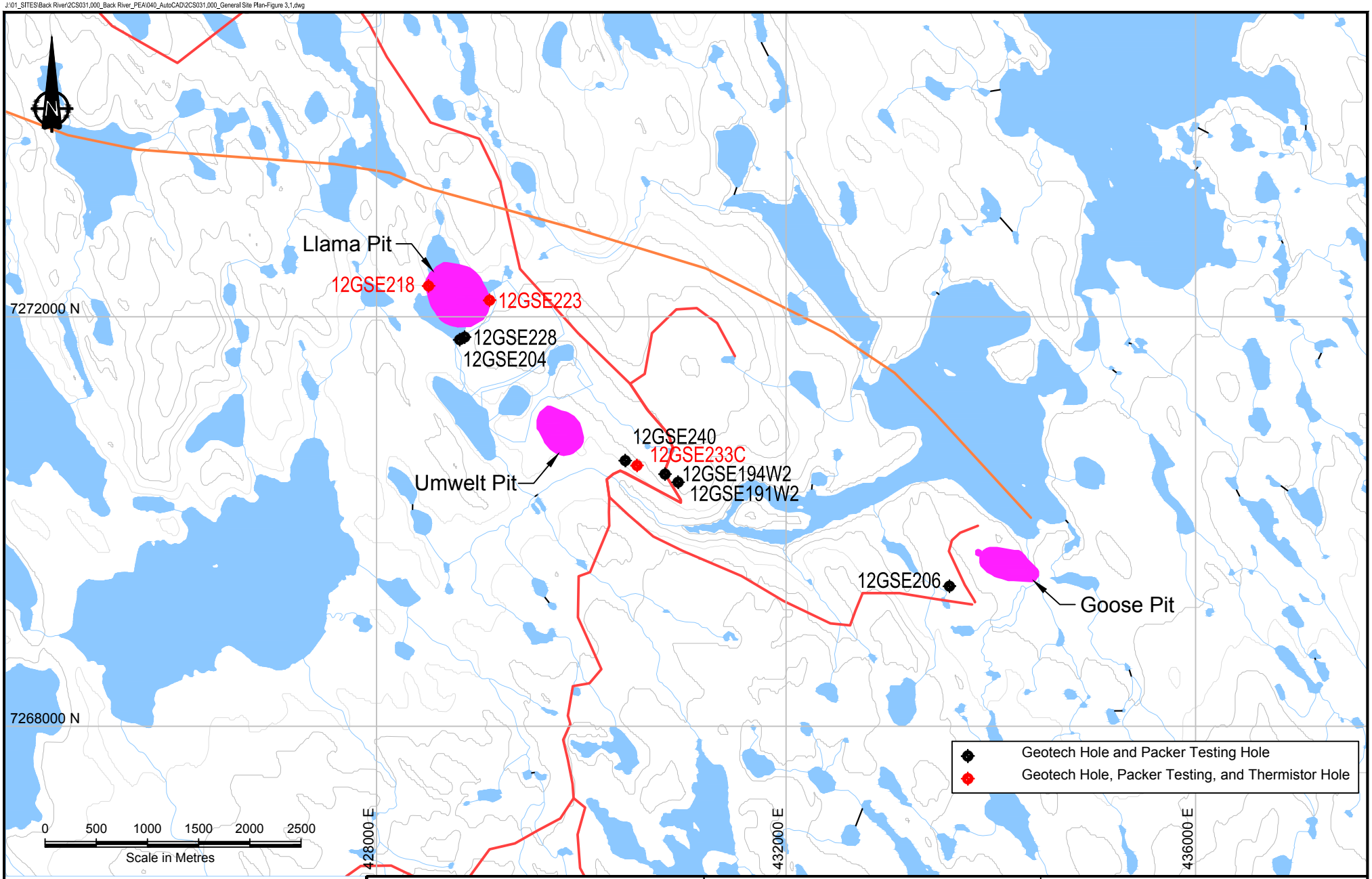

LEGEND

- Proposed All-Weathered Road
- Proposed Winter Road
- Pits
- Lakes and Rivers

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SRK JOB NO.: 2CS031.000

FILE NAME: 2CS031.000_General Site Plan-Figure 3.1.dwg

Sabina Gold and Silver Corporation

Back River PEA

Drillholes with thermistor installations and packer tests

DATE:	APPROVED:	FIGURE:
November 2012	BG	3.1

3.2.1 Packer Injection Testing

The goal of the packer injection testing in 2012 was to determine the variation of the hydraulic conductivity (K) of the bedrock lithologies below the anticipated permafrost zone, and across any lithological contacts or structures intercepted in the drillhole.

The testing was completed by the SRK Site Senior, with assistance from Sabina geotechnical field staff. In addition, a site visit was made by a SRK Senior Hydrogeologist, to provide QC and supervision of the testing methods, installation procedures and data collection. Appendix B1 details the packer testing procedure and theory.

Planning of the packer tests assumed that permafrost was present to approximately 300 mbgs (extrapolated from historical data from the single existing Goose drillhole 08GSE009 thermistor, Rescan 2012).

A total of 16 tests were completed successfully and accepted after an offsite QA process (electronic pressure data and flow data review). Four attempted tests failed due suspected packer bypass, unsuccessful packer inflation, or problems with the shear pins or the inflation valve not deploying correctly. These test results are not included in the final hydraulic conductivity database. The test results are provided in Table 2. Full details of the testwork are provided in Appendix B2.

Table 3.2: Details and Results of packer testing at Goose, Llama and Umwelt

Hole	Deposit Name	Test No	Successful Test	Elevation	From (m)	To (m)	From Vertical Depth (m)	To Vertical Depth (m)	Length (m)	From (Elevation) (m)	To (Elevation) (m)	Total Drilled Depth (m)	Hydraulic Conductivity (K, m/s)	Lithology	Structure	Field Comments on Lithology	Other Field Comments
12GSE191W1	Umwelt	1	N	315.56	899	920	868.4	888.7	19.8	-552.8	-573.1	920	-	Greywacke		Greywacke. Low fracture frequency, fabric breaks throughout.	Used Cacl and DD2000 while drilling, full return. No test performed because wireline broke and had to pull rods to retrieve
12GSE194W2	Umwelt	1	Y	314.84	794	812	767.3	784.7	16.8	-452.5	-469.9	812	3.55E-10	-		Solid Core, very low fracture frequency	Artesian pressures exist ~ 5psi, 95% return
12GSE204	Llama	1	Y	303.69	383	405	320.1	338.5	20.8	-16.4	-34.8	405	1.20E-09	Greywacke		Greywacke and Iron formation with a graphitic zone	Likely still in permafrost, however drilling beside a lake. 1st attempt IVS opened before leak test, 2nd attempt good test, artesian flow measured.
12GSE206	Goose	1	Y	291.74	518	539	475.6	494.9	19.8	-183.9	-203.2	519	7.60E-09	Greywacke/ Mudstone		IF (rock type) with interbedded mudstone, mudstone contact AT 535.78 m, low fracture frequency.	Good return, Good fluctuating flow rate throughout the injection
12GSE218	Llama	1	Y	307.4	143	203	109.1	154.8	58.8	198.3	152.6	302	5.10E-09	Greywacke		Greywacke, very solid/competent	Poor return at early stages of drilling, lowered casing. Good test quality.
		2	Y	307.4	239	269	182.3	205.2	28.8	125.1	102.2	302	5.80E-09	Greywacke	Fault	Fault between 245 to 248 m tested. Very fractured zone of greywacke, heavy M.O.'s	Good test quality
		3	Y	307.4	269	302	209.1	234.7	31.8	98.3	72.7	302	2.95E-10	Greywacke		Greywacke	EOH test
12GSE228	Llama	1	Y	304.8	160	380	131.1	311.3	218.8	173.7	-6.5	380	2.5E-10	-	Fault @ 175 m	-	Difficult hole, rods stuck around faults @175 m.
12GSE233	Umwelt	1	Y	311	346	394	286.8	326.6	46.8	24.2	-15.6	394	1.45E-11	-	-	Solid, good quality core	Injection test below permafrost. Flow almost the same as leak
		2	Y	311	394	442	314.7	353.0	46.8	-3.7	-42.0	422	1.35E-11	-	-	Good core	Good test quality
		3	Y	311	442	490	338.6	375.4	46.8	-27.6	-64.4	490	1.25E-11	Greywacke	Permafrost	Solid core	Permafrost test, good quality
		4	N	311	490	526	368.7	395.8	34.8	-57.7	-84.8	526	-	Greywacke, interbedded IF	-	-	Test abandoned
		5	Y	311	490	565	365.3	421.2	73.8	-54.3	-110.2	565	4.55E-10	-	Permafrost	Solid, tight rock	Retest permafrost zone, good quality test
		6	N	311	565	625	407.8	451.1	58.8	-96.8	-140.1	625	-	Interbedded IF	Permafrost	-	Permafrost profiling. Failed test, IVA did not open
		7	Y	311	565	679	402.3	483.5	112.8	-91.3	-172.5	679	1.4E-09	Interbedded	Permafrost	-	Permafrost profiling,

Hole	Deposit Name	Test No	Successful Test	Elevation	From (m)	To (m)	From Vertical Depth (m)	To Vertical Depth (m)	Length (m)	From (Elevation) (m)	To (Elevation) (m)	Total Drilled Depth (m)	Hydraulic Conductivity (K, m/s)	Lithology	Structure	Field Comments on Lithology	Other Field Comments
														IF			good quality test
12GSE240	Umwelt	1	N	307.8	317	365	262.8	302.6	46.8	45.0	5.2	365	3.8E-09	Greywacke	Permafrost profiling		Less pressure than 12GSE233C. Not a good test, packer not inflated properly or tool length wrong
		2	Y	307.8	335	413	269.6	332.4	76.8	38.2	-24.6	413	1.9E-10	Greywacke	Permafrost	Solid, tight rock	Permafrost profiling
		3	Y	307.8	413	464	312.6	351.2	49.8	-4.8	-43.4	464	2.8E-09	Greywacke	-	Solid, tight rock	Good test quality, could not deflate packer, pulled through bit inflated
		4	Y	307.8	464	539	332.6	386.4	73.8	-24.8	-78.6	539	1.5E-09	Greywacke, interbedded IF	-	Solid, tight rock	Good test quality
		5	N	307.8	539	575	372.4	397.3	34.8	-64.6	-89.5	575	-	Greywacke, interbedded IF	-	-	Trouble pressuring/inflating the packer

Source: \\van-svr0.van.na.srk.ad\Projects\01_SITES\Back River\2CS031.002_Geotech & Hydro PFS\!080_Deliverables\081_DataReport\040_tables

Quality Assurance/Quality Control of Injection Tests

The test quality was verified by observing the packer tool seal quality prior to inflation, the packer inflation behaviour, and the flow rate history during the test. A Leak Test was also carried out as part of the routine test procedure before the activation of the injection valve, to test for leaks in the rod string, landing ring seal, and flow meter system at the specified pressure (planned test pressure). If significant leaks were observed, the packer tool was reset to obtain a better landing ring seal, or the test zone was moved. If a minor leak was detected, the flow was subtracted from the injection flow rate observed during the test.

Based on SRK's experience, the overall low flow limit of the system is approximately 0.02 L/min. Where no flow was observed in a test, a flow of 0.01 L/min was entered into the calculation sheets, typically producing a result around $1x10^{-11}$ m/s, below the reasonable limit of the system. It is possible that the actual hydraulic conductivity in these test zones is much lower. The results appended to this report are the values generated from the numeric calculation sheets using 0.01 L/min flow for tests with no observable flow.

All test results were reviewed by the Site Senior or a Hydrogeologist in the field and compared to the drill core to ensure the test results were reasonable and the forms were complete. After the field program, a Senior Hydrogeologist reviewed all tests, comparing the field notes and manually recorded flows and pressures to the down hole transducer and pressure records, which were plotted to show test behaviour. The graphs are provided in Appendix B2. After plotting, the digital data were matched to the manual readings, and a correlation factor was calculated to calibrate the digital records.

Manual readings for flow and electronic down hole pressure readings were used to calculate the hydraulic conductivity. Electronic records of flow were useful to determine what happened during a test, and as a comparison and QA/QC check.

3.2.2 2012 Installation of Thermistors with Vibrating Wire Piezometers

A total of three thermistors were installed within the Back River concession. The objective of the installations was to obtain a better understanding of the distribution of ground temperatures through the permafrost and talik across the area, both spatially and to depth, and in particular what the effect the nearby lakes has on the distribution of permafrost. The thermistors used were manufactured by RST Instruments. The datasheet for the thermistors can be viewed at http://www.rstinstruments.com/Thermistor%20Strings.html.

After completion of the hole, the thermistors were attached to a PVC guide tube and lowered into the well. Once the thermistor and PVC were in place and resting on the bottom of hole, the hole was flushed with fresh water through the drill rods until the return water was recorded as having a total dissolved solids (TDS) of <5 g/L. The drill rods were then removed and the datalogger was connected. The thermistors were allowed to freeze in place.

The ground temperature data collected by the dataloggers should be considered 'early time' data, and the sensors have probably not fully settled out to reflect the ambient subsurface conditions. In particular, this is the case with the dataset from the last installed thermistor in 12-GSE-233C.

Table 3 summarizes the installations. Further details on quotes and serial numbers for each thermistor string and datalogger, and calibration records for the vibrating wire piezometers are provided in Appendix B3.

Table 3.3: Summary of thermistor installations at Back River

Drillhole	Deposit	Bead locations (m along hole)	Target/ Objective of Thermistor	Vibe Wire?	Datalogger?
12-GSE-218	Llama (NW)	285, 260, 235, 210, 185, 160, 135, 110, 85, 60, 35	Talik depth below Llama lake	Yes	Yes
12-GSE-223	Llama (SE)	390, 370, 350, 330, 310, 290, 270, 250, 230, 210, 110	Permafrost depth away from Llama lake	Yes	Yes
12-GSE-233C	Umwelt (SE)	565, 515, 465, 415, 65, 315, 265, 215, 65,115, 65	Permafrost depth away from Llama lake	Yes	Yes

3.2.3 Vibrating Wire Piezometers

On the end of each thermistor string, a vibrating wire piezometer (vibe wire) was installed. The vibe wires used were manufactured by RST Instruments. The datasheet for the vibe wires can be viewed at http://www.rstinstruments.com/Vibrating%20Wire%20Piezometer.html.

The objective of the vibe installations was to collect pore pressure information from below the permafrost, in the likely areas for future underground mine operations. The vibe wire sensors were pre-moulded onto the thermistor string.

For vibe wire calibration purposes, readings were taken before installation, after installation in the hole but before grouting, and then on a 6 hour frequency (as per the datalogger program) after grouting to monitor the stabilization of the vibe wire as the grout set. Readings were monitored and recorded on a Campbell Scientific datalogger. Installation data and calibration results are found in Appendix B4.

It should be noted that vibrating wire piezometers are subjected to a number of instrument, density and positional errors, such as cable stretch, surveying errors, PVC buckling and variability in PVC/drill rod length. Therefore, SRK recommends that caution should be taken when using vibrating wire data as a measure of absolute water levels.

3.3 Data Collection

As per the request from Sabina, thermistor and vibe wire data was collected using Flexdaq 1000 dataloggers (Campbell CR1000 Logger) with compact flash card module and PS100 Battery unit. The dataloggers were supplied by RST Instruments. These dataloggers are used as standard across the project site to facilitate data downloads and database formatting.

Details of battery charging checks and procedures are found in Appendix B3.

Date was downloaded (October 5, 2012) just prior to the break-up of the Back River Camp. This data was corrected to vertical depth, and is provided in electrical format in Appendix B5 DVD-1.

4 Summary

4.1 Geotechnical

The geotechnical data collected during the Back River Pre-Feasibility 2012 Data Collection Program included the following:

- Geotechnical and oriented core data collection from 22 diamond core drill holes across the Umwelt and Goose underground and open pit mining areas, and Llama open pit.
- Geotechnical data collection completed at the drill on and 24 hour per day basis.
- Mine scale structural review of the Umwelt, Goose and Llama deposits including modeling of 3D wireframes of interpreted brittle faults and air photo interpretation.
- Limited laboratory testing for intact rock strength parameters.

4.2 Hydrogeology

The hydrogeological data collected during the Back River Pre-Feasibility Summer 2012 Field Data Collection Program included the following:

- 16 injection tests using IPI packer system within the talik zones at the Back River deposits.
- Locations/opportunities for hydraulic testing were limited during the 2012 field program by the lack of ice drilling (for lake talik testing) and by the tight resource drilling planning and schedule.
- Installation of multi-bead thermistor strings in 3 drillholes at the Llama deposit (2 installations), and at the Umwelt deposit), to complement the existing thermistor located at the Goose deposit. Dataloggers programmed to record ground temperature and hydraulic pressure on 6 hour intervals.
- Collection of the early data from dataloggers indicates that thermistors and vibe wires have not yet settled to their ambient conditions.

5 Recommendations

5.1 Geotechnical

- Completion of laboratory testing program utilizing the remaining samples stored at MDH Solutions laboratory in Saskatoon.
- Engineering and computation of geotechnical and oriented core data as described in section 2.4.2.

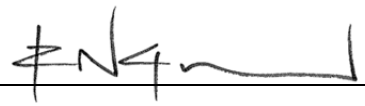
5.2 Hydrogeology

- Data to be downloaded off the datalogger twice a year; once as the dataloggers become accessible in the spring, and once before winter.
- The next phase of hydraulic testing should identify and test key areas such as:
  - Shallow Lake talik (ice drilling) at the Llama deposit.
- Additional thermistor strings should be installed to refine understanding of the presence and distribution of permafrost around proposed developments.
  - One thermistor string between the Goose Pit and Goose Lake to refine the spatial understanding of permafrost interaction with Goose Lake (this was not possible in 2012 field season as no resource drilling was carried out in this area).

This report contains data collected from the SRK 2012 geotechnical and hydrogeological field investigations from the Back River project. If you have any questions regarding this information please do not hesitate to contact the undersigned.

This report, "**Back River 2012 Geotechnical and Hydrogeological Drilling Program - Factual Data Report**", has been prepared by SRK Consulting (Canada) Inc.

Prepared by



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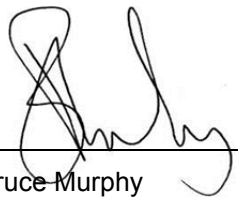

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All data used as source material plus the text, tables, figures, and attachments of this document have been reviewed and prepared in accordance with generally accepted professional engineering/geoscience and environmental practices.

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References

SRK Consulting (Canada) (Inc). 2012.
BackRiver_PEA_Report_2CS031.000_Sabina_JY_20120629.

Singhal B.B.S., and Gupta R.P. 2010. Applied hydrogeology of fractured rocks: second edition. Springer, Dordrecht, Heidelberg, London, New York. 408 pp.

Rescan 2012: Thermistor Data Summary, Back River Project. Memorandum.

Appendix A:
Geotechnical Data (Provided on DVD)

DVD not included in this version of the report.

Appendix B:
Hydrogeology Data

Appendix B1:
Injection Test Theory & Analysis

Injection Test Analysis – Radial Flow Analytical Solution

All injection tests were carried out at constant pressure. Manual readings of average flow and pressure for each test were entered into an SRK-generated spreadsheet that calculated the hydraulic conductivity (K). The injection rate varies during the test, usually starting at high rate and levelling off to a stable value if the test pressure is held constant. The initial unstable flow rate is caused by storage effects and other hydraulic effects; whereas, the stable flow rate is the most appropriate for use in these hydraulic conductivity calculations. The longest time step is then used to determine one K value for each test.

Assuming that the test is performed in a single borehole with no observation wells, the transmissivity of the tested interval can be determined using the Thiem equation (Singhal and Gupta 2010):

$$T = \frac{Q_i}{2\pi s} \ln \frac{R}{r_b} \quad (1)$$

where *T* is the transmissivity perpendicular to the axis of the borehole [m^2/s], Q_i is the steady injection rate [m^3/s], *s* is the drawdown [m], *R* is the radius of influence [m] (assumed to be 10m), and r_b is the radius of the borehole [m] (or radius of well in original equation).

The transmissivity is then related to the hydraulic conductivity *K* [m/s] using:

$$T = K b = K L \quad (2)$$

where *b* is the "aquifer thickness", in this case b = L, the length of the test interval [m].

The drawdown occurs during pumping tests, but during an injection test, the reverse occurs and there is a mounding of water near the well. Inside the well, the reverse of drawdown is the net injection head applied to the test zone (H_{nit}). Replacing drawdown with the net injection head (H_{nit}) in Equation 1 and solving Equation 2 for hydraulic conductivity, the hydraulic conductivity is:

$$K = \frac{Q_i}{L\, 2\pi\, H_{nit}} \ln \frac{R}{r_b} \quad (3)$$

During testing only the Q and H_{nit} parameters change, while other parameters depend on test zone geometry and do not change during test.

Net injection head (the driving head of injection flow) is calculated as the injection pressure is applied, adding the water column above static level and subtracting friction losses:

$$H_{nit} = \frac{\left(D_w' + H_g - H_f\right) + P_g}{1.42} \quad (4)$$

where D_w' is the vertical depth to static water level, H_g is pressure gauge height above ground, H_f is friction loss of the flow system (pump, hoses, packer tool), P_g is gauge pressure applied by pump.

Friction loss is a minor component of H_{nit} and it is estimated using the following formula:

$$H_f = 8.65 \times 10^{-15}\, Q^2 \frac{L_p}{r_p^5} \quad (5)$$

where L_p is length of discharge pipe, r_p is radius of discharge pipe. H_f increases with flow rate (friction loss only becomes significant at high injection flow rates).

Other factors affect results in the fractured rock itself that are not explicitly calculated, but may be important in some circumstances:

- Fracture plugging with drill cuttings; fracture cleaning during testing; and
- Injection water viscosity (use of drilling gels may be overcome by increasing injection pressure).
- There are also operational limitations such as flow gauge sensitivity, flow meter sensitivity, and pump output stability (e.g. oscillations in pressure and flow).

Uncertainty analysis shows that the flow rate can be measured to within 5% of the actual flow in most tests using a cumulative flow meter averaging over a 30 second time interval. Pressure data can be noisy and can drift over time despite adjustments and is usually within 10% of target pressure. Pressure control is the limiting factor in accuracy of the tests in moderately permeable test zones. In low permeability test zones, any leaks in the system become progressively more important as most of the small injection flow may be explained by rod leak in some tests and this leak value is measured before each test. In high permeability test zones, the injection flow rate error becomes the dominant error because pressure is usually stable but flow rate is large and difficult to measure (usually within 10%). In low permeability test zones, the flow estimate may contain up to +100% error (e.g. a measured flow of 0.01 L/min could be 0.02 L/min), although this would not impact results significantly as flows are so low.

Appendix B2:
2012 Packer Test Field Data Sheets

PACKER INJECTION TEST SETUP

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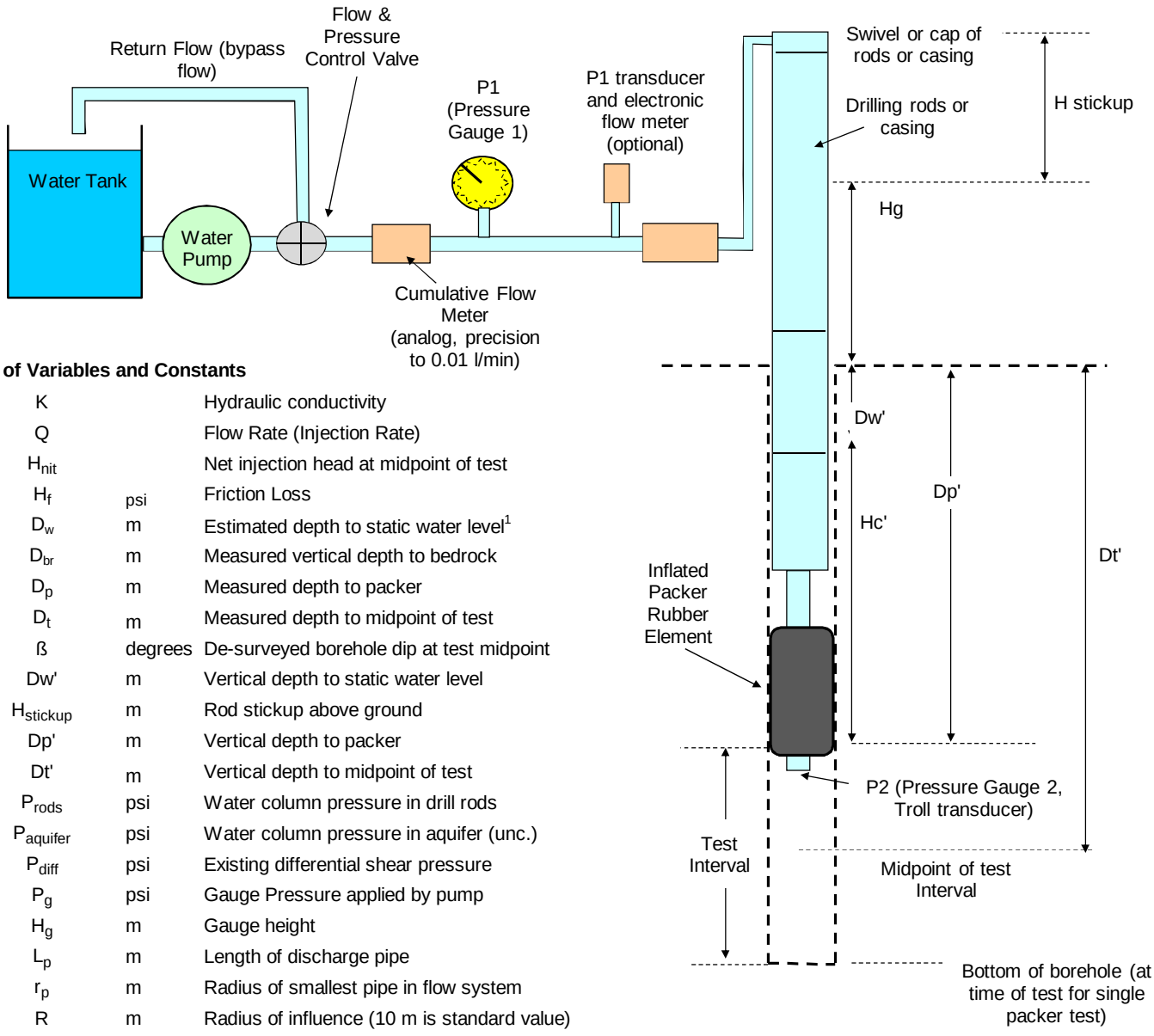
Variable	Units	Equation	Description
Pgmax	psi	vertical depth top test zone * 1.5	Maximum allowed Pressure to avoid hydrojacking:
Pgmax	psi	vertical depth top test zone * 1.5	Maximum allowed Pressure to avoid hydrojacking:
P1 (surface)	psi		Surface gauge pressure in flow system (observed)
$P2_{nit}$ (downhole)	psi	$P_2 - P_{atm - Dw' - Dp'}$	Downhole pressure transducer datalogger (Troll type)
Step duration	min		Approximate duration of test step
Q (flow rate)	l/min		Stable injection flow rate based on observations
system leak	l/min		Measured leak from system (rod joints, hose couplings, etc)
Q (adj.flow rate)	l/min	Q (adj) = Q - system leak	Stable injection flow rate - leak rate
H_f (friction loss)	m	$Hf = 8.65x10\text{-}15\ (Q^2*Lp/r_p^5)$	Friction loss of flow through smallest diameter components.
H_{nit} (net inj.head)	m	Hnit = (Dw'+Hg-Hf)+P1/1.42	Net injection head in test zone.
K1	m/s	$K = (Q*Ln(R/rb)) / 2*\pi*Hnit*L)$	Calculated from P1, where Hnit = (Dw + Hg-Hf)+P1/1.422
K2	m/s	$K = (Q*Ln(R/rb)) / 2*\pi*P2/1.422*L)$	Calculated from P2, where Hnit = P2/1.422



List of Variables and Constants

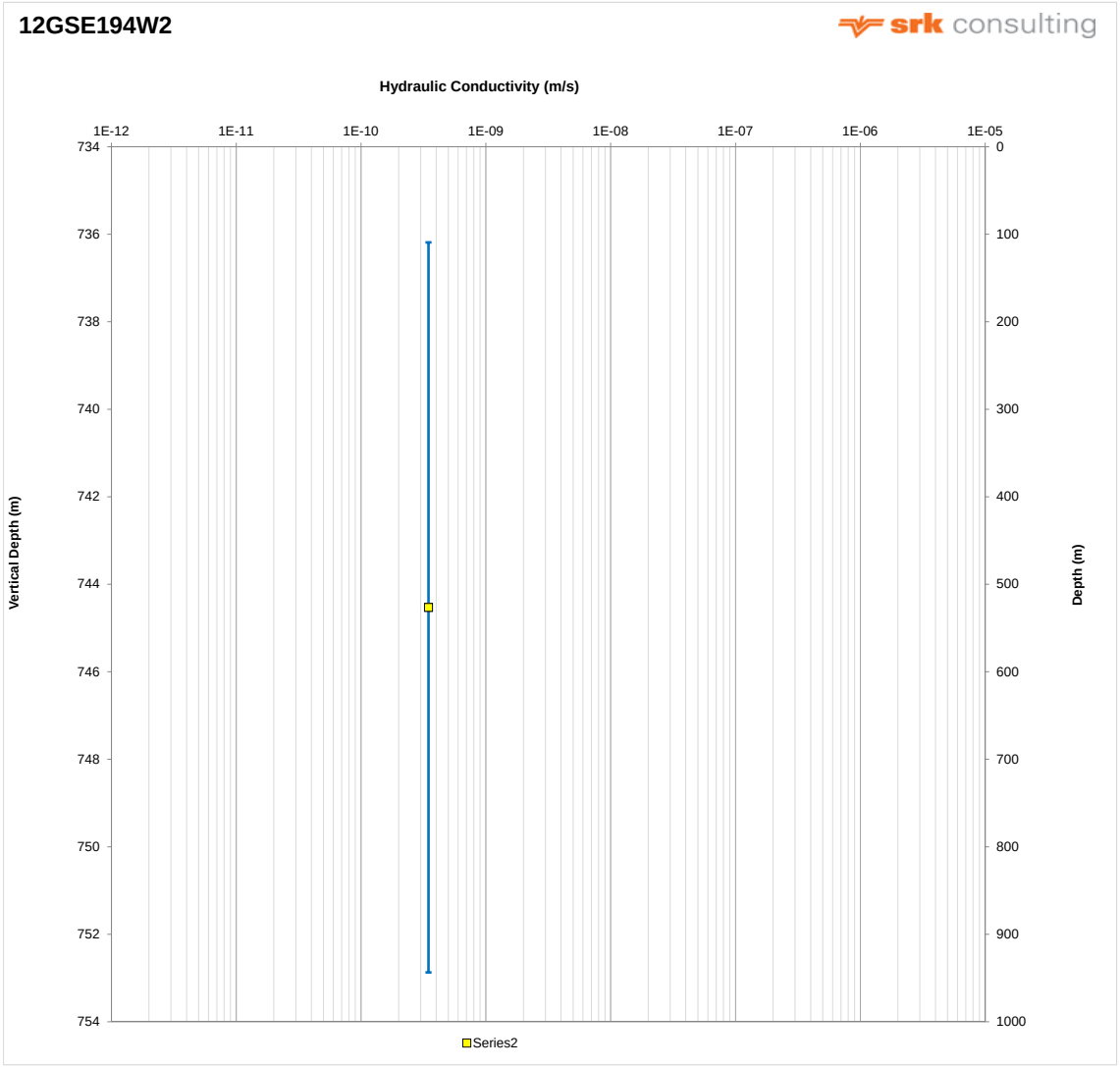
K		Hydraulic conductivity
Q		Flow Rate (Injection Rate)
H_{nit}		Net injection head at midpoint of test
H_f	psi	Friction Loss
D_w	m	Estimated depth to static water level[1]
D_{br}	m	Measured vertical depth to bedrock
D_p	m	Measured depth to packer
D_t	m	Measured depth to midpoint of test
ß	degrees	De-surveyed borehole dip at test midpoint
Dw'	m	Vertical depth to static water level
$H_{stickup}$	m	Rod stickup above ground
Dp'	m	Vertical depth to packer
Dt'	m	Vertical depth to midpoint of test
P_{rods}	psi	Water column pressure in drill rods
$P_{aquifer}$	psi	Water column pressure in aquifer (unc.)
P_{diff}	psi	Existing differential shear pressure
P_g	psi	Gauge Pressure applied by pump
H_g	m	Gauge height
L_p	m	Length of discharge pipe
r_p	m	Radius of smallest pipe in flow system
R	m	Radius of influence (10 m is standard value)
r_b	m	Borehole radius
L	m	Length of test section

Notes: 1: If hole is dry enter Dw = Boring Depth; if AQUIFER water level at test zone above ground surface use negative value

Client hole ID:	12GSE194W2

depth to bedrock 1 m
Planned dip 68.0

Test	Date	Time	Time not drilled (hours)	Test Interval - Depth along hole (m) Top	Bottom	Mid point	Interval Length	hole dip at this test interval for correcting vertical depth to borehole survey	Test Interval - Vertical depth (m) Top	Bottom	Interval Length	Mid point	Flow > Max Flow Rate?	Hydraulic conductivity (m/s) K1	K2	tests where K > measured (max flow rate supplied)	Field QA/QC	Field QA/QC Quality	Field QA/QC Comments	static water level (from pressure transducer) before tests (m below ground) using planned dip (don't use)	from de-surveyed dip at mid test depth
1	Aug 16, 2012	2:00 PM	0.0	794.0	812.0	803.0	16.8	68.00	736.2	752.9	16.7	744.5	FALSE	3.6E-10	3.5E-10						
		AVG	0.0																		
		TOTAL	0.0																		



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PACKER INJECTION TEST

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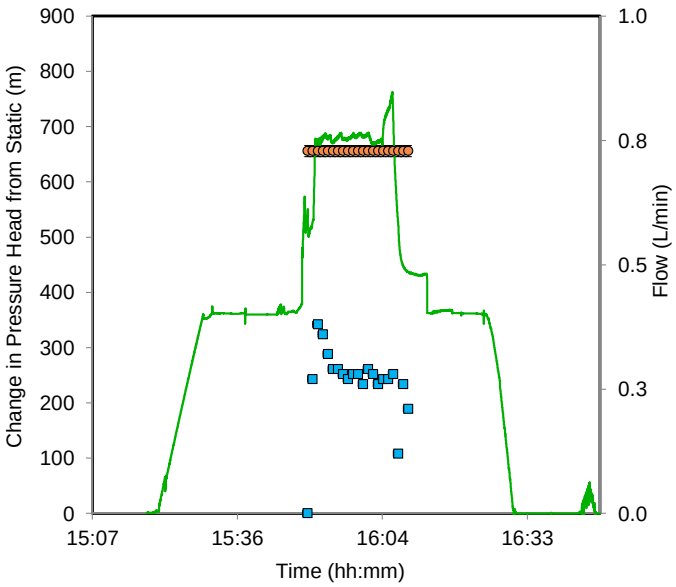
Location Description		Test Interval		Date (m/d/y)	Time
Drillhole ID:	12GSE194W2	Test Number:	1	Start:	8/16/12	9:00
Drillhole ID 2:	LBP-2	From depth (m):	794.0	End:	8/16/12	13:00
Location:	Llama	To depth (m):	812.0	Supervisor:	SC/TC	
Project Number:	2CS031.002	Drilled depth (m):	203.0	Water Table (m):	100.00	

Test zone comments & results

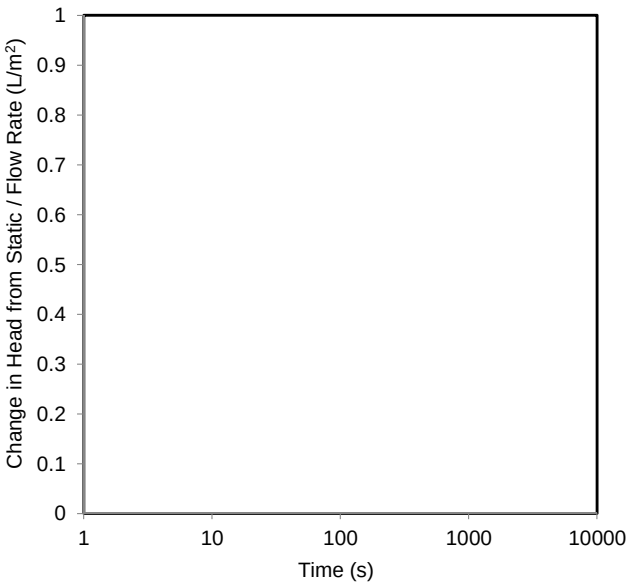
Test purpose & type:	Training TC and JP on using the IPI SWPS for Injection testing
Drilling comments:	Do not have full return (returns at 95%), using a 20% CaCl solution for drilling, Artesian pressurses exist in the hole
Geology, hydrogeology & rock mass:	Very low FF, no joints apparent in test interval, Artesian pressures exist in the hole.
Test quality:	Good test, artesian pressures ~5psi

Pressure and Flow Rate vs. Time Graph



- Pressure from surface gauge (manual readings, uncertainty shown by vertical bars)
- Pressure from transducer below packer (differential pressure in test zone)
- Flow rate from cumulative flow meter (time period of reading shown by horizontal bar)

Diagnostic Plot



- Differential pressure data from transducer below packer (data averaged over 3 second intervals)
- Derivative of differential pressure data from transducer below packer (data averaged using a logrithmic sampling interval)

Summary of Calculation Results

	psi
P_{max} (hydrojacking)	1104.3
P1 (surface)	800.0
$P2_{nit}$ (downhole)	967.0

	l/min
Q (flow rate)	0.30
System leak	0.00
Q (adj.flow rate)	0.30

H_f (friction loss)	m	0.00
H_{nit} (net inj.head)	m	655.8
K1 (surface)	m/s	**3.6E-10**
K2 (downhole)	m/s	**3.5E-10**

Variables and Constants

D_w	100.0	m	$P_{aquifer}$	915	psi
D_{br}	1.0	m	P_{diff}	135	psi
D_p	794.0	m	P_g	800	psi
D_t	803.0	m	H_g	0.5	m
ß	68.0	deg.	L_p	2.50	m
Dw'	92.7	m	r_p	0.0075	m
$H_{stickup}$	1.9	m	R	10	m
Dp'	736.2	m	r_b	0.048	m
Dt'	744.5	m	L	18.0	m
P_{rods}	1050	psi			

Drilling and testing

Rod size	**HQ**
Water	Muddy Water
Additive	mixed Muds
Drill type	Diamond Drill
Packer Tool	SWIPS

Pressure monitoring

Below Packer (transducer)	√
Above packer (transducer)	
Surface (flow meter)	
Surface (manual)	√
Other	

Flow monitoring

Electronic	
Cumulative	√
Other	

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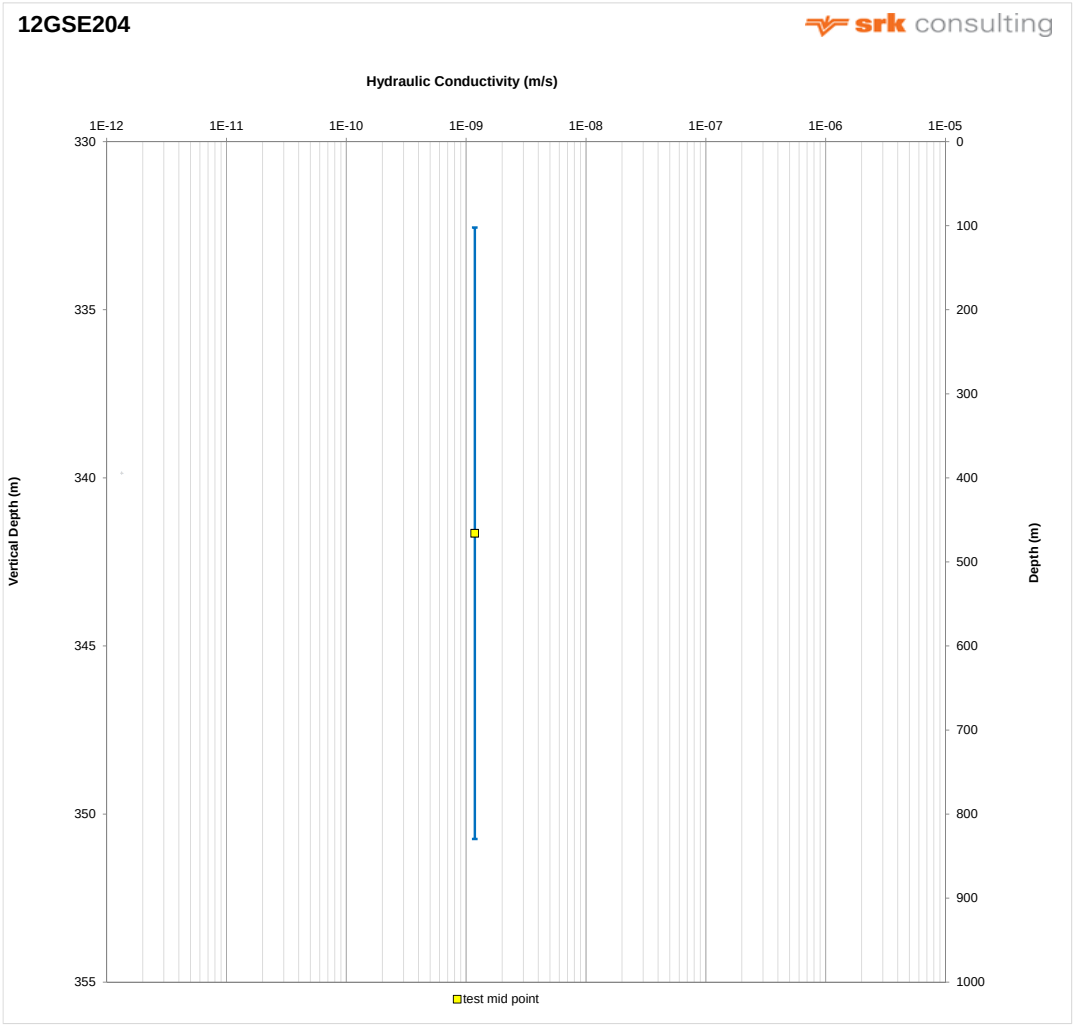
Client hole ID:	12GSE204

Test	Date	Time	Time not drilled (hours)	Test Interval - Depth along hole (m) Top	Bottom	Mid point	Interval Length	hole dip at this test interval for correcting vertical depth to borehole survey	Test Interval - Vertical depth (m) Top	Bottom	Interval Length	Mid point	Flow > Max Flow Rate?	Hydraulic conductivity (m/s) K1	K2	tests where K > measured (max flow rate supplied)	Field QA/QC	Field QA/QC Quality	Field QA/QC Comments	static water level (meters along borehole)	static water level (from pressure transducer) before tests (**m below ground**) using planned dip (don't use)	from de-surveyed dip at mid test depth
1	Jun 19, 2012	4:00 PM	27.0	384.0	405.0	394.5	19.8	60.00	332.6	350.7	18.2	341.6	FALSE	1.1E-09	1.2E-09					-		
2																						
3																						
		AVG	27.0																			
		TOTAL	27.0																			



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PACKER INJECTION TEST

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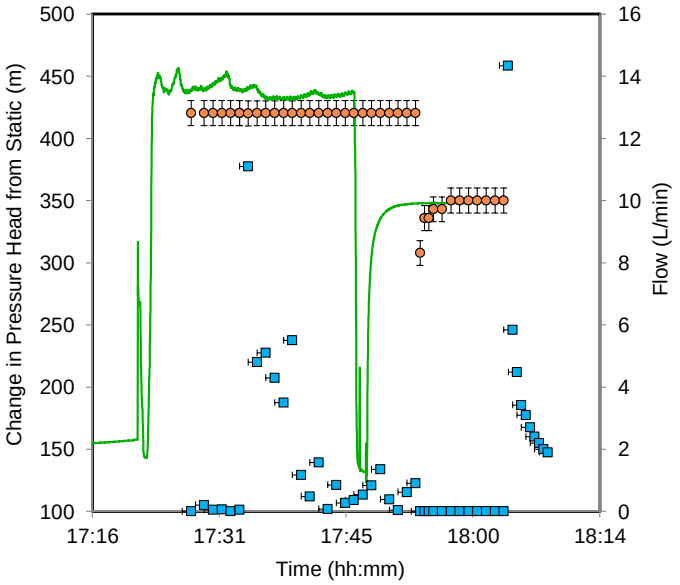
Location Description		Test Interval		Date & Time (d-mmm-yy hh:mm)	
Drillhole ID:	**12GSE204**	Test Number:	**1**	Start:	**19-Jun-12 16:00**
Drillhole ID 2:	**LBP-2**	From depth (m):	**384.0**	End:	**20-Jun-12 19:00**
Location:	Llama	To depth (m):	**405.0**	Supervisor:	**SC/TC**
Project Number:	2CS031.002	Drilled depth (m):	**405.0**	Water Table (m):	**-**

Test zone comments & results

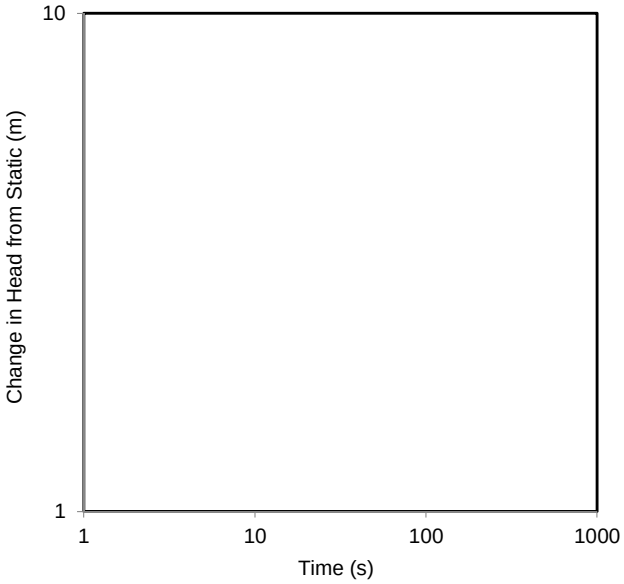
Test purpose & type:	Single packer injection test of flow rate at constant pressure, training for Sabina field staff.
Drilling comments:	Return, but "it needs to be primed" - I believe he is talking about filling up the rods (10m water level)
Geology, hydrogeology & rock mass:	Interbeded greywacke and iron formation with a graphitic rich section from 395.5-396m
Test quality:	Good Test, 1st attempt to set packer - IVA opened during leak test 2nd attempt - Good test, artesian pressures exist at ~300psi and 2.38L/min

Pressure and Flow Rate vs. Time Graph



- Pressure from surface gauge (manual readings, uncertainty shown by vertical bars)
- Pressure from transducer below packer (differential pressure in test zone)
- Flow rate from cumulative flow meter (time period of reading shown by horizontal bar)

Diagnostic Plot



- Differential pressure data from transducer below packer (data averaged over 3 second intervals)
- Derivative of differential pressure data from transducer below packer (data averaged using a logrithmic sampling interval)

Summary of Calculation Results

	psi
P_{max} (hydrojacking)	400.0
P1 (surface)	400.0
$P2_{nit}$ (downhole)	568.8

	l/min
Q (flow rate)	0.70
System leak	0.00
Q (adj.flow rate)	0.70

H_f (friction loss)	m	0.00
H_{nit} (net inj.head)	m	420.4
K1 (surface)	m/s	**1.1E-09**
K2 (downhole)	m/s	**1.2E-09**

Variables and Constants

D_w	160.0	m	$P_{aquifer}$	276	psi
D_{br}	1.0	m	P_{diff}	200	psi
D_p	384.0	m	P_g	400	psi
D_t	394.5	m	H_g	0.5	m
ß	60.0	deg.	L_p	2.50	m
Dw'	138.6	m	r_p	0.0075	m
$H_{stickup}$	1.9	m	R	10	m
Dp'	332.6	m	r_b	0.048	m
Dt'	341.6	m	L	21.0	m
P_{rods}	476	psi			

Drilling and testing

Rod size	**HQ**
Water	Muddy (water from sump)
Additive	Mixed Muds
Drill type	Diamond
Packer Tool	SWiPS

Below Packer (transducer)	✓
Above packer (transducer)	
Surface (flow meter)	
Surface (manual)	✓
Other	

Flow monitoring

Electronic	
Cumulative	✓
Other	

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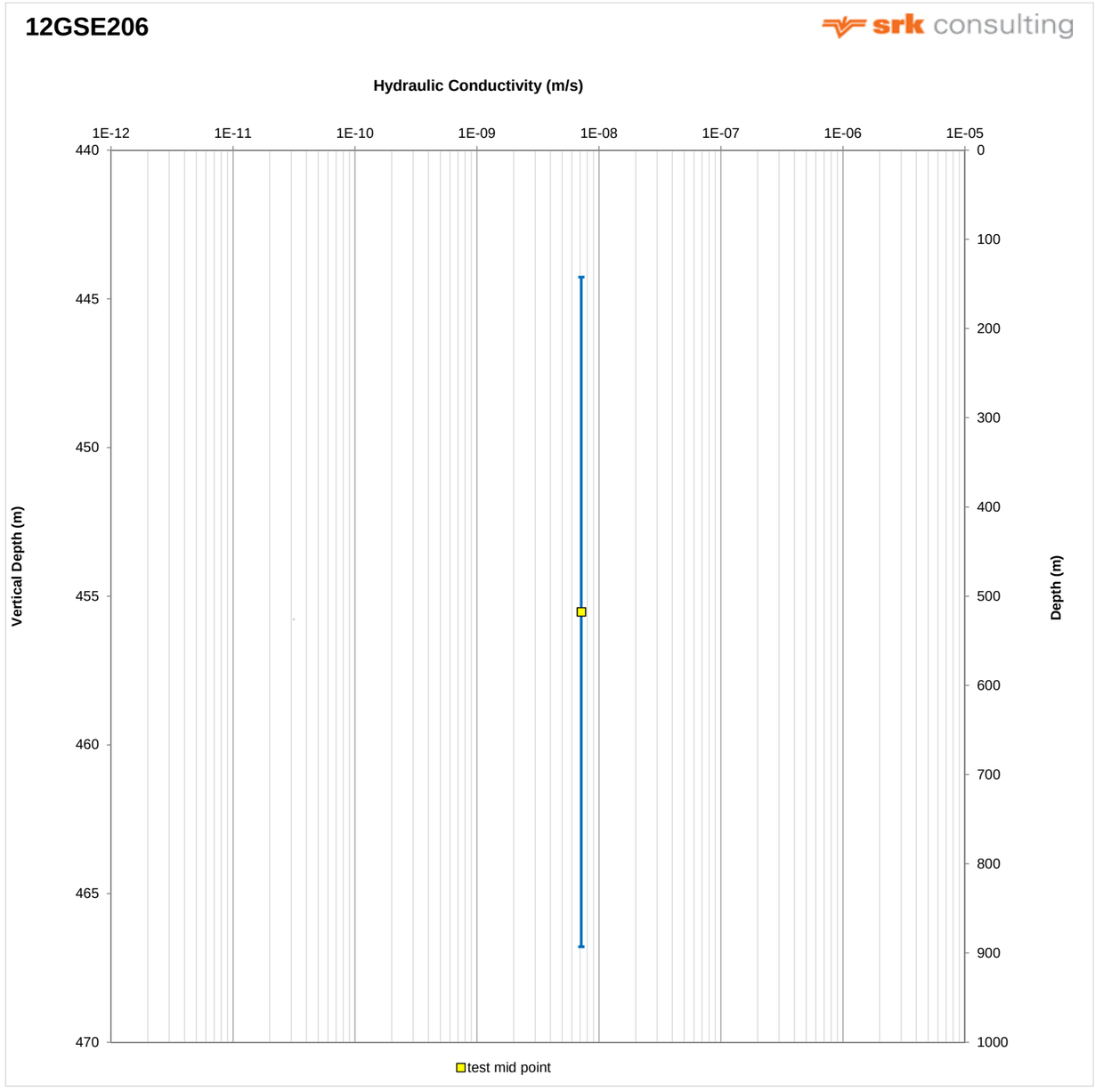
Client hole ID:	**12GSE206**

Test	Date	Time	Time not drilled (hours)	Test Interval - Depth along hole (m)				hole dip at this test interval for correcting vertical depth to borehole survey	Test Interval - Vertical depth (m)				Flow > Max Flow Rate?	Hydraulic conductivity (m/s)		tests where K > measured (max flow rate supplied)	Field QA/QC	Field QA/QC Quality	Field QA/QC Comments	static water level (meters along borehole)	static water level (from pressure transducer) before tests (**m below ground**)	
				Top	**Bottom**	**Mid point**	**Interval Length**		**Top**	**Bottom**	**Interval Length**	**Mid point**		**K1**	**K2**						using planned dip (don't use)	from de-surveyed dip at mid test depth
1	Jun 22, 2012	12:00 AM	0.0	513.0	539.0	526.0	24.8	60.00	444.3	466.8	22.5	455.5	FALSE	8.0E-09	7.2E-09							
2																						
3																						
		AVG	0.0																			
		TOTAL	0.0																			



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PACKER INJECTION TEST

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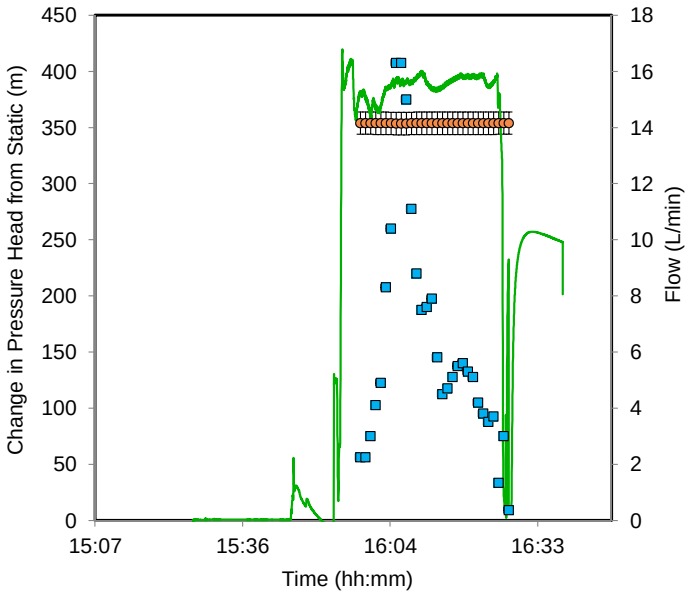
Location Description		Test Interval		Date & Time (d-mmm-yy hh:mm)		
Drillhole ID:	12GSE206	Test Number:	1	Start:	6/22/12	14:23
Drillhole ID 2:	Goose Lake	From depth (m):	513.0	End:	6/22/12	17:30
Location:	Back River	To depth (m):	539.0	Supervisor:	SC/TC	
Project Number:	12CS031.002	Drilled depth (m):	539.0	Water Table (m):	2.00	

Test zone comments & results

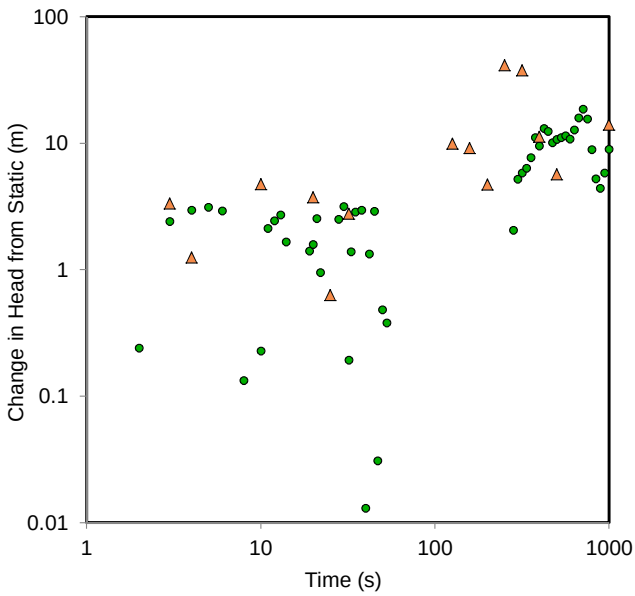
Test purpose & type:	Injection Test flow over time at constant pressure
Drilling comments:	good return
Geology, hydrogeology & rock mass:	low FF, Iforn Formation interbeded Mudstone and Mudstone contact 535.78m Mudstone FF ~2.3J/m (all on fabric)
Test quality:	Good Test, but flow rate was in flux during entire test. Artesian conditions pressent at 450psi at a rate of 2L/min

Pressure and Flow Rate vs. Time Graph



- Pressure from surface gauge (manual readings, uncertainty shown by vertical bars)
- Pressure from transducer below packer (differential pressure in test zone)
- Flow rate from cumulative flow meter (time period of reading shown by horizontal bar)

Diagnostic Plot



- Differential pressure data from transducer below packer (data averaged over 3 second intervals)
- Derivative of differential pressure data from transducer below packer (data averaged using a logrithmic sampling interval)

Summary of Calculation Results

	psi
P_{max} (hydrojacking)	650.0
P1 (surface)	500.0
$P2_{nit}$ (downhole)	561.7

	l/min
Q (flow rate)	5.20
System leak	0.00
Q (adj.flow rate)	5.20

H_f (friction loss)	m	0.00
H_{nit} (net inj.head)	m	353.8
K1 (surface)	m/s	**8.0E-09**
K2 (downhole)	m/s	**7.2E-09**

Variables and Constants

D_w	2.0	m	$P_{aquifer}$	629	psi
D_{br}	1.0	m	P_{diff}	5	psi
D_p	513.0	m	P_g	500	psi
D_t	526.0	m	H_g	0.5	m
ß	60.0	deg.	L_p	2.50	m
Dw'	1.7	m	r_p	0.0075	m
$H_{stickup}$	1.9	m	R	10	m
Dp'	444.3	m	r_b	0.048	m
Dt'	455.5	m	L	26.0	m
P_{rods}	634	psi			

Drilling and testing

Rod size	**HQ**
Water	Muddy (water from sump)
Additive	Mixed Muds
Drill type	Diamond
Packer Tool	SWiPS

Below Packer (transducer)	✓
Above packer (transducer)	
Surface (flow meter)	
Surface (manual)	✓
Other	

Flow monitoring

Electronic	
Cumulative	✓
Other	

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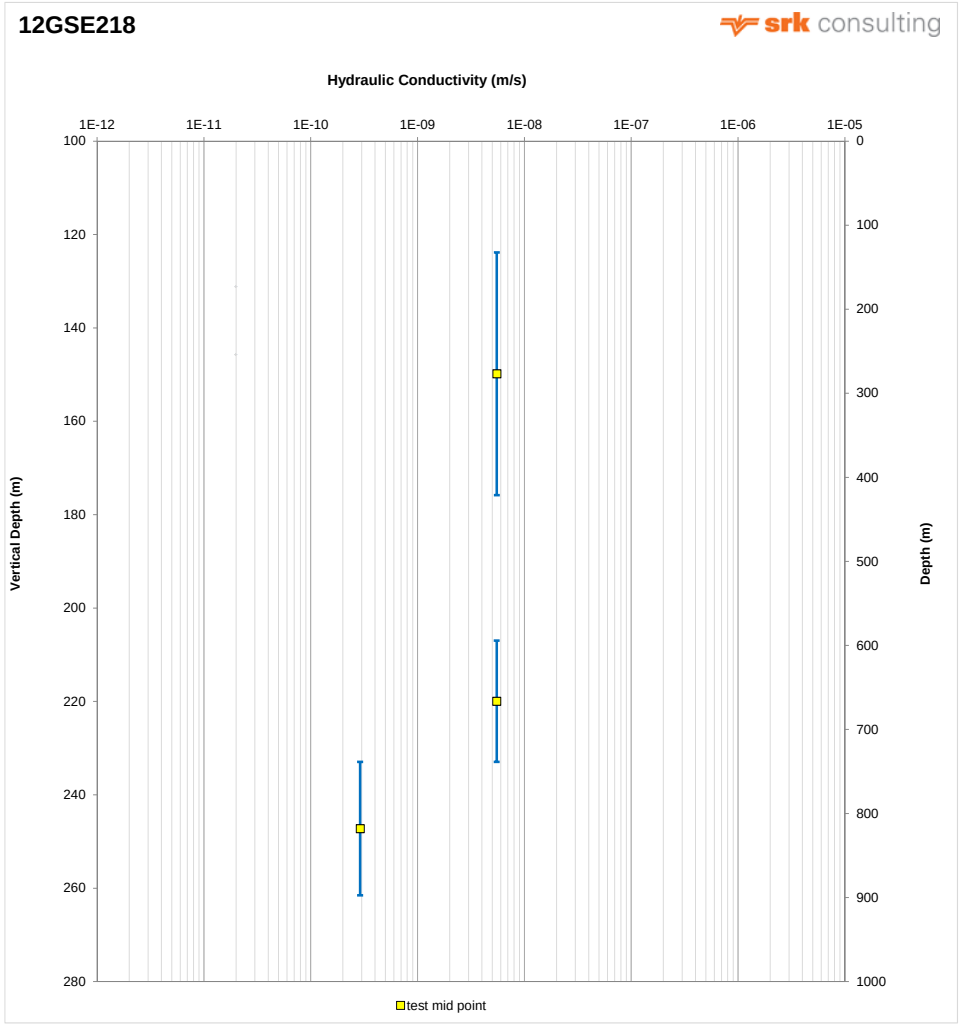
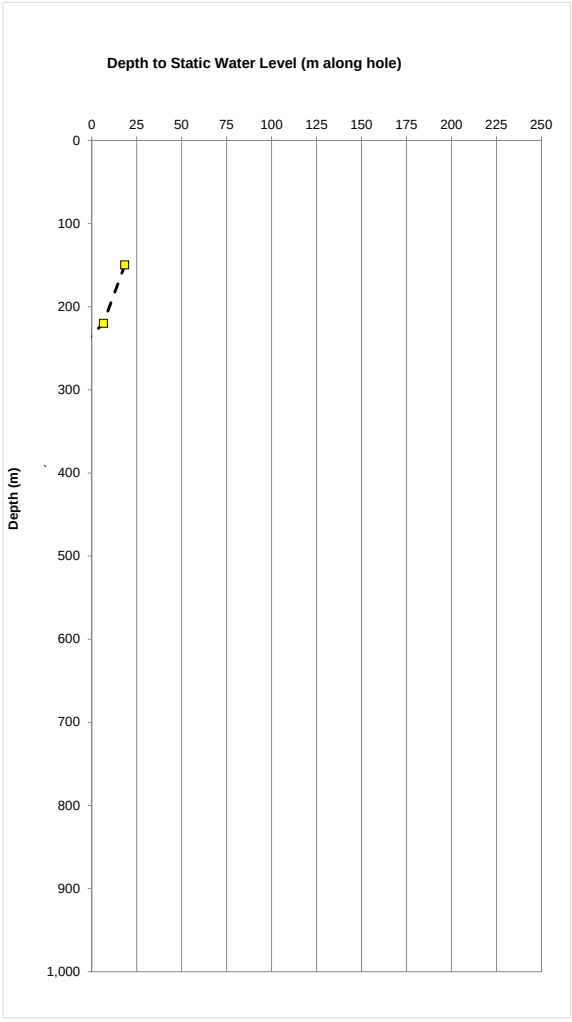
Client hole ID:	12GSE218

Test	Date	Time	Time not drilled (hours)	Test Interval - Depth along hole (m) Top	Bottom	Mid point	Interval Length	hole dip at this test interval for correcting vertical depth to borehole survey	Test Interval - Vertical depth (m) Top	Bottom	Interval Length	Mid point	Flow > Max Flow Rate?	Hydraulic conductivity (m/s) K1	K2	tests where K > measured (max flow rate supplied)	Field QA/QC	Field QA/QC Quality	Field QA/QC Comments	static water level (meters along borehole)	static water level (from pressure transducer) before tests (**m below ground**) using planned dip (don't use)	from de-surveyed dip at mid test depth
1	Jul 15, 2012	7:00 PM	2.0	143.0	203.0	173.0	58.8	60.00	123.8	175.8	52.0	149.8	FALSE	4.8E-09	5.5E-09					21.19704239	18.36	
2	Jul 17, 2012	8:00 AM	2.0	239.0	269.0	254.0	28.8	60.00	207.0	233.0	26.0	220.0	FALSE	6.1E-09	5.5E-09					7.500491247	6.50	
3	Jul 18, 2012	8:30 AM	1.5	269.0	302.0	285.5	31.8	60.00	233.0	261.5	28.6	247.3	FALSE	3.0E-10	2.9E-10					-6.878129211	-5.96	
		AVG	1.8																			
		TOTAL	5.5																			





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PACKER INJECTION TEST

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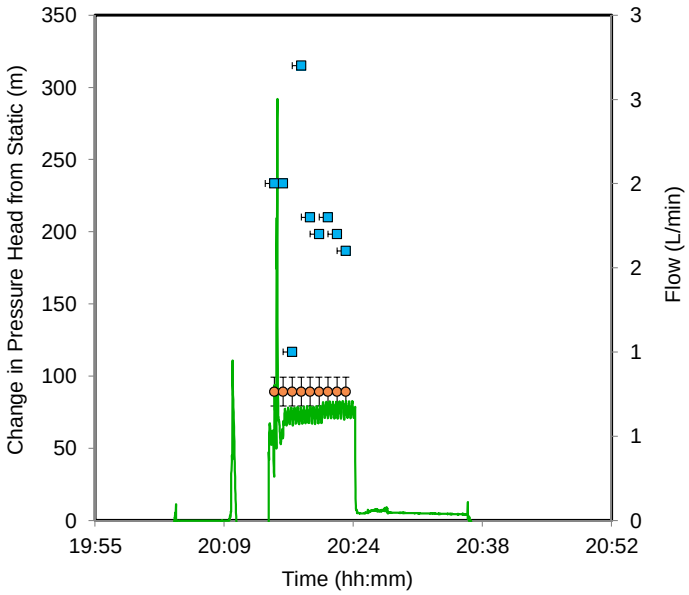
Location Description		Test Interval		Date & Time (d-mmm-yy hh:mm)	
Drillhole ID:	**12GSE218**	Test Number:	**1**	Start:	**15-Jul-12 19:00**
Drillhole ID 2:	**LBP-2**	From depth (m):	**143.0**	End:	**15-Jul-12 21:00**
Location:	Llama	To depth (m):	**203.0**	Supervisor:	**NW/JW**
Project Number:	2CS031.002	Drilled depth (m):	**203.0**	Water Table (m):	**21.20**

Test zone comments & results

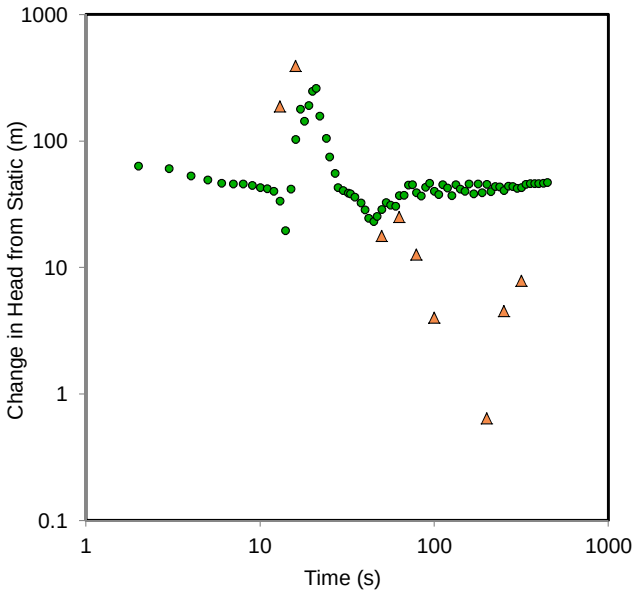
Test purpose & type:	Test permeability under lake
Drilling comments:	Poor return at early stages of drilling. Lowered casing
Geology, hydrogeology & rock mass:	Very solid/competent greywacke
Test quality:	Good test quality

Pressure and Flow Rate vs. Time Graph



- Pressure from surface gauge (manual readings, uncertainty shown by vertical bars)
- Pressure from transducer below packer (differential pressure in test zone)
- Flow rate from cumulative flow meter (time period of reading shown by horizontal bar)

Diagnostic Plot



- Differential pressure data from transducer below packer (data averaged over 3 second intervals)
- Derivative of differential pressure data from transducer below packer (data averaged using a logrithmic sampling interval)

Summary of Calculation Results

	psi
P_{max} (hydrojacking)	29.0
P1 (surface)	100.0
$P2_{nit}$ (downhole)	109.5

	l/min
Q (flow rate)	1.80
System leak	0.00
Q (adj.flow rate)	1.80

H_f (friction loss)	m	0.00
H_{nit} (net inj.head)	m	89.2
K1 (surface)	m/s	**4.8E-09**
K2 (downhole)	m/s	**5.5E-09**

Variables and Constants

D_w	21.2	m	$P_{aquifer}$	150	psi
D_{br}	1.0	m	P_{diff}	29	psi
D_p	143.0	m	P_g	100	psi
D_t	173.0	m	H_g	0.5	m
ß	60.0	deg.	L_p	2.50	m
Dw'	18.4	m	r_p	0.0075	m
$H_{stickup}$	1.9	m	R	10	m
Dp'	123.8	m	r_b	0.048	m
Dt'	149.8	m	L	60.0	m
P_{rods}	179	psi			

Drilling and testing

Rod size	**HQ**
Water	Muddy (water from sump)
Additive	Mixed Muds
Drill type	Diamond
Packer Tool	SWiPS

Below Packer (transducer)	✓
Above packer (transducer)	
Surface (flow meter)	
Surface (manual)	✓
Other	

Flow monitoring

Electronic	
Cumulative	✓
Other	

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PACKER INJECTION TEST

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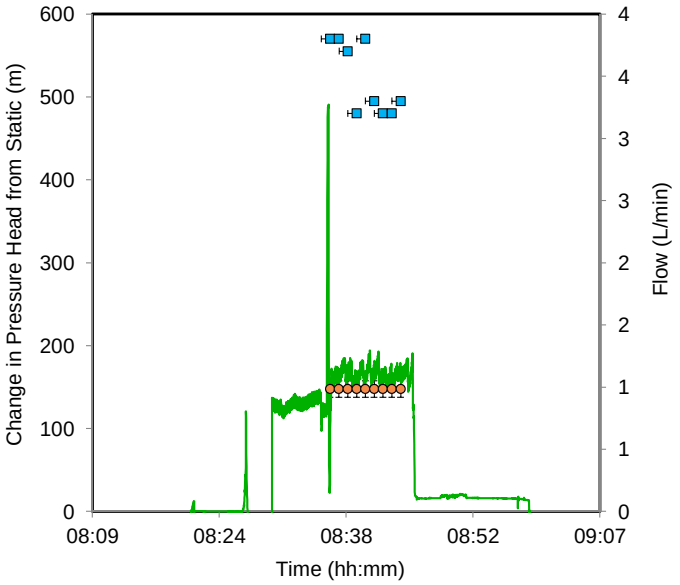
Location Description		Test Interval		Date & Time (d-mmm-yy hh:mm)	
Drillhole ID:	12GSE218	Test Number:	2	Start:	17-Jul-12 8:00
Drillhole ID 2:	LBP-2	From depth (m):	239.0	End:	17-Jul-12 10:00
Location:	Llama	To depth (m):	269.0	Supervisor:	NW/SN
Project Number:	2CS031.002	Drilled depth (m):	269.0	Water Table (m):	7.50

Test zone comments & results

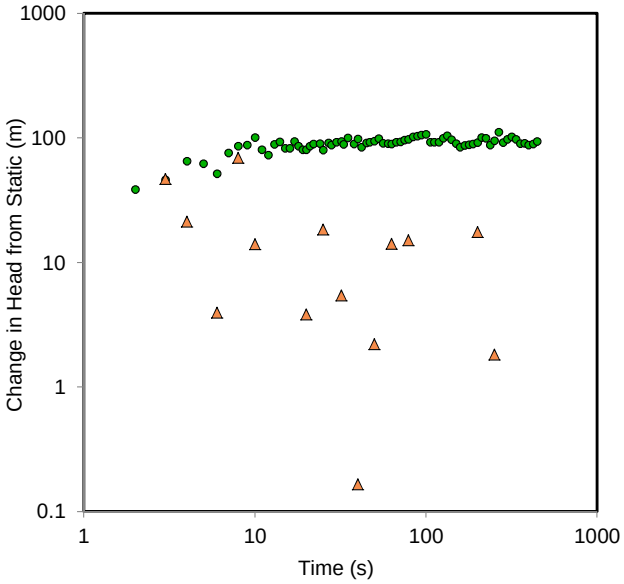
Test purpose & type:	Fault between 245 to 248m tested.
Drilling comments:	None
Geology, hydrogeology & rock mass:	Very fractured zone of greywacke, heavy M.O.'s
Test quality:	Good

Pressure and Flow Rate vs. Time Graph



- Pressure from surface gauge (manual readings, uncertainty shown by vertical bars)
- Pressure from transducer below packer (differential pressure in test zone)
- Flow rate from cumulative flow meter (time period of reading shown by horizontal bar)

Diagnostic Plot



- Differential pressure data from transducer below packer (data averaged over 3 second intervals)
- Derivative of differential pressure data from transducer below packer (data averaged using a logrithmic sampling interval)

Summary of Calculation Results

	psi
P_{max} (hydrojacking)	310.5
P1 (surface)	200.0
$P2_{nit}$ (downhole)	231.8

	l/min
Q (flow rate)	3.20
System leak	1.30
Q (adj.flow rate)	1.90

H_f (friction loss)	m	0.00
H_{nit} (net inj.head)	m	147.6
K1 (surface)	m/s	**6.1E-09**
K2 (downhole)	m/s	**5.5E-09**

Variables and Constants

D_w	7.5	m	$P_{aquifer}$	285	psi
D_{br}	1.0	m	P_{diff}	12	psi
D_p	239.0	m	P_g	200	psi
D_t	254.0	m	H_g	0.5	m
ß	60.0	deg.	L_p	2.50	m
Dw'	6.5	m	r_p	0.0075	m
$H_{stickup}$	1.9	m	R	10	m
Dp'	207.0	m	r_b	0.048	m
Dt'	220.0	m	L	30.0	m
P_{rods}	297	psi			

Drilling and testing

Rod size	**HQ**
Water	Muddy (Sump Water)
Additive	polymer
Drill type	diamond
Packer Tool	SWiPS

Pressure monitoring

Below Packer (transducer)	✓
Above packer (transducer)	
Surface (flow meter)	
Surface (manual)	✓
Other	

Flow monitoring

Electronic	
Cumulative	✓
Other	

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PACKER INJECTION TEST

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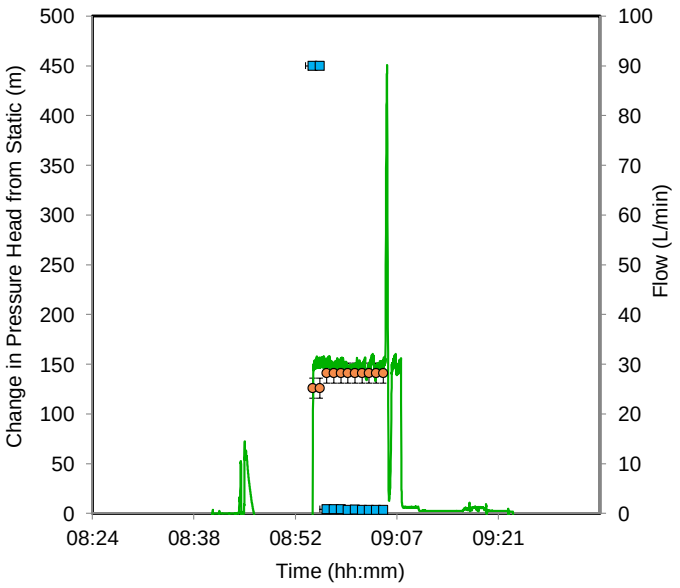
Location Description		Test Interval		Date & Time (d-mmm-yy hh:mm)	
Drillhole ID:	12GSE218	Test Number:	3	Start:	18-Jul-12 8:30
Drillhole ID 2:	LBP-2	From depth (m):	269.0	End:	18-Jul-12 10:00
Location:	Llama	To depth (m):	302.0	Supervisor:	NW
Project Number:	2CS031.002	Drilled depth (m):	302.0	Water Table (m):	-6.88

Test zone comments & results

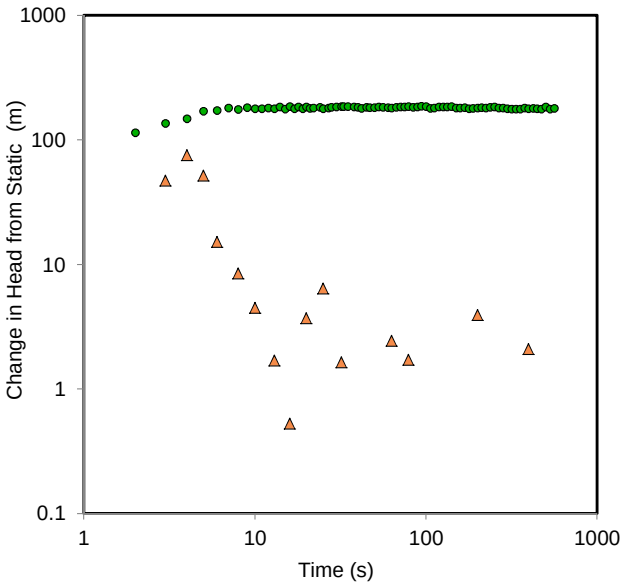
Test purpose & type:	Injection
Drilling comments:	None
Geology, hydrogeology & rock mass:	Greywacke
Test quality:	

Pressure and Flow Rate vs. Time Graph



- Pressure from surface gauge (manual readings, uncertainty shown by vertical bars)
- Pressure from transducer below packer (differential pressure in test zone)
- Flow rate from cumulative flow meter (time period of reading shown by horizontal bar)

Diagnostic Plot



- Differential pressure data from transducer below packer (data averaged over 3 second intervals)
- Derivative of differential pressure data from transducer below packer (data averaged using a logrithmic sampling interval)

Summary of Calculation Results

	psi
P_{max} (hydrojacking)	349.4
P1 (surface)	200.0
$P2_{nit}$ (downhole)	210.5

	l/min
Q (flow rate)	0.70
System leak	0.60
Q (adj.flow rate)	0.10

H_f (friction loss)	m	0.00
H_{nit} (net inj.head)	m	141.1
K1 (surface)	m/s	**3.0E-10**
K2 (downhole)	m/s	**2.9E-10**

Variables and Constants

D_w	-6.9	m	$P_{aquifer}$	331	psi
D_{br}	1.0	m	P_{diff}	3	psi
D_p	269.0	m	P_g	200	psi
D_t	285.5	m	H_g	0.5	m
ß	60.0	deg.	L_p	2.50	m
Dw'	0.0	m	r_p	0.0075	m
$H_{stickup}$	1.9	m	R	10	m
Dp'	233.0	m	r_b	0.048	m
Dt'	247.3	m	L	33.0	m
P_{rods}	334	psi			

Drilling and testing

Rod size	**HQ**
Water	Muddy (Sump Water)
Additive	polymer
Drill type	diamond
Packer Tool	SWiPS

Pressure monitoring

Below Packer (transducer)	✓
Above packer (transducer)	
Surface (flow meter)	
Surface (manual)	✓
Other	

Flow monitoring

Electronic	
Cumulative	✓
Other	

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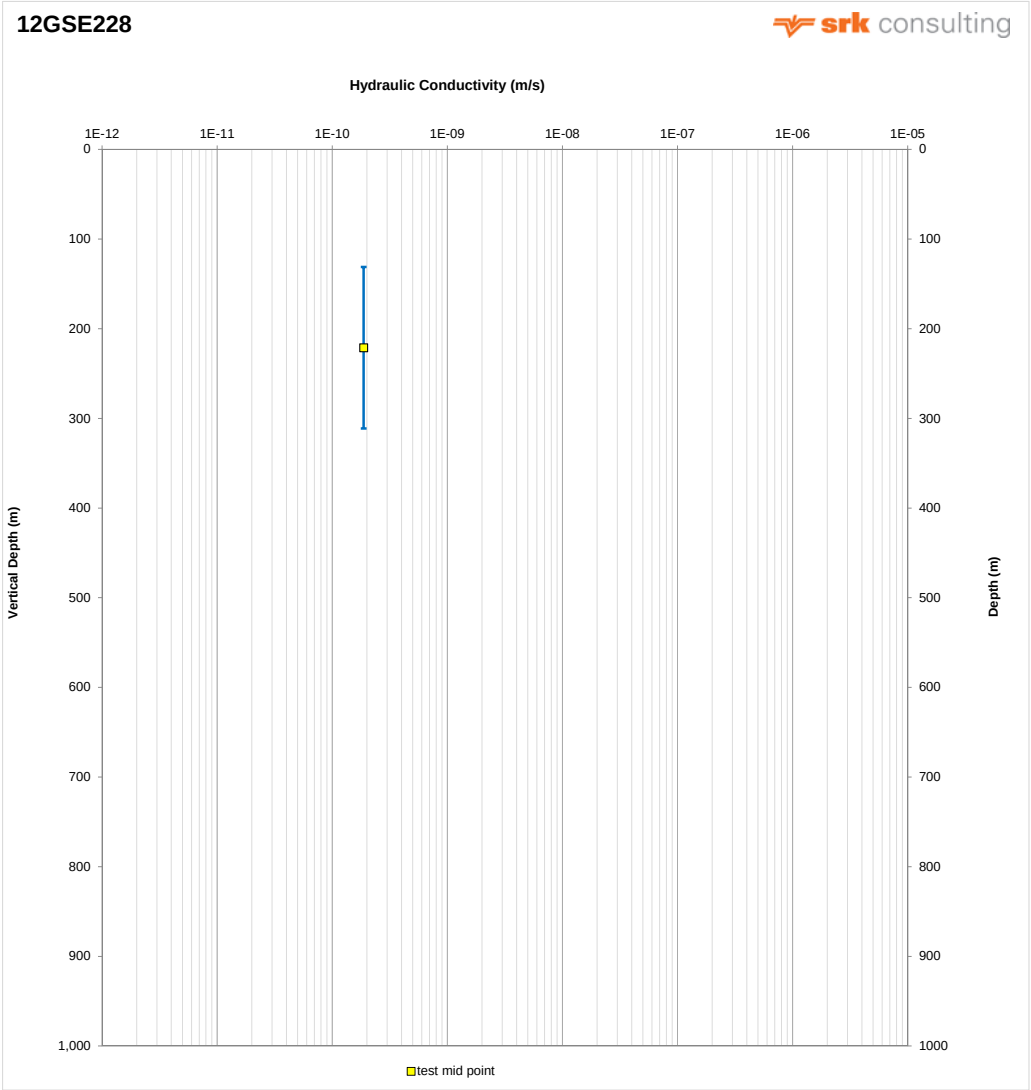
Client hole ID:	12GSE228

Test	Date	Time	Time not drilled (hours)	Test Interval - Depth along hole (m)				hole dip at this test interval for correcting vertical depth to borehole survey	Test Interval - Vertical depth (m)				Flow > Max Flow Rate?	Hydraulic conductivity (m/s)			Field QA/QC	Field QA/QC Quality	Field QA/QC Comments	static water level (meters along borehole)	static water level (from pressure transducer) before tests (m below ground)	
				Top	Bottom	Mid point	Interval Length		Top	Bottom	Interval Length	Mid point		K1	K2	tests where K > measured (max flow rate supplied)					using planned dip (don't use)	from de-surveyed dip at mid test depth
1	Aug 8, 2012	1:00 PM	25.0	160.0	380.0	270.0	218.8	55.00	131.1	311.3	180.2	221.2	FALSE	1.9E-10	1.9E-10							
2																						
3																						
		AVG	25.0																			
		TOTAL	25.0																			



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PACKER INJECTION TEST

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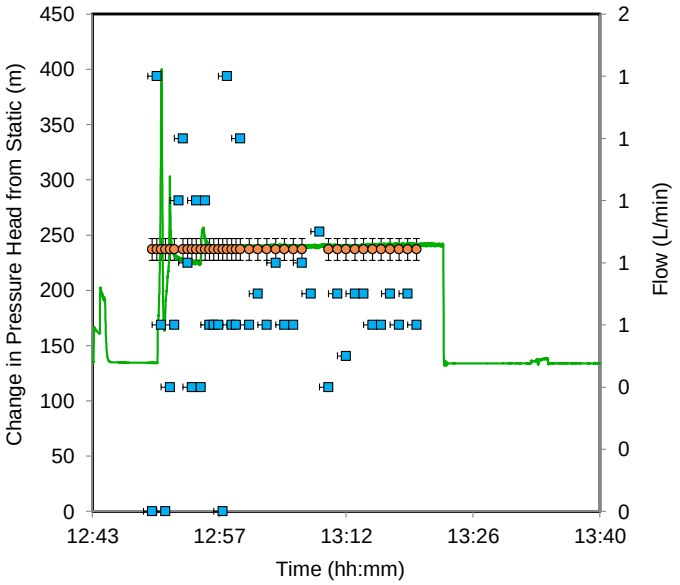
Location Description		Test Interval		Date & Time (d-mmm-yy hh:mm)	
Drillhole ID:	12GSE228	Test Number:	1	Start:	8-Aug-12 13:00
Drillhole ID 2:	LBP-2	From depth (m):	160.0	End:	9-Aug-12 14:00
Location:	Llama	To depth (m):	380.0	Supervisor:	MT
Project Number:	2CS031.002	Drilled depth (m):	380.0	Water Table (m):	-

Test zone comments & results

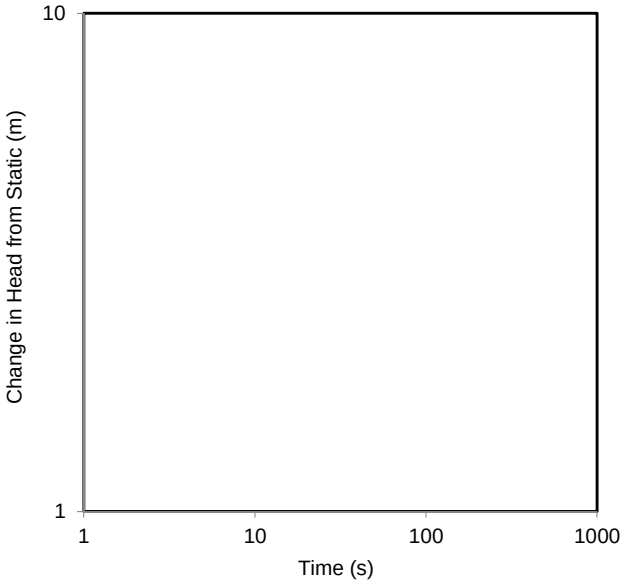
Test purpose & type:	Single packer injection test. Investigate fault at 175m
Drilling comments:	Difficult hole- rods stuck around faults @175m
Geology, hydrogeology & rock mass:	
Test quality:	

Pressure and Flow Rate vs. Time Graph



- Pressure from surface gauge (manual readings, uncertainty shown by vertical bars)
- Pressure from transducer below packer (differential pressure in test zone)
- Flow rate from cumulative flow meter (time period of reading shown by horizontal bar)

Diagnostic Plot



- Differential pressure data from transducer below packer (data averaged over 3 second intervals)
- Derivative of differential pressure data from transducer below packer (data averaged using a logrithmic sampling interval)

Summary of Calculation Results

	psi
P_{max} (hydrojacking)	0.0
P1 (surface)	150.0
$P2_{nit}$ (downhole)	341.3

	l/min
Q (flow rate)	0.70
System leak	0.00
Q (adj.flow rate)	0.70

H_f (friction loss)	m	0.00
H_{nit} (net inj.head)	m	237.0
K1 (surface)	m/s	**1.9E-10**
K2 (downhole)	m/s	**1.9E-10**

Variables and Constants

D_w	160.0	m	$P_{aquifer}$	0	psi
D_{br}	1.0	m	P_{diff}	189	psi
D_p	160.0	m	P_g	150	psi
D_t	270.0	m	H_g	0.5	m
ß	55.0	deg.	L_p	2.50	m
Dw'	131.1	m	r_p	0.0075	m
$H_{stickup}$	1.9	m	R	10	m
Dp'	131.1	m	r_b	0.048	m
Dt'	221.2	m	L	220.0	m
P_{rods}	189	psi			

Drilling and testing

Rod size	**HQ**
Water	Muddy (water from sump)
Additive	Mixed Muds
Drill type	Diamond
Packer Tool	SWiPS

Below Packer (transducer)	✓
Above packer (transducer)	
Surface (flow meter)	
Surface (manual)	✓
Other	

Flow monitoring

Electronic	
Cumulative	✓
Other	

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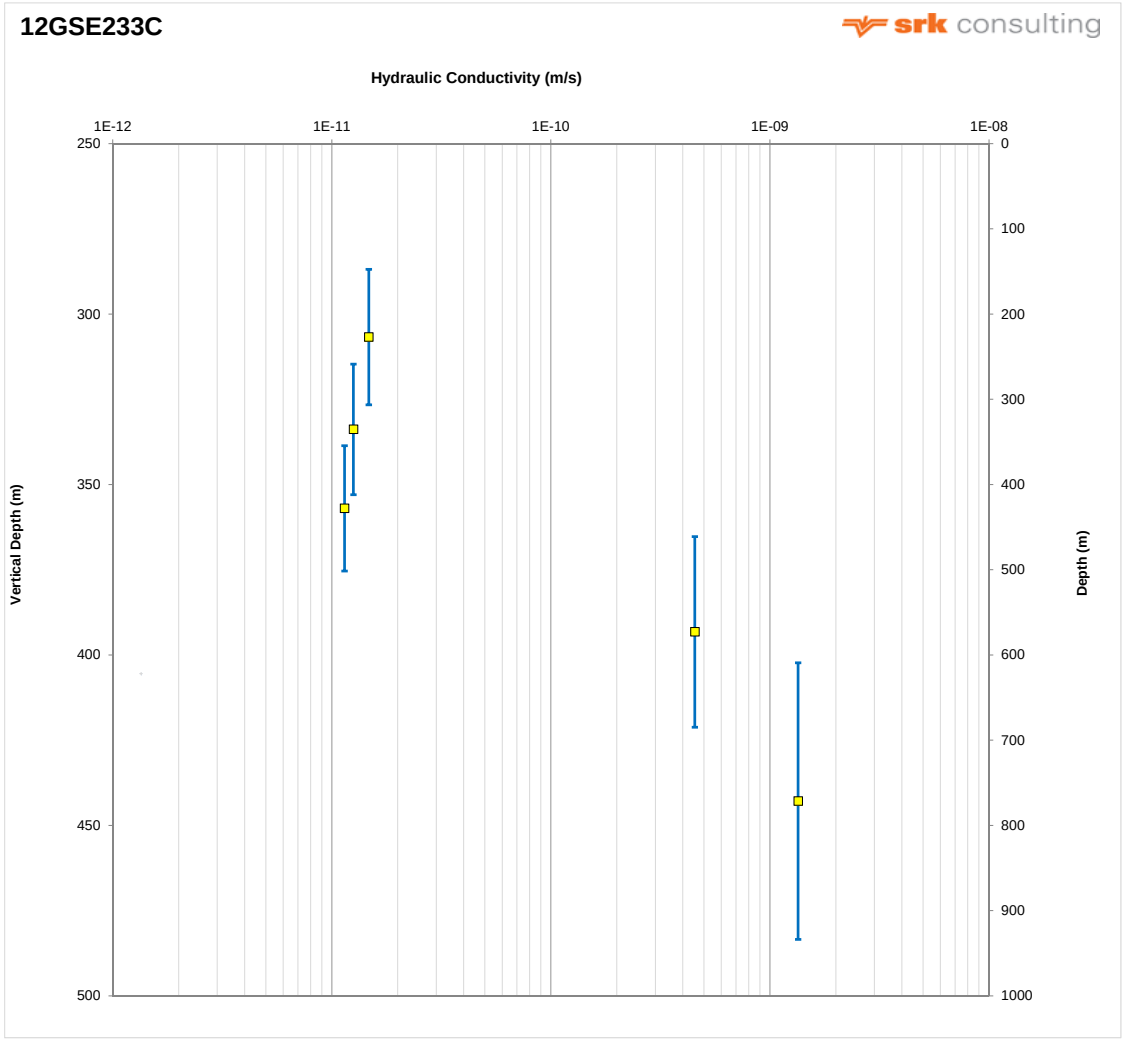
Client hole ID:	12GSE233C	depth to bedrock	1	m
		Planned dip	65.0	

Test	Date	Time	Time not drilled (hours)	Test Interval - Depth along hole (m)				hole dip at this test interval for correcting vertical depth to borehole survey	Test Interval - Vertical depth (m)				Flow > Max Flow Rate?	Hydraulic conductivity (m/s)		tests where K > measured (max flow rate supplied)	Field QA/QC	Field QA/QC Quality	Field QA/QC Comments	static water level (from pressure transducer) before tests (**m below ground**)	
				Top	Bottom	Mid point	Interval Length		Top	Bottom	Interval Length	Mid point		K1	K2					using planned dip (don't use)	from de-surveyed dip at mid test depth
1	Aug 28, 2012	12:00 AM	0.0	346.0	394.0	370.0	46.8	56.00	286.8	326.6	39.8	306.7	FALSE	1.4E-11	1.5E-11						
2	Aug 29, 2012	12:00 AM	0.0	394.0	442.0	418.0	46.8	53.00	314.7	353.0	38.3	333.8	FALSE	1.4E-11	1.3E-11						
3	Aug 30, 2012	12:00 AM	0.0	442.0	490.0	466.0	46.8	50.00	338.6	375.4	36.8	357.0	FALSE	1.4E-11	1.1E-11						
4	Aug 31, 2012	3:00 PM	-15.0	490.0	526.0	508.0	34.8	48.80	368.7	395.8	27.1	382.2	FALSE	#N/A	#N/A						
5	Sep 1, 2012	11:00 AM	3.0	490.0	565.0	527.5	73.8	48.20	365.3	421.2	55.9	393.2	FALSE	4.6E-10	4.5E-10						
6	Sep 3, 2012	3:30 PM	-15.5	565.0	625.0	595.0	58.8	46.20	407.8	451.1	43.3	429.4	FALSE	#N/A	#N/A						
7	Sep 5, 2012	12:00 PM	-12.0	565.0	679.0	622.0	112.8	45.40	402.3	483.5	81.2	442.9	FALSE	1.5E-09	1.3E-09						
		AVG	-5.6																		
		TOTAL	-39.5																		



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PACKER INJECTION TEST

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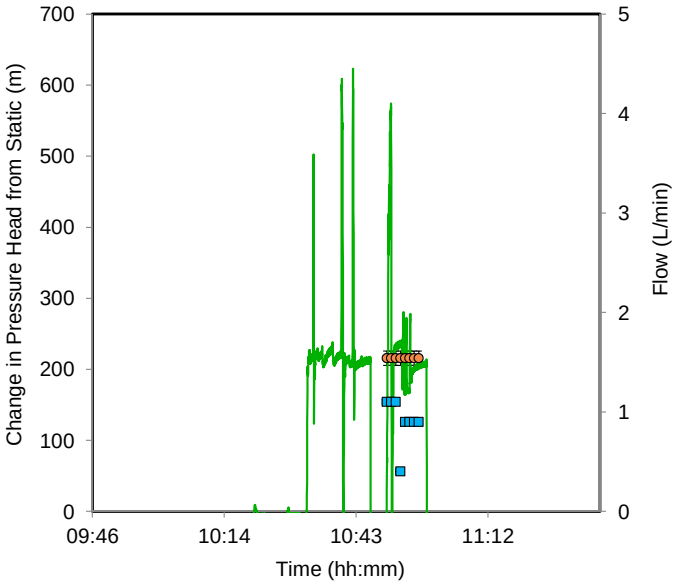
Location Description		Test Interval		Date (m/d/y)	Time
Drillhole ID:	12GSE233C	Test Number:	1	Start:	8/28/12	
Drillhole ID 2:	UBL	From depth (m):	346.0	End:	8/28/12	
Location:	UMWELT	To depth (m):	394.0	Supervisor:	NW	
Project Number:	12CS031.002	Drilled depth (m):	394.0	Water Table (m):	5.00	

Test zone comments & results

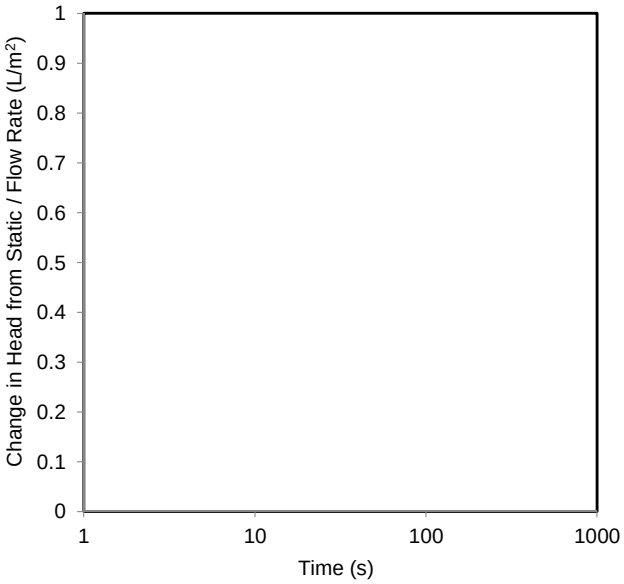
Test purpose & type:	Injection test below permafrost
Drilling comments:	None - 800psi when drilling, Normally 300psi.
Geology, hydrogeology & rock mass:	Solid/ Good quality core
Test quality:	Ok, Flow was almost the same as leak

Pressure and Flow Rate vs. Time Graph



- Pressure from surface gauge (manual readings, uncertainty shown by vertical bars)
- Pressure from transducer below packer (differential pressure in test zone)
- Flow rate from cumulative flow meter (time period of reading shown by horizontal bar)

Diagnostic Plot



- Differential pressure data from transducer below packer (data averaged over 3 second intervals)
- Derivative of differential pressure data from transducer below packer (data averaged using a logrithmic sampling interval)

Summary of Calculation Results

	psi
P_{max} (hydrojacking)	430.3
P1 (surface)	300.0
$P2_{nit}$ (downhole)	284.4

	l/min
Q (flow rate)	0.91
System leak	0.90
Q (adj.flow rate)	0.01

H_f (friction loss)	m	0.00
H_{nit} (net inj.head)	m	215.6
K1 (surface)	m/s	**1.4E-11**
K2 (downhole)	m/s	**1.5E-11**

Variables and Constants

D_w	5.0	m	$P_{aquifer}$	402	psi
D_{br}	1.0	m	P_{diff}	9	psi
D_p	346.0	m	P_g	300	psi
D_t	370.0	m	H_g	0.5	m
ß	56.0	deg.	L_p	2.50	m
Dw'	4.1	m	r_p	0.0075	m
$H_{stickup}$	1.9	m	R	10	m
Dp'	286.8	m	r_b	0.048	m
Dt'	306.7	m	L	48.0	m
P_{rods}	411	psi			

Drilling and testing

Rod size	**HQ**
Water	Muddy Water
Additive	mixed Muds
Drill type	Diamond Drill
Packer Tool	SWIPS

Pressure monitoring

Below Packer (transducer)	√
Above packer (transducer)	
Surface (flow meter)	
Surface (manual)	√
Other	

Flow monitoring

Electronic	
Cumulative	√
Other	

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PACKER INJECTION TEST

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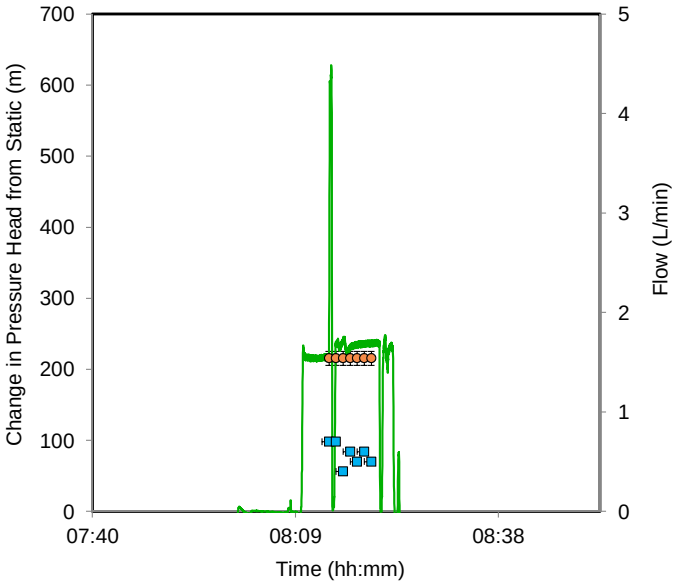
Location Description		Test Interval		Date (m/d/y)	Time
Drillhole ID:	12GSE233C	Test Number:	2	Start:	8/29/12
Drillhole ID 2:	UBL	From depth (m):	394.0	End:	8/29/12
Location:	UMWELT	To depth (m):	442.0	Supervisor:	NW
Project Number:	12CS031.002	Drilled depth (m):	442.0	Water Table (m):	5.00

Test zone comments & results

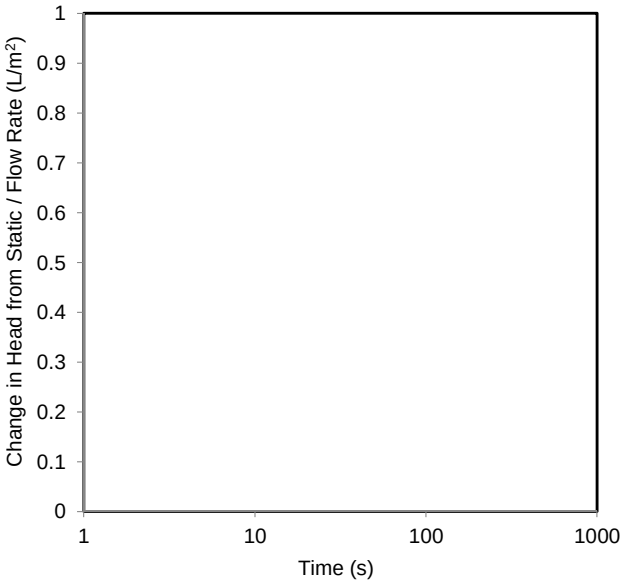
Test purpose & type:	
Drilling comments:	800psi when drilling, Normally 300psi.
Geology, hydrogeology & rock mass:	Good core
Test quality:	Good

Pressure and Flow Rate vs. Time Graph



- Pressure from surface gauge (manual readings, uncertainty shown by vertical bars)
- Pressure from transducer below packer (differential pressure in test zone)
- Flow rate from cumulative flow meter (time period of reading shown by horizontal bar)

Diagnostic Plot



- Differential pressure data from transducer below packer (data averaged over 3 second intervals)
- Derivative of differential pressure data from transducer below packer (data averaged using a logrithmic sampling interval)

Summary of Calculation Results

	psi
P_{max} (hydrojacking)	472.0
P1 (surface)	300.0
$P2_{nit}$ (downhole)	334.2

	l/min
Q (flow rate)	0.51
System leak	0.50
Q (adj.flow rate)	0.01

H_f (friction loss)	m	0.00
H_{nit} (net inj.head)	m	215.5
K1 (surface)	m/s	**1.4E-11**
K2 (downhole)	m/s	**1.3E-11**

Variables and Constants

D_w	5.0	m	$P_{aquifer}$	442	psi
D_{br}	1.0	m	P_{diff}	8	psi
D_p	394.0	m	P_g	300	psi
D_t	418.0	m	H_g	0.5	m
ß	53.0	deg.	L_p	2.50	m
Dw'	4.0	m	r_p	0.0075	m
$H_{stickup}$	1.9	m	R	10	m
Dp'	314.7	m	r_b	0.048	m
Dt'	333.8	m	L	48.0	m
P_{rods}	450	psi			

Drilling and testing

Rod size	**HQ**
Water	Muddy Water
Additive	mixed Muds
Drill type	Diamond Drill
Packer Tool	SWIPS

Pressure monitoring

Below Packer (transducer)	√
Above packer (transducer)	
Surface (flow meter)	
Surface (manual)	√
Other	

Flow monitoring

Electronic	
Cumulative	√
Other	

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PACKER INJECTION TEST

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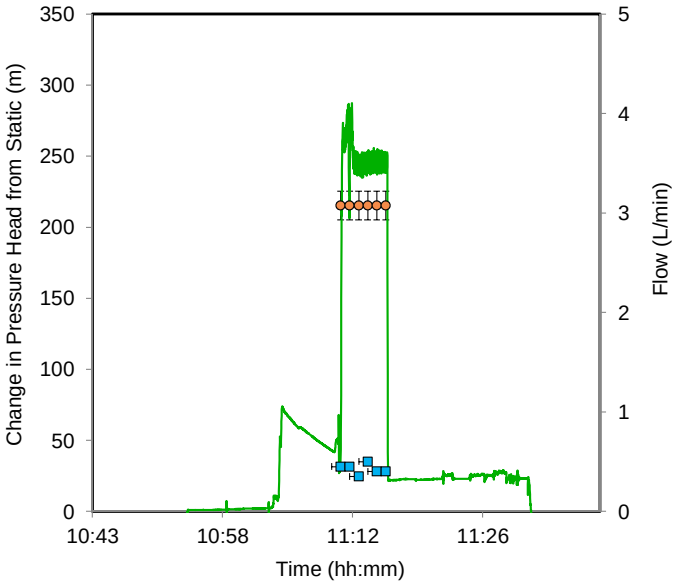
Location Description		Test Interval		Date (m/d/y)	Time
Drillhole ID:	12GSE233C	Test Number:	3	Start:	8/30/12	
Drillhole ID 2:	UBL	From depth (m):	442.0	End:	8/30/12	
Location:	UMWELT	To depth (m):	490.0	Supervisor:	NW	
Project Number:	12CS031.002	Drilled depth (m):	490.0	Water Table (m):	5.00	

Test zone comments & results

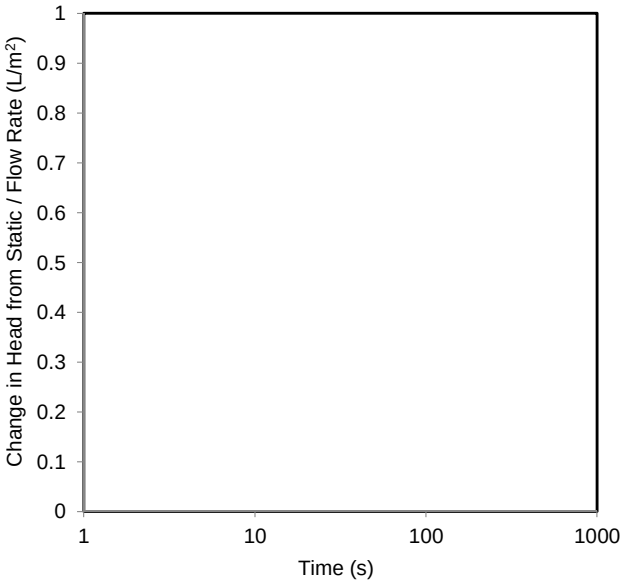
Test purpose & type:	Permafrost
Drilling comments:	
Geology, hydrogeology & rock mass:	Solid greywacke
Test quality:	Good

Pressure and Flow Rate vs. Time Graph



- Pressure from surface gauge (manual readings, uncertainty shown by vertical bars)
- Pressure from transducer below packer (differential pressure in test zone)
- Flow rate from cumulative flow meter (time period of reading shown by horizontal bar)

Diagnostic Plot



- Differential pressure data from transducer below packer (data averaged over 3 second intervals)
- Derivative of differential pressure data from transducer below packer (data averaged using a logrithmic sampling interval)

Summary of Calculation Results

	psi
P_{max} (hydrojacking)	507.9
P1 (surface)	300.0
$P2_{nit}$ (downhole)	366.9

	l/min
Q (flow rate)	0.51
System leak	0.50
Q (adj.flow rate)	0.01

H_f (friction loss)	m	0.00
H_{nit} (net inj.head)	m	215.3
K1 (surface)	m/s	**1.4E-11**
K2 (downhole)	m/s	**1.1E-11**

Variables and Constants

D_w	5.0	m	$P_{aquifer}$	476	psi
D_{br}	1.0	m	P_{diff}	8	psi
D_p	442.0	m	P_g	300	psi
D_t	466.0	m	H_g	0.5	m
ß	50.0	deg.	L_p	2.50	m
Dw'	3.8	m	r_p	0.0075	m
$H_{stickup}$	1.9	m	R	10	m
Dp'	338.6	m	r_b	0.048	m
Dt'	357.0	m	L	48.0	m
P_{rods}	484	psi			

Drilling and testing

Rod size	**HQ**
Water	Muddy Water
Additive	mixed Muds
Drill type	Diamond Drill
Packer Tool	SWIPS

Pressure monitoring

Below Packer (transducer)	√
Above packer (transducer)	
Surface (flow meter)	
Surface (manual)	√
Other	

Flow monitoring

Electronic	
Cumulative	√
Other	

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PACKER INJECTION TEST

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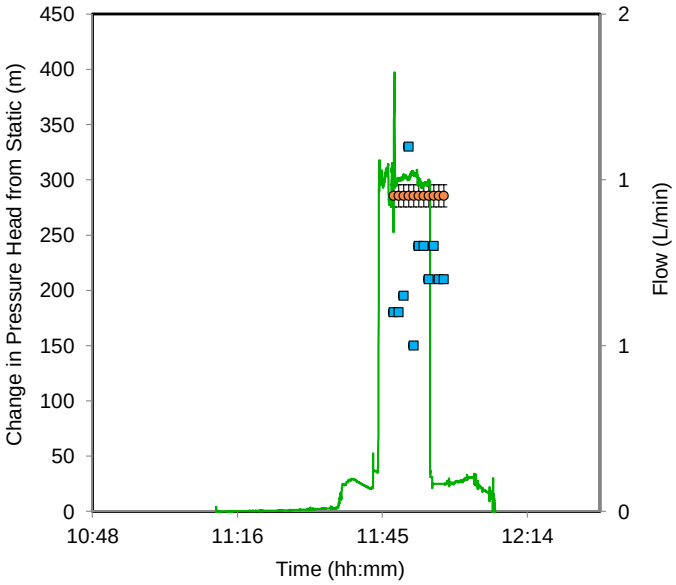
Location Description		Test Interval		Date (m/d/y)	Time
Drillhole ID:	12GSE233C	Test Number:	5	Start:	9/1/12	11:00
Drillhole ID 2:	UBL	From depth (m):	490.0	End:	9/1/12	14:00
Location:	UMWELT	To depth (m):	565.0	Supervisor:	NW	
Project Number:	12CS031.002	Drilled depth (m):	565.0	Water Table (m):	5.00	

Test zone comments & results

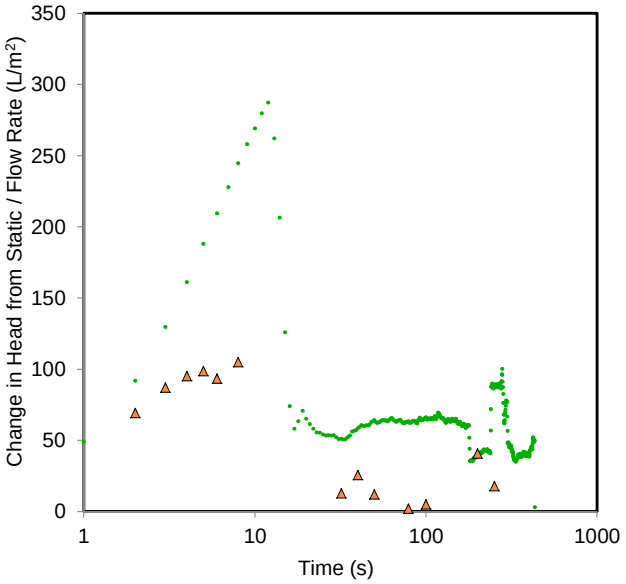
Test purpose & type:	Retest zone (Permafrost)
Drilling comments:	
Geology, hydrogeology & rock mass:	Solid/ Tight rock
Test quality:	Good test

Pressure and Flow Rate vs. Time Graph



- Pressure from surface gauge (manual readings, uncertainty shown by vertical bars)
- Pressure from transducer below packer (differential pressure in test zone)
- Flow rate from cumulative flow meter (time period of reading shown by horizontal bar)

Diagnostic Plot



- Differential pressure data from transducer below packer (data averaged over 3 second intervals)
- Derivative of differential pressure data from transducer below packer (data averaged using a logrithmic sampling interval)

Summary of Calculation Results

	psi
P_{max} (hydrojacking)	547.9
P1 (surface)	400.0
$P2_{nit}$ (downhole)	413.7

	l/min
Q (flow rate)	0.70
System leak	0.00
Q (adj.flow rate)	0.70

H_f (friction loss)	m	0.00
H_{nit} (net inj.head)	m	285.5
K1 (surface)	m/s	**4.6E-10**
K2 (downhole)	m/s	**4.5E-10**

Variables and Constants

D_w	5.0	m	$P_{aquifer}$	514	psi
D_{br}	1.0	m	P_{diff}	8	psi
D_p	490.0	m	P_g	400	psi
D_t	527.5	m	H_g	0.5	m
ß	48.2	deg.	L_p	2.50	m
Dw'	3.7	m	r_p	0.0075	m
$H_{stickup}$	1.9	m	R	10	m
Dp'	365.3	m	r_b	0.048	m
Dt'	393.2	m	L	75.0	m
P_{rods}	522	psi			

Drilling and testing

Rod size	**HQ**
Water	Muddy Water
Additive	mixed Muds
Drill type	Diamond Drill
Packer Tool	SWIPS

Pressure monitoring

Below Packer (transducer)	√
Above packer (transducer)	
Surface (flow meter)	
Surface (manual)	√
Other	

Flow monitoring

Electronic	
Cumulative	√
Other	

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PACKER INJECTION TEST

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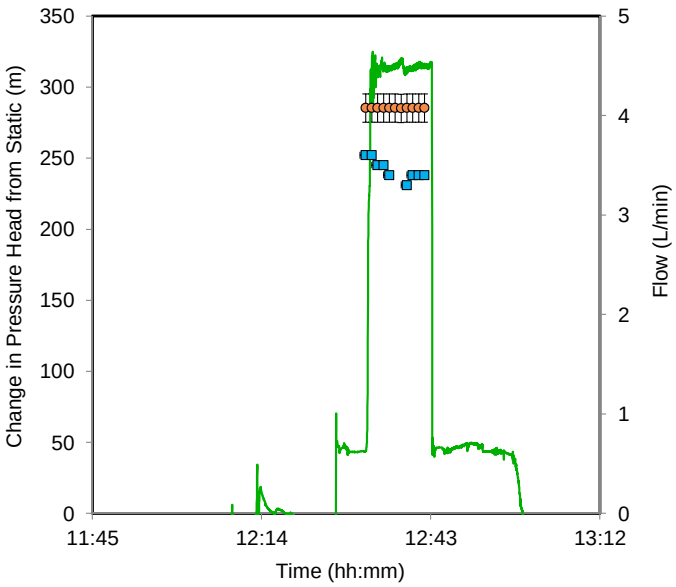
	Location Description		Test Interval			Date (m/d/y)	Time
Drillhole ID:	12GSE233C	Test Number:	7	Start:		9/5/12	12:00
Drillhole ID 2:	UBL	From depth (m):	565.0	End:		9/5/12	14:00
Location:	UMWELT	To depth (m):	679.0	Supervisor:		NW	
Project Number:	12CS031.002	Drilled depth (m):	679.0	Water Table (m):		5.00	

Test zone comments & results

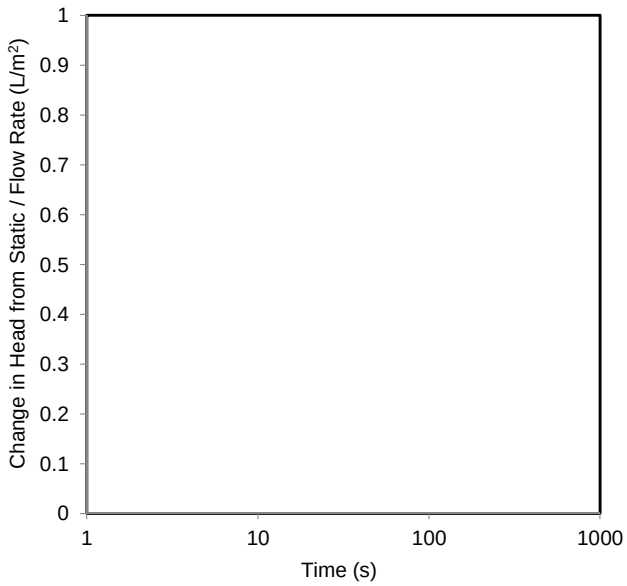
Test purpose & type:	Permafrost profiling
Drilling comments:	
Geology, hydrogeology & rock mass:	Interbeded IF
Test quality:	Good

Pressure and Flow Rate vs. Time Graph



- Pressure from surface gauge (manual readings, uncertainty shown by vertical bars)
- Pressure from transducer below packer (differential pressure in test zone)
- Flow rate from cumulative flow meter (time period of reading shown by horizontal bar)

Diagnostic Plot



- Differential pressure data from transducer below packer (data averaged over 3 second intervals)
- Derivative of differential pressure data from transducer below packer (data averaged using a logrithmic sampling interval)

Summary of Calculation Results

	psi
P_{max} (hydrojacking)	603.4
P1 (surface)	400.0
$P2_{nit}$ (downhole)	446.5

	l/min
Q (flow rate)	3.40
System leak	0.00
Q (adj.flow rate)	3.40

H_f (friction loss)	m	0.00
H_{nit} (net inj.head)	m	285.4
K1 (surface)	m/s	**1.5E-09**
K2 (downhole)	m/s	**1.3E-09**

Variables and Constants

D_w	5.0	m	$P_{aquifer}$	567	psi
D_{br}	1.0	m	P_{diff}	8	psi
D_p	565.0	m	P_g	400	psi
D_t	622.0	m	H_g	0.5	m
ß	45.4	deg.	L_p	2.50	m
Dw'	3.6	m	r_p	0.0075	m
$H_{stickup}$	1.9	m	R	10	m
Dp'	402.3	m	r_b	0.048	m
Dt'	442.9	m	L	114.0	m
P_{rods}	575	psi			

Drilling and testing

Rod size	**HQ**
Water	Muddy Water
Additive	mixed Muds
Drill type	Diamond Drill
Packer Tool	SWIPS

Pressure monitoring

Below Packer (transducer)	√
Above packer (transducer)	
Surface (flow meter)	
Surface (manual)	√
Other	

Flow monitoring

Electronic	
Cumulative	√
Other	

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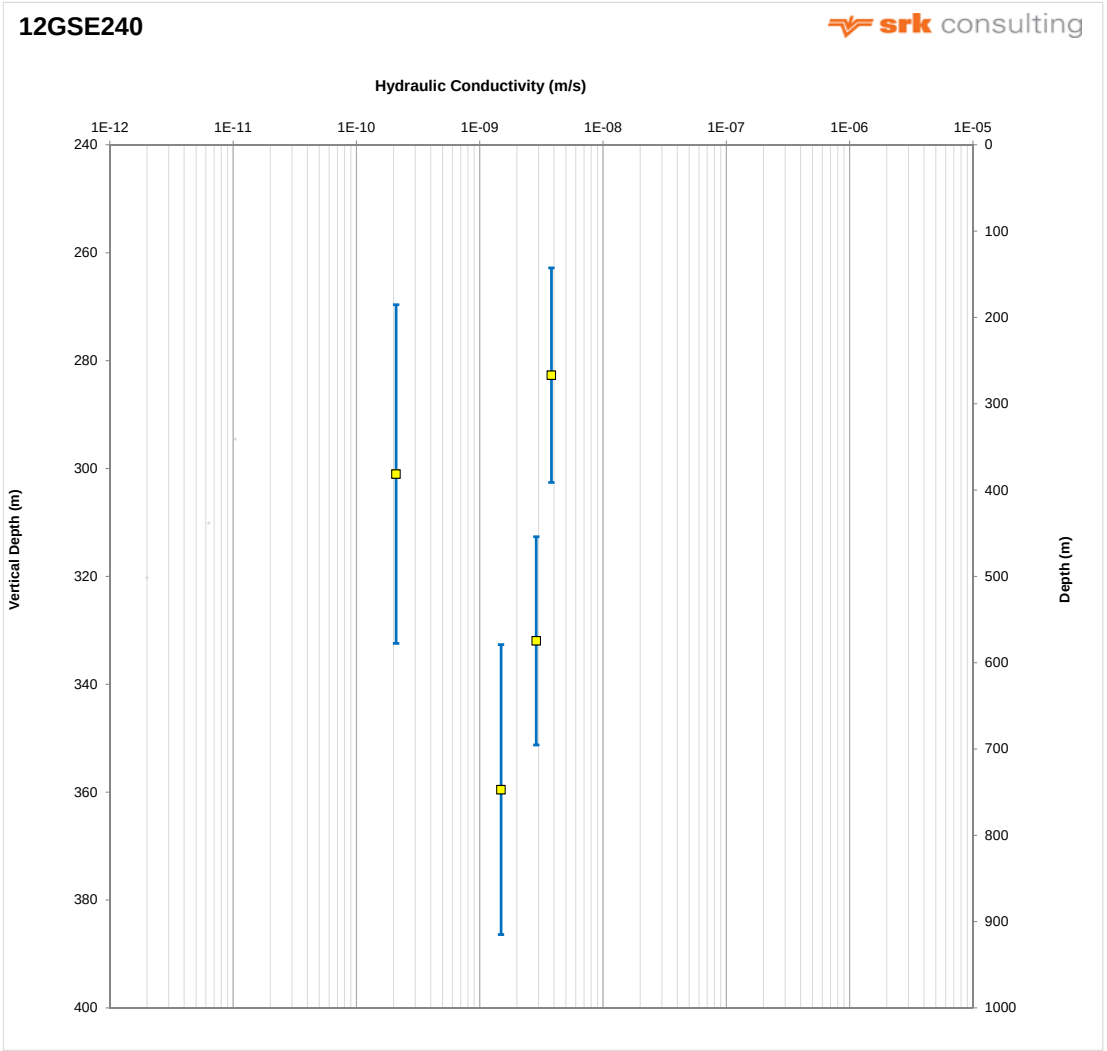
Client hole ID:	12GSE240		depth to bedrock	1	m
			Planned dip	68.0	

				Test Interval - Depth along hole (m)					Test Interval - Vertical depth (m)					Hydraulic conductivity (m/s)							static water level (from pressure transducer) before tests (**m below ground**)	
Test	**Date**	**Time**	**Time not drilled (hours)**	**Top**	**Bottom**	**Mid point**	**Interval Length**	hole dip at this test interval for correcting vertical depth to borehole survey	**Top**	**Bottom**	**Interval Length**	**Mid point**	**Flow > Max Flow Rate?**	**K1**	**K2**	tests where K > measured (max flow rate supplied)	Field QA/QC	Field QA/QC Quality	Field QA/QC Comments	using planned dip (don't use)	from de-surveyed dip at mid test depth
1	Sep 12, 2012	9:00 AM	-9.0	317.0	365.0	341.0	46.8	56.00	262.8	302.6	39.8	282.7	FALSE	3.8E-09	3.8E-09						
2	Sep 13, 2012	2:00 PM	2.0	335.0	413.0	374.0	76.8	53.60	269.6	332.4	62.8	301.0	FALSE	1.7E-10	2.1E-10						
3	Sep 14, 2012	4:45 PM	-40.7	413.0	464.0	438.5	49.8	49.20	312.6	351.2	38.6	331.9	FALSE	2.7E-09	2.9E-09						
4	Sep 16, 2012	12:00 AM	0.0	464.0	539.0	501.5	73.8	45.80	332.6	386.4	53.8	359.5	FALSE	1.5E-09	1.5E-09						
5	Sep 17, 2012	12:00 AM	0.0	539.0	575.0	557.0	34.8	43.70	372.4	397.3	24.9	384.8	FALSE								
		AVG	-9.6																		
		TOTAL	-47.8																		



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PACKER INJECTION TEST

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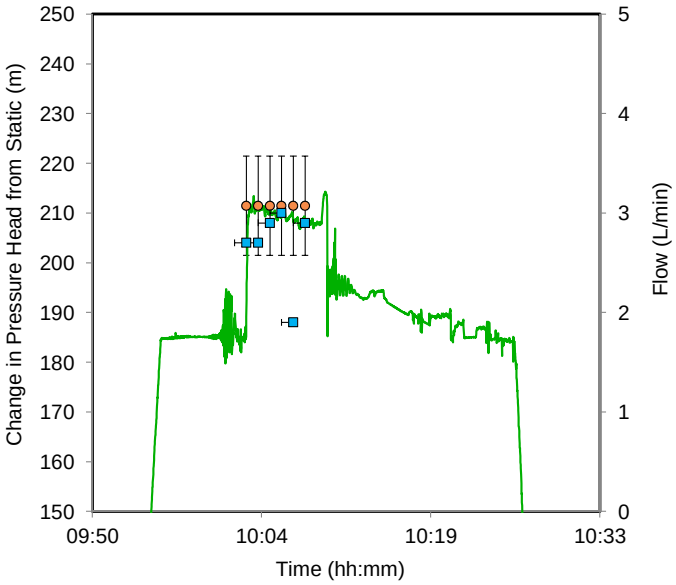
Location Description		Test Interval		Date (m/d/y)	Time
Drillhole ID:	12GSE240	Test Number:	1	Start:	9/12/12	9:00
Drillhole ID 2:	UBH	From depth (m):	317.0	End:	9/12/12	
Location:	UMWELT	To depth (m):	365.0	Supervisor:	NW	
Project Number:	12CS031.002	Drilled depth (m):	365.0	Water Table (m):		

Test zone comments & results

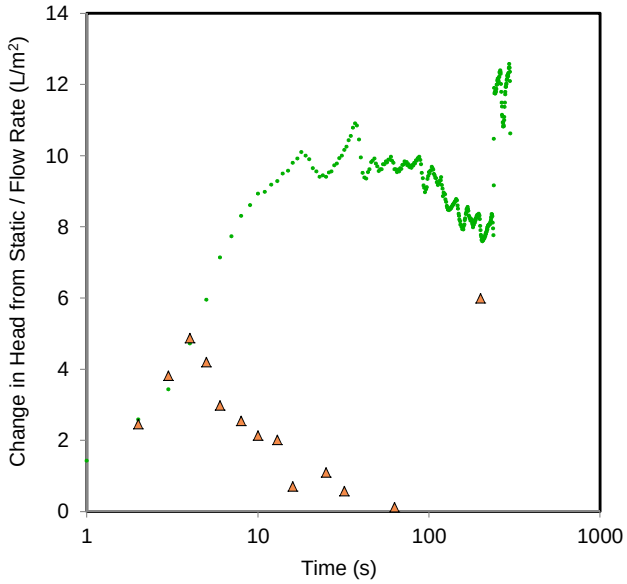
Test purpose & type:	Permafrost profiling
Drilling comments:	Less pressure than 12GSE233C
Geology, hydrogeology & rock mass:	Greywacke
Test quality:	Not good. Packer not inflated or tool length wrong

Pressure and Flow Rate vs. Time Graph



- Pressure from surface gauge (manual readings, uncertainty shown by vertical bars)
- Pressure from transducer below packer (differential pressure in test zone)
- Flow rate from cumulative flow meter (time period of reading shown by horizontal bar)

Diagnostic Plot



- Differential pressure data from transducer below packer (data averaged over 3 second intervals)
- Derivative of differential pressure data from transducer below packer (data averaged using a logrithmic sampling interval)

Summary of Calculation Results

	psi
P_{max} (hydrojacking)	394.2
P1 (surface)	300.0
$P2_{nit}$ (downhole)	297.2

	l/min
Q (flow rate)	2.70
System leak	0.00
Q (adj.flow rate)	2.70

H_f (friction loss)	m	0.00
H_{nit} (net inj.head)	m	211.5
K1 (surface)	m/s	**3.8E-09**
K2 (downhole)	m/s	**3.8E-09**

Variables and Constants

D_w	0.0	m	$P_{aquifer}$	374	psi
D_{br}	1.0	m	P_{diff}	3	psi
D_p	317.0	m	P_g	300	psi
D_t	341.0	m	H_g	0.5	m
ß	56.0	deg.	L_p	2.50	m
Dw'	0.0	m	r_p	0.0075	m
$H_{stickup}$	1.9	m	R	10	m
Dp'	262.8	m	r_b	0.048	m
Dt'	282.7	m	L	48.0	m
P_{rods}	376	psi			

Drilling and testing

Rod size	**HQ**
Water	Muddy Water
Additive	mixed Muds
Drill type	Diamond Drill
Packer Tool	SWIPS

Pressure monitoring

Below Packer (transducer)	√
Above packer (transducer)	
Surface (flow meter)	
Surface (manual)	√
Other	

Flow monitoring

Electronic	
Cumulative	√
Other	

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PACKER INJECTION TEST

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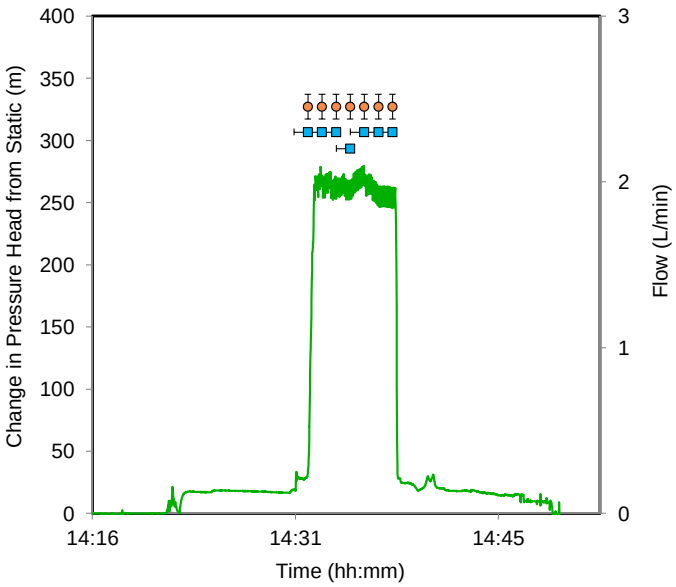
Location Description		Test Interval			Date (m/d/y)	Time
Drillhole ID:	12GSE240	Test Number:	2	Start:	9/13/12	14:00
Drillhole ID 2:	UBH	From depth (m):	335.0	End:	9/13/12	16:00
Location:	UMWELT	To depth (m):	413.0	Supervisor:	NW	
Project Number:	12CS031.002	Drilled depth (m):	413.0	Water Table (m):	100.00	

Test zone comments & results

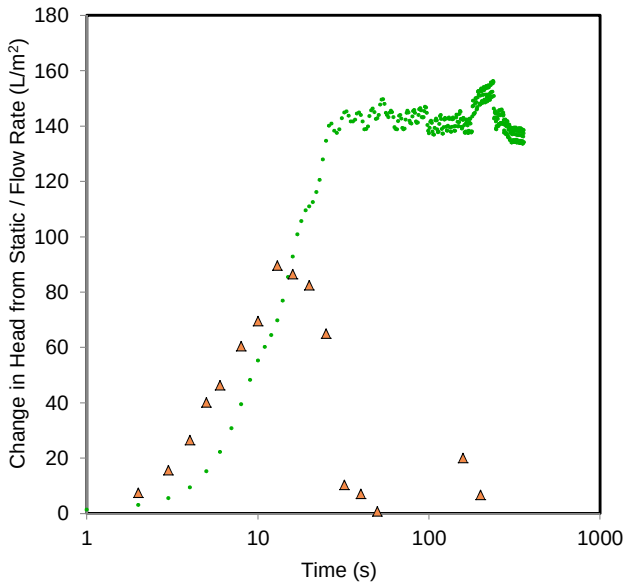
Test purpose & type:	Permafrost profiling
Drilling comments:	
Geology, hydrogeology & rock mass:	greywacke, Solid/tight
Test quality:	Good

Pressure and Flow Rate vs. Time Graph



- Pressure from surface gauge (manual readings, uncertainty shown by vertical bars)
- Pressure from transducer below packer (differential pressure in test zone)
- Flow rate from cumulative flow meter (time period of reading shown by horizontal bar)

Diagnostic Plot



- Differential pressure data from transducer below packer (data averaged over 3 second intervals)
- Derivative of differential pressure data from transducer below packer (data averaged using a logrithmic sampling interval)

Summary of Calculation Results

	psi
P_{max} (hydrojacking)	404.5
P1 (surface)	350.0
$P2_{nit}$ (downhole)	369.7

	l/min
Q (flow rate)	2.30
System leak	2.00
Q (adj.flow rate)	0.30

H_f (friction loss)	m	0.00
H_{nit} (net inj.head)	m	327.1
K1 (surface)	m/s	**1.7E-10**
K2 (downhole)	m/s	**2.1E-10**

Variables and Constants

D_w	100.0	m	$P_{aquifer}$	269	psi
D_{br}	1.0	m	P_{diff}	117	psi
D_p	335.0	m	P_g	350	psi
D_t	374.0	m	H_g	0.5	m
ß	53.6	deg.	L_p	2.50	m
Dw'	80.5	m	r_p	0.0075	m
$H_{stickup}$	1.9	m	R	10	m
Dp'	269.6	m	r_b	0.048	m
Dt'	301.0	m	L	78.0	m
P_{rods}	386	psi			

Drilling and testing

Rod size	**HQ**
Water	Muddy Water
Additive	mixed Muds
Drill type	Diamond Drill
Packer Tool	SWIPS

Pressure monitoring

Below Packer (transducer)	√
Above packer (transducer)	
Surface (flow meter)	
Surface (manual)	√
Other	

Flow monitoring

Electronic	
Cumulative	√
Other	

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PACKER INJECTION TEST

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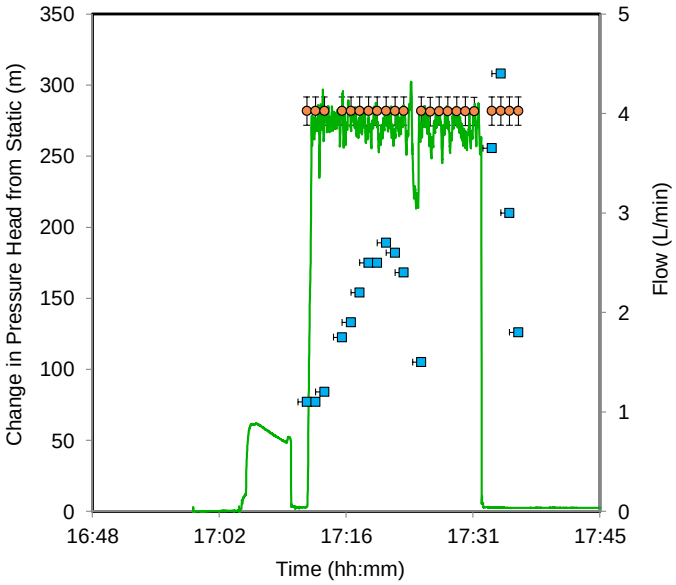
Location Description		Test Interval		Date (m/d/y)	Time
Drillhole ID:	12GSE240	Test Number:	3	Start:	9/14/12	16:45
Drillhole ID 2:	UBH	From depth (m):	413.0	End:	9/13/12	
Location:	UMWELT	To depth (m):	464.0	Supervisor:	NW	
Project Number:	12CS031.002	Drilled depth (m):	464.0	Water Table (m):		

Test zone comments & results

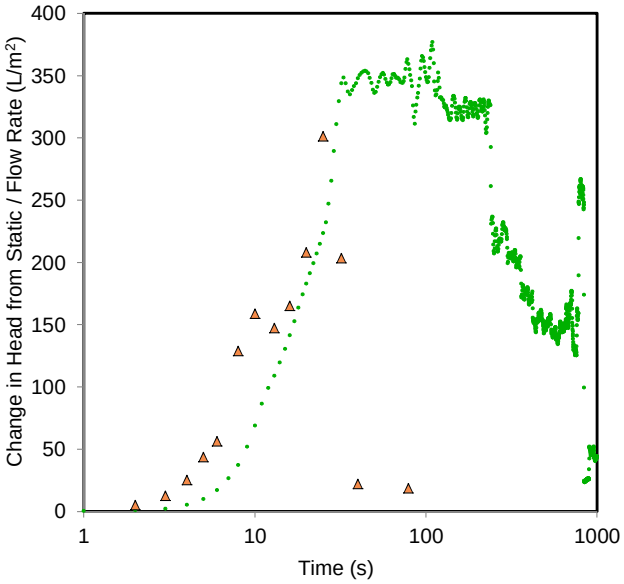
Test purpose & type:	
Drilling comments:	
Geology, hydrogeology & rock mass:	greywacke, Solid/tight
Test quality:	Good, could not deflate packer, pulled through bit inflated

Pressure and Flow Rate vs. Time Graph



- Pressure from surface gauge (manual readings, uncertainty shown by vertical bars)
- Pressure from transducer below packer (differential pressure in test zone)
- Flow rate from cumulative flow meter (time period of reading shown by horizontal bar)

Diagnostic Plot



- Differential pressure data from transducer below packer (data averaged over 3 second intervals)
- Derivative of differential pressure data from transducer below packer (data averaged using a logrithmic sampling interval)

Summary of Calculation Results

	psi
P_{max} (hydrojacking)	469.0
P1 (surface)	400.0
$P2_{nit}$ (downhole)	371.1

	l/min
Q (flow rate)	2.70
System leak	0.00
Q (adj.flow rate)	2.70

H_f (friction loss)	m	0.00
H_{nit} (net inj.head)	m	281.8
K1 (surface)	m/s	**2.7E-09**
K2 (downhole)	m/s	**2.9E-09**

Variables and Constants

D_w	0.0	m	$P_{aquifer}$	445	psi
D_{br}	1.0	m	P_{diff}	3	psi
D_p	413.0	m	P_g	400	psi
D_t	438.5	m	H_g	0.5	m
ß	49.2	deg.	L_p	2.50	m
Dw'	0.0	m	r_p	0.0075	m
$H_{stickup}$	1.9	m	R	10	m
Dp'	312.6	m	r_b	0.048	m
Dt'	331.9	m	L	51.0	m
P_{rods}	447	psi			

Drilling and testing

Rod size	**HQ**
Water	Muddy Water
Additive	mixed Muds
Drill type	Diamond Drill
Packer Tool	SWIPS

Pressure monitoring

Below Packer (transducer)	√
Above packer (transducer)	
Surface (flow meter)	
Surface (manual)	√
Other	

Flow monitoring

Electronic	
Cumulative	√
Other	

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PACKER INJECTION TEST

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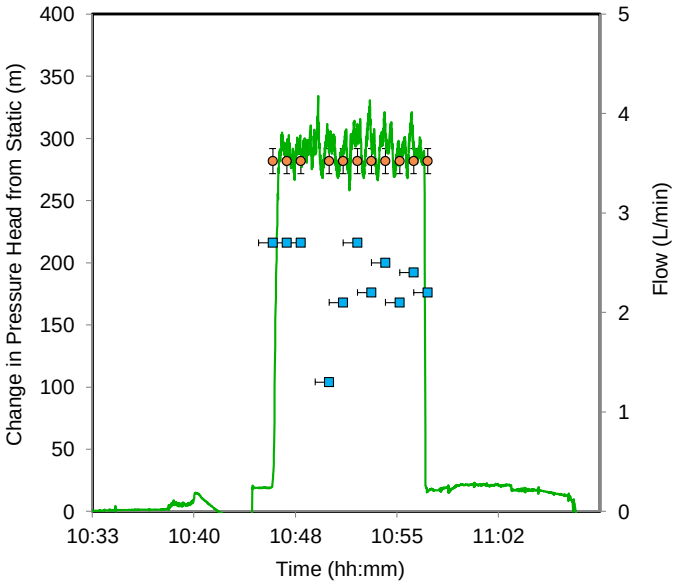
Location Description		Test Interval		Date (m/d/y)	Time
Drillhole ID:	12GSE240	Test Number:	4	Start:	9/16/12	
Drillhole ID 2:	UBH	From depth (m):	464.0	End:	9/16/12	
Location:	UMWELT	To depth (m):	539.0	Supervisor:	NW	
Project Number:	12CS031.002	Drilled depth (m):	539.0	Water Table (m):		

Test zone comments & results

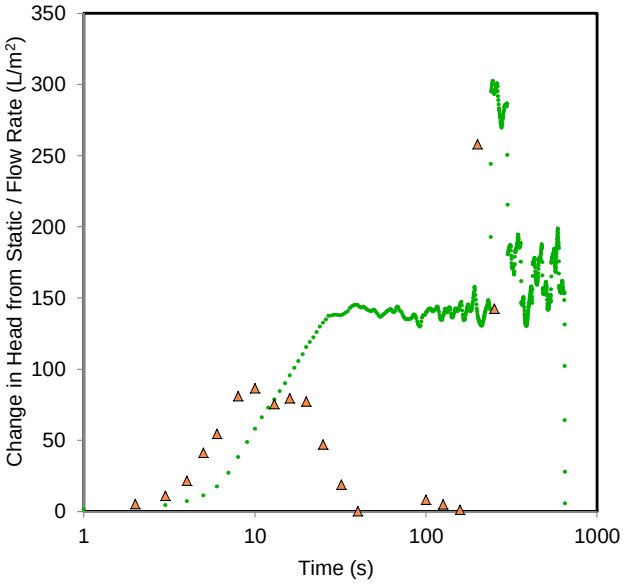
Test purpose & type:	
Drilling comments:	
Geology, hydrogeology & rock mass:	greywacke, Intebeded IF, Solid/tight
Test quality:	Good

Pressure and Flow Rate vs. Time Graph



- Pressure from surface gauge (manual readings, uncertainty shown by vertical bars)
- Pressure from transducer below packer (differential pressure in test zone)
- Flow rate from cumulative flow meter (time period of reading shown by horizontal bar)

Diagnostic Plot



- Differential pressure data from transducer below packer (data averaged over 3 second intervals)
- Derivative of differential pressure data from transducer below packer (data averaged using a logrithmic sampling interval)

Summary of Calculation Results

	psi
P_{max} (hydrojacking)	499.0
P1 (surface)	400.0
$P2_{nit}$ (downhole)	415.2

	l/min
Q (flow rate)	2.30
System leak	0.00
Q (adj.flow rate)	2.30

H_f (friction loss)	m	0.00
H_{nit} (net inj.head)	m	281.8
K1 (surface)	m/s	**1.5E-09**
K2 (downhole)	m/s	**1.5E-09**

Variables and Constants

D_w	0.0	m	$P_{aquifer}$	473	psi
D_{br}	1.0	m	P_{diff}	3	psi
D_p	464.0	m	P_g	400	psi
D_t	501.5	m	H_g	0.5	m
ß	45.8	deg.	L_p	2.50	m
Dw'	0.0	m	r_p	0.0075	m
$H_{stickup}$	1.9	m	R	10	m
Dp'	332.6	m	r_b	0.048	m
Dt'	359.5	m	L	75.0	m
P_{rods}	476	psi			

Drilling and testing

Rod size	**HQ**
Water	Muddy Water
Additive	mixed Muds
Drill type	Diamond Drill
Packer Tool	SWIPS

Pressure monitoring

Below Packer (transducer)	√
Above packer (transducer)	
Surface (flow meter)	
Surface (manual)	√
Other	

Flow monitoring

Electronic	
Cumulative	√
Other	

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Appendix B3:
2012 Vibrating Wire / Thermistor Documentation

RST INSTRUMENTS LTD.

11545 Kingston Street
Maple Ridge BC V2X 0Z5
Phone: (604) 540-1100 Ext.
Fax: (604) 540-1005

www.rstinstruments.com

ISO 9001

Quote

Q023396

CUSTOMER NO. SRKRO1

BILL TO:
STEFFEN, ROBERTSON & KIRSTEN
OCEANIC PLAZA
2200 - 1066 WEST HASTINGS ST.
VANCOUVER BC V6E 3X2
(604) 681-4196 Ext.

SHIP TO:
STEFFEN, ROBERTSON & KIRSTEN
OCEANIC PLAZA
2200 - 1066 WEST HASTINGS ST.
VANCOUVER BC V6E 3X2
(604) 681-4196 Ext.
BEN GREEN

EST. SHIP DATE	SHIP VIA	F.O.B.	TERMS	ORDER NUMBER
	TBA	Our Dock	NET 30 DAYS	Q023396

ORDER DATE	P.O. NUMBER	SALESPERSON
24-May-12		Alin Plesu

L#	PART NUMBER	DESCRIPTION	QTY.	U/M	UNIT PRICE	TOTAL
		OPTION 1 - ANALOG THERMISTORS				
		.				
	TH0021-12-410-3MPA	410m LONG THERMISTOR STRING 12 PT. 10k ohm 0.1° C w/ VW2100-3.0 *CABLE 13 PAIR 24 AWG STC, 1xKEVLAR #49, WATER BLOCKED PU JACKET 0.410"* *THERMISTOR BEADS 0.75" DIA. INSTALLED @ 390, 370, 350, 330, 310, 290, 270, 250, 230, 210, 110m* *1 VIBRATING WIRE PIEZOMETER 0.75" 3.0 MPa w/ THERMISTOR INSTALLED @ 410m*	1.00	EA	6,685.0000	6,685.00
	TH0021-12-310-3MPA	310m LONG THERMISTOR STRING 12 PT. 10k ohm 0.1° C w/ VW2100-3.0 *CABLE 13 PAIR 24 AWG STC, 1xKEVLAR #49, WATER BLOCKED PU JACKET 0.410"* *THERMISTOR BEADS 0.75" DIA. INSTALLED @ 285, 260, 235, 210, 185, 160, 135, 110, 85, 60, 35m* *1 VIBRATING WIRE PIEZOMETER 0.75" 3.0 MPa w/ THERMISTOR INSTALLED @ 310m* *PARTS TO CONNECT TO CAMPBELL DATALOGGERS* *(EACH ELGL2042 CAN TAKE UP TO 10 POINTS. FEW POINTS CAN BE CONNECTED DIRECTLY TO DATALOGGER IF CHANNELS ARE AVAILABLE)*	1.00	EA	5,360.0000	5,360.00
	ELGL2042	FLEXI-MUX 5/10 CHANNELS - DATALOGGER MULTIPLEXER w/ CONNECTORS	4.00	EA	350.0000	1,400.00
		TOTAL OPTION 1: $13,445				
		OPTION 2 - DIGITAL THERMARRAY				
		.				
	TH0100-12-410	410m LONG DIGITAL THERMARRAY STRING 12 PT. *CABLE, THERMARRAY - 22 AWG, 4 COND, KEVLAR, PU JACKET 0.25"* *POINTS 0.75" INSTALLED @ 410, 390, 370, 350, 330, 310, 290, 270, 250, 230, 210, 110m* *Includes: Electrostatic Discharge Module,*	1.00	EA	5,165.0000	5,165.00
	TH0100-12-310	410m LONG DIGITAL THERMARRAY STRING 12 PT. *CABLE, THERMARRAY - 22 AWG, 4 COND, KEVLAR, PU JACKET 0.25"* *POINTS 0.75" INSTALLED @ 310, 285, 260, 235, 210, 185, 160, 135, 110, 85, 60, 35m* *Includes: Electrostatic Discharge Module,*	1.00	EA	4,520.0000	4,520.00
	VW2100-3.0	VIBRATING WIRE PIEZOMETER 3.0 MPa *Cable lengths: 1 x 410m, 1 x 310m*	2.00	EA	472.0000	944.00
	EL380004	CABLE, 4 CONDUCTOR x 22 AWG, OSD, RED POLYURETHANE JACKET 0.250" DIA.	720.00	M	2.6500	1,908.00

CONTINUED

RST INSTRUMENTS LTD.

11545 Kingston Street
Maple Ridge BC V2X 0Z5
Phone: (604) 540-1100 Ext.
Fax: (604) 540-1005

www.rstinstruments.com

ISO 9001

Quote

Q023396

CUSTOMER NO. SRKRO1

BILL TO:

STEFFEN, ROBERTSON & KIRSTEN
OCEANIC PLAZA
2200 - 1066 WEST HASTINGS ST.
VANCOUVER BC V6E 3X2
(604) 681-4196 Ext.

SHIP TO:

STEFFEN, ROBERTSON & KIRSTEN
OCEANIC PLAZA
2200 - 1066 WEST HASTINGS ST.
VANCOUVER BC V6E 3X2
(604) 681-4196 Ext.
BEN GREEN

EST. SHIP DATE	SHIP VIA	F.O.B.	TERMS	ORDER NUMBER
	TBA	Our Dock	NET 30 DAYS	Q023396

ORDER DATE	P.O. NUMBER	SALESPERSON
24-May-12		Alin Plesu

L#	PART NUMBER	DESCRIPTION	QTY.	U/M	UNIT PRICE	TOTAL
		PARTS TO CONNECT TO CAMPBELL DATALOGGERS 9EXCEPT CR200 (EACH DATALOGGER NEEDS ONE ELGL4000)				
	ELGL4000	RS485 TO RS232 SENSOR INTERFACE - DIN RAIL MOUNT	2.00	EA	600.0000	1,200.00

TOTAL OPTION 2: $13,737

Validity of quote: 60 Days
Estimated delivery: 4 Weeks
Subject to RST Instruments Sales Terms and Conditions (http://www.rstinstruments.com/StandardTerms.pdf).

	NET AMOUNT	27,182.00
	BC 12% HST	3,261.84
CDN DOLLARS	**TOTAL DUE**	30,443.84

RST INSTRUMENTS LTD.

11545 Kingston Street
Maple Ridge BC V2X 0Z5
Phone: (604) 540-1100 Ext.
Fax: (604) 540-1005

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ISO 9001

Confirmation

Q023936

CUSTOMER NO. SRKRO1

BILL TO:

STEFFEN, ROBERTSON & KIRSTEN
OCEANIC PLAZA
2200 - 1066 WEST HASTINGS ST.
VANCOUVER BC V6E 3X2
(604) 681-4196 Ext.

SHIP TO:

SRK CONSULTING
GOOSE LAKE CAMP
C/O DISCOVERY MINING SERVICES
101- 487 RANGE LAKE ROAD
867-445-1643
YELLOWKNIFE NT X1A 3R9
(876) 920-4600 Ext.
ATTENTION: NORM CASE

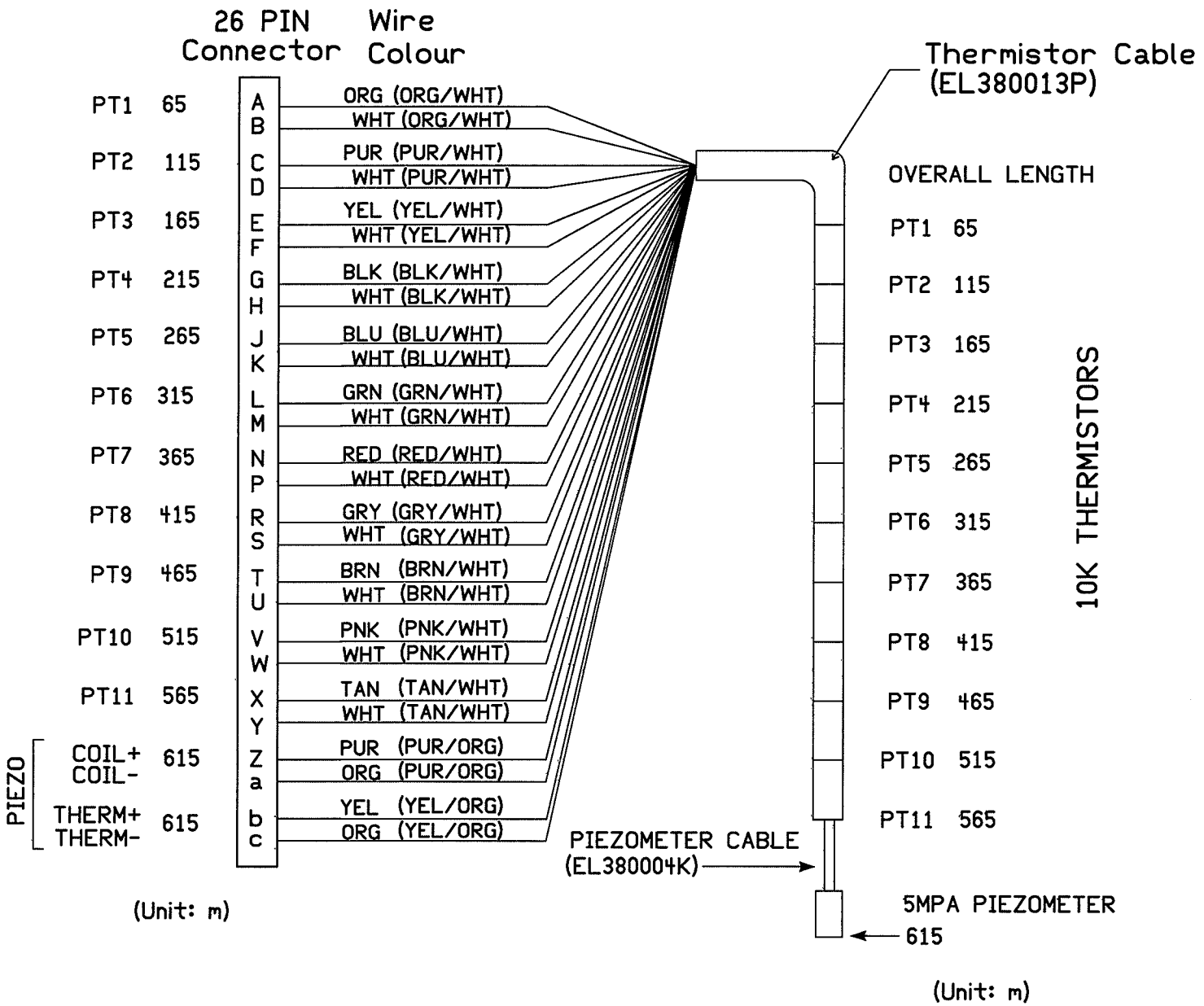
EST. SHIP DATE	SHIP VIA	F.O.B.	TERMS	ORDER NUMBER
21-Aug-12	AIR CANADA PPD/CHGD	Our Dock	NET 30 DAYS	Q023936

ORDER DATE	P.O. NUMBER	SALESPERSON
24-Jul-12	BEN GREEN	Alin Plesu

L#	PART NUMBER	DESCRIPTION	QTY.	U/M	UNIT PRICE	TOTAL
	TH0021-12-615-5MPA	615m LONG THERMISTOR STRING 12 PT. 10k ohm 0.1° C w/ VW2100-5.0HD *CABLE 13 PAIR 24 AWG STC, 1xKEVLAR #49, WATER BLOCKED PU JACKET 0.410"* *THERMISTOR BEADS 0.75" DIA. INSTALLED @ 565m, 515m, 465m, 415m, 365m, 315m, 265m, 215m, 165m, 115m, 65m* *1 VIBRATING WIRE PIEZOMETER 5.0 MPa HD 1" w/ THERMISTOR INSTALLED @ 615m*	1.00	EA	9,550.0000	9,550.00
	PTO6A-16-26P	PLUG, MALE #16 SHELL, 26PIN ATTACHED AND OVERMOLDED	1.00	EA	375.0000	375.00
	ELGL1200	FLEXDAQ LOGGER 1000 (To monitor 12 Thermistors and 1 VW Sensor) *Includes: Campbell CR1000 Logger, Cold tested, CFM100 - COMPACT FLASH MODULE, CFLASH-G-256M-I, AVW200 2 Ch VW interface, PS100 Battery unit, Power DIN mount/ fuse, 17365 7.2hr spare battery w/ mount, 17394 USB to 9 Pin Male RS-232 cable, SC32B Optical Isolated RS-232, 26 pin connector - panel mount, Fiberglass enc. & back panel, ground lug' Cable gland.* *Note: All FLEXDAQ loggers are pre-programmed and ready to run.*	1.00	EA	5,685.0000	5,685.00
	ELCHRG110	BATTERY CHARGER 110VAC	1.00	EA	135.0000	135.00

Subject to RST Instruments Sales Terms and Conditions (http://www.rstinstruments.com/StandardTerms.pdf).

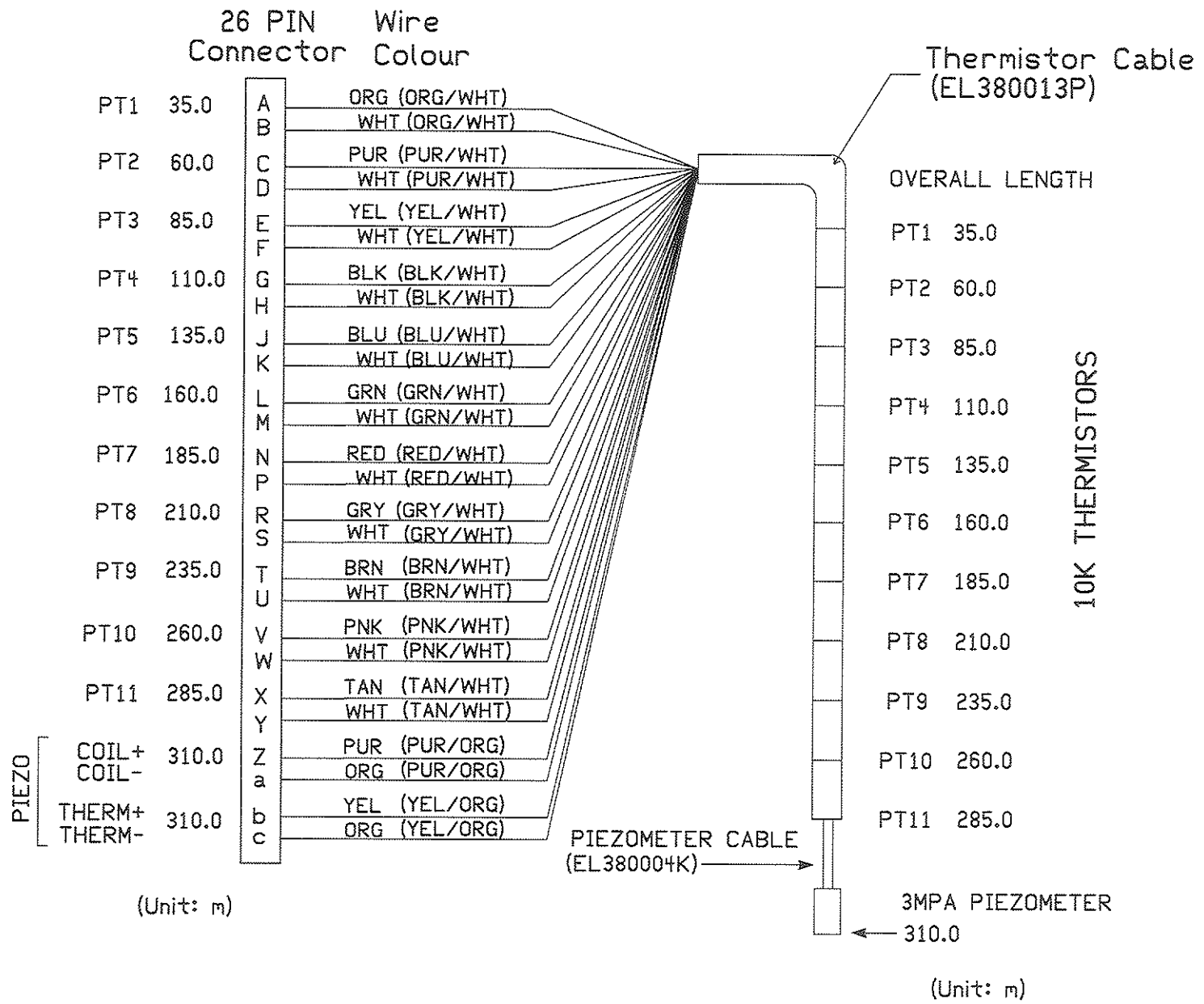
	NET AMOUNT	15,745.00
	BC 12% HST	1,889.40
CDN DOLLARS	**TOTAL DUE**	17,634.40



SPLICE COLOR EL380013P	EL380004K
PUR (PUR/ORG)	RED
ORG (PUR/ORG)	BLK
YEL (YEL/ORG)	GRN
ORG (YEL/ORG)	WHT

S/N: TS3382
PIEZOMETER S/N: VW22780

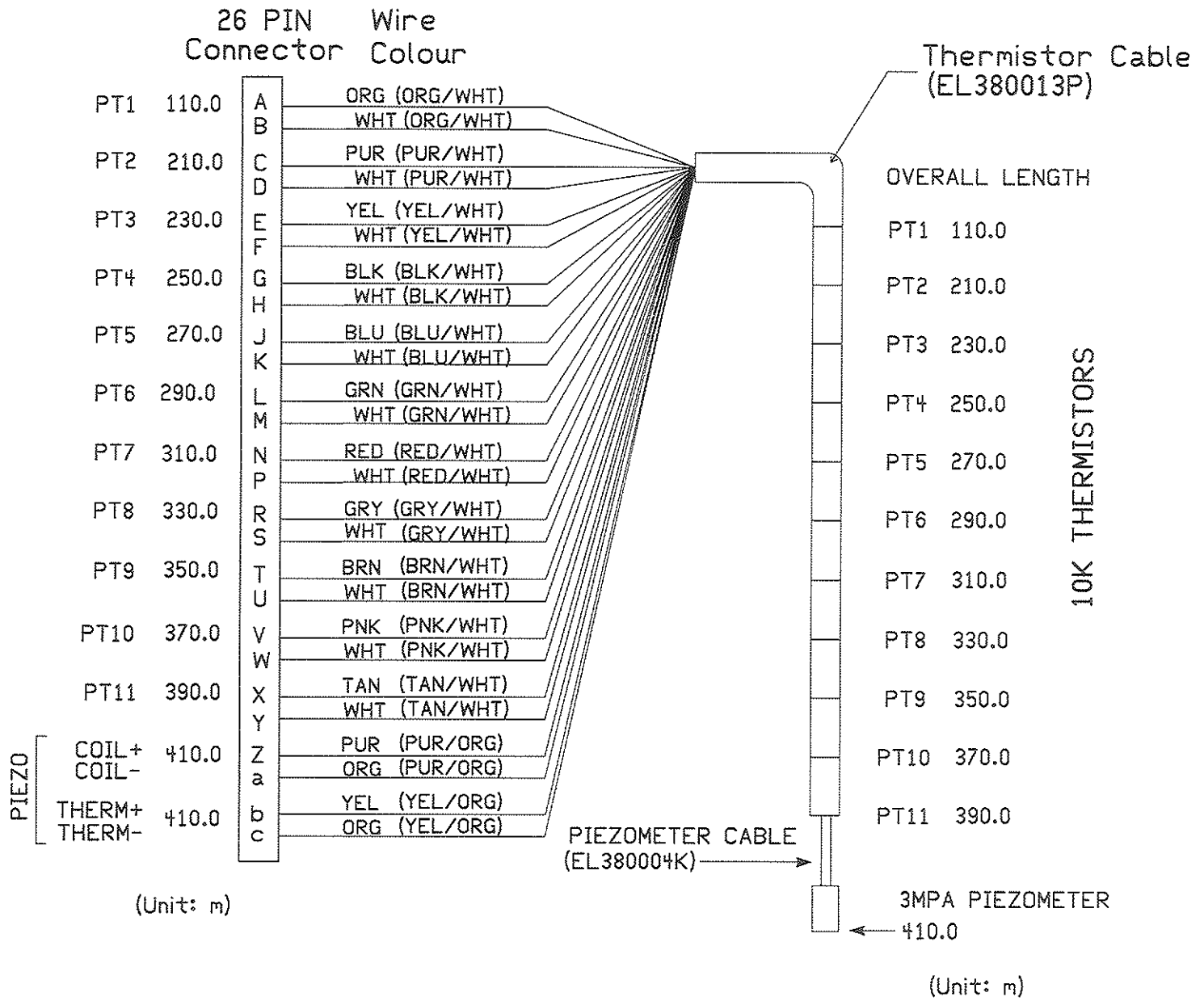
Co:	RST INSTRUMENTS LTD
Title:	THERMISTOR CABLE
J/N:	THW0108_WOQ023936 Revision: A
Author:	WY Size: A
Date:	2012/07/26 Sheet 1 of 1



SPLICE COLOR EL380013P	EL380004K
PUR (PUR/ORG)	RED
ORG (PUR/ORG)	BLK
YEL (YEL/ORG)	GRN
ORG (YEL/ORG)	WHT

S/N: TS3344
PIEZOMETER S/N: VW22216

Co:	RST INSTRUMENTS LTD
Title:	THERMISTOR CABLE
J/N:	THW0096_WOQ023396 Revision: A
Author:	CB Size: A
Date:	2012/05/29 Sheet 1 of 1



SPLICE COLOR EL380013P	EL380004K
PUR (PUR/ORG)	RED
ORG (PUR/ORG)	BLK
YEL (YEL/ORG)	GRN
ORG (YEL/ORG)	WHT

S/N: TS3345
PIEZOMETER S/N: VW22217

Co:	RST INSTRUMENTS LTD
Title:	THERMISTOR CABLE
J/N:	THW0095_WOQ023396 Revision: A
Author:	CB Size: A
Date:	2012/05/29 Sheet 1 of 1

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RST Instruments Ltd., 11545 Kingston St., Maple Ridge, British Columbia, Canada V2X 0Z5
Tel: 604 540 1100 • Fax: 604 540 1005 • Toll Free: 1 800 665 5599 (North America only)
e-mail: info@rstinstruments.com • Website: www.rstinstruments.com

Calibration Record

Vibrating Wire Piezometer

Customer:	Steffen, Robertson & Kirsten
Model:	VW2100-5.0HD
Serial Number:	**VW22780**
Mfg Number:	1217755
Range:	5.0 MPa
Temperature:	23.5 °C
Barometric Pressure:	987.3 millibars
Work Order Number:	Q023936
Cable Length:	615 meters
Cable Markings:	n/a
Cable Colour Code:	Pin Z Orange / Pin a Purple (Coil)
	Pin b Orange / Pin c Yellow (Thermistor)
Cable Type:	EL380013P / EL380004K
Thermistor Type:	10 Kohms

Applied Pressure (MPa)	First Reading (B units)	Second Reading (B units)	Average Reading (B units)	Calculated Linear (MPa)	Linearity Error (% FS)	Polynomial Error (% FS)
0.0	8794	8795	8795	0.013	0.25	-0.01
1.0	8019	8019	8019	0.999	-0.03	0.02
2.0	7239	7240	7240	1.990	-0.21	0.01
3.0	6454	6454	6454	2.988	-0.24	-0.02
4.0	5660	5661	5661	3.997	-0.06	0.00
5.0	4861	4860	4861	5.014	0.28	0.01
				Max. Error (%):	0.28	0.02

Linear Calibration Factor:	**C.F.=**	**0.0012712 MPa/B unit**
Regression Zero:	**At Calibration =**	**8804.5 B unit**
Temperature Correction Factor:	**Tk =**	**0.0008607 MPa/°C rise**

Polynomial Gage Factors (MPa) **A:** -6.5486E-09 **B:** -0.0011818 **C:** 10.899

Pressure is calculated with the following equations:

Linear: $P(MPa) = C.F.(Li-Lc) - [Tk(Ti-Tc)] + [0.00010(Bi-Bc)]$

Polynomial: $P(MPa) = A(Lc)^2 + BLc + C + Tk(Tc-Ti) - [0.00010(Bc-Bi)]$

	Date (dd/mm/yy)	VW Readout Pos. B (Li)	Temp °C (Ti)	Baro (Bi)
Shipped Zero Readings:	20-Aug-12	8803	22.7	1017.7

Li, Lc = initial (at installation) and current readings
Ti, Tc = initial (at installation) and current temperature, in °C
Bi, Bc = initial (at installation) and current barometric pressure readings, in millibars
B units = B scale output of VW 2102, VW 2104, VW 2106 and DT 2011 readouts
B units = $Hz^2 / 1000$ ie: 1700Hz = 2890 B units

Technician: J. Chu Date: 20-Aug-12

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This instrument has been calibrated using standards traceable to the NIST in compliance with ANSI Z540-1

Document Number: ELL0143H

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e-mail: info@rstinstruments.com • Website: www.rstinstruments.com

Calibration Record

Vibrating Wire Piezometer

Customer:		Steffen, Robertson & Kirsten	
Model:		TH0021-12-410-3MPA	
Serial Number:		**VW22217**	
Mfg Number:		1207892	
Range:		3.0	MPa
Temperature:		23.1	°C
Barometric Pressure:		1002.4	millibars
Work Order Number:		Q023396	
Cable Length:		410	meters
Cable Markings:		n/a	
Cable Colour Code:	Coil: Pins Z & a	Pur/Org	
	Thermistor: Pins b & c	Yel/Org	
Cable Type:		EL380013P / EL380004K	
Thermistor Type:		10	Kohms

Applied Pressure (MPa)	First Reading (B units)	Second Reading (B units)	Average Reading (B units)	Calculated Linear (MPa)	Linearity Error (% FS)	Polynomial Error (% FS)
0.0	8986	8987	8987	0.008	0.26	0.00
0.6	8281	8282	8282	0.599	-0.04	0.01
1.2	7572	7572	7572	1.193	-0.22	-0.01
1.8	6856	6856	6856	1.794	-0.22	0.00
2.4	6135	6134	6135	2.398	-0.06	0.00
3.0	5407	5407	5407	3.008	0.27	0.00
			Max. Error (%):		0.27	0.01

Linear Calibration Factor:	**C.F.=**	**0.00083814 MPa/B unit**
Regression Zero:	**At Calibration =**	**8995.9 B unit**
Temperature Correction Factor:	**Tk =**	**0.001045 MPa/°C rise**

Polynomial Gage Factors (MPa) **A:** -4.6877E-09 **B:** -0.00077067 **C:** 7.3041

Pressure is calculated with the following equations:

Linear: $P(MPa) = C.F.(Li-Lc) - [Tk(Ti-Tc)] + [0.00010(Bi-Bc)]$

Polynomial: $P(MPa) = A(Lc)^2 + BLc + C + Tk(Tc-Ti) - [0.00010(Bc-Bi)]$

	Date (dd/mm/yy)	VW Readout Pos. B (Li)	Temp °C (Ti)	Baro (Bi)
Shipped Zero Readings:	19-Jun-12	8989	21.3	1018.6

Li, Lc = initial (at installation) and current readings
Ti, Tc = initial (at installation) and current temperature, in °C
Bi, Bc = initial (at installation) and current barometric pressure readings, in millibars
B units = B scale output of VW 2102, VW 2104, VW 2106 and DT 2011 readouts
B units = Hz^2 / 1000 ie: 1700Hz = 2890 B units

Technician: J. Chu Date: 19-Jun-12

This instrument has been calibrated using standards traceable to the NIST in compliance with ANSI Z540-1

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AScT

Document Number: ELL0143H

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e-mail: info@rstinstruments.com • Website: www.rstinstruments.com

Calibration Record

Vibrating Wire Piezometer

Customer:		Steffen, Robertson & Kirsten	
Model:		TH0021-12-310-3MPA	
Serial Number:		**VW22216**	
Mfg Number:		1207893	
Range:		3.0	MPa
Temperature:		23.1	°C
Barometric Pressure:		1002.4	millibars
Work Order Number:		Q023396	
Cable Length:		310	meters
Cable Markings:		n/a	
Cable Colour Code:	Coil: Pins Z & a	Pur/Org	
	Thermistor: Pins b & c	Yel/Org	
Cable Type:		EL380013P / EL380004K	
Thermistor Type:		10	Kohms

Applied Pressure (MPa)	First Reading (B units)	Second Reading (B units)	Average Reading (B units)	Calculated Linear (MPa)	Linearity Error (% FS)	Polynomial Error (% FS)
0.0	8978	8979	8979	0.006	0.20	-0.04
0.6	8284	8284	8284	0.601	0.03	0.08
1.2	7592	7592	7592	1.194	-0.21	-0.02
1.8	6892	6892	6892	1.793	-0.22	-0.03
2.4	6186	6186	6186	2.398	-0.06	-0.01
3.0	5475	5475	5475	3.007	0.25	0.01
				Max. Error (%):	0.25	0.08

Linear Calibration Factor:	**C.F.=**	**0.00085672 MPa/B unit**
Regression Zero:	**At Calibration =**	**8985.4 B unit**
Temperature Correction Factor:	**Tk =**	**0.0009482 MPa/°C rise**

Polynomial Gage Factors (MPa) A: -4.3182E-09 B: -0.00079431 C: 7.4787

Pressure is calculated with the following equations:

Linear: $P(MPa) = C.F.(Li-Lc) - [Tk(Ti-Tc)] + [0.00010(Bi-Bc)]$

Polynomial: $P(MPa) = A(Lc)^2 + BLc + C + Tk(Tc-Ti) - [0.00010(Bc-Bi)]$

	Date (dd/mm/yy)	VW Readout Pos. B (Li)	Temp °C (Ti)	Baro (Bi)
Shipped Zero Readings:	19-Jun-12	8974	21.4	1018.6

Li, Lc = initial (at installation) and current readings
Ti, Tc = initial (at installation) and current temperature, in °C
Bi, Bc = initial (at installation) and current barometric pressure readings, in millibars
B units = B scale output of VW 2102, VW 2104, VW 2106 and DT 2011 readouts
B units = Hz^2 / 1000 ie: 1700Hz = 2890 B units

Technician: J. Chu Date: 19-Jun-12

This instrument has been calibrated using standards traceable to the NIST in compliance with ANSI Z540-1

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Document Number: ELL0143H

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Thermistor Documentation

The following summarises the recommendations for the checking and charging considerations for the PS100 Battery unit that powers the CR 1000 Datalogger.

This procedure is considered conservative as it will not be -30° C for 6 months, but it is advised that the datalogger battery is checked about every 4 -5 months to be on the safe side.

The battery voltage is stored in the data file. This is presented in the downloaded data. The voltage of the batteries should not drop below 10.5 V or there will be permanent damage.

Calculation for battery life:

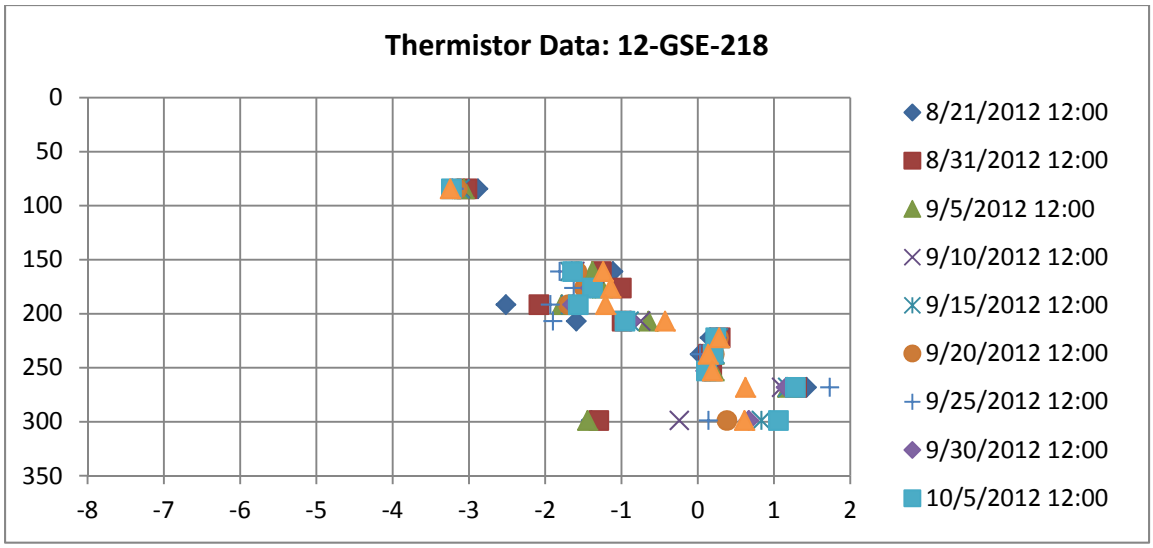
- You have 2 x 7.2 AH batteries. (spare battery connected)
- Divide by 2 for extreme cold ~7000 mA hrs (-30 deg)
- The stand by current when the logger is sleeping is the main power draw as the logger is sleeping most of the time. Standby is ~1.5 mA
- 7000/1.5 = 4667 hours = 194 days with no logging

Logging

- 15 mA for 10 seconds /reading twice a day = 5mA min/60min/hr ~ 0.1 mA Hr /day
- 200 days = 20 mA hr so subtract 4 days and you should be good for 190 days.

If the location is difficult to get to, you should replace the batteries on every visit. Batteries are cheap compared to missing data.

Appendix B4:
Summary Temperature Results and Pore Pressure


Thermistor Data: 12-GSE-218
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50
100
150
200
250
300
350
-8
-7
-6
-5
-4
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-2
-1
0
1
2
8/21/2012 12:00
8/31/2012 12:00
9/5/2012 12:00
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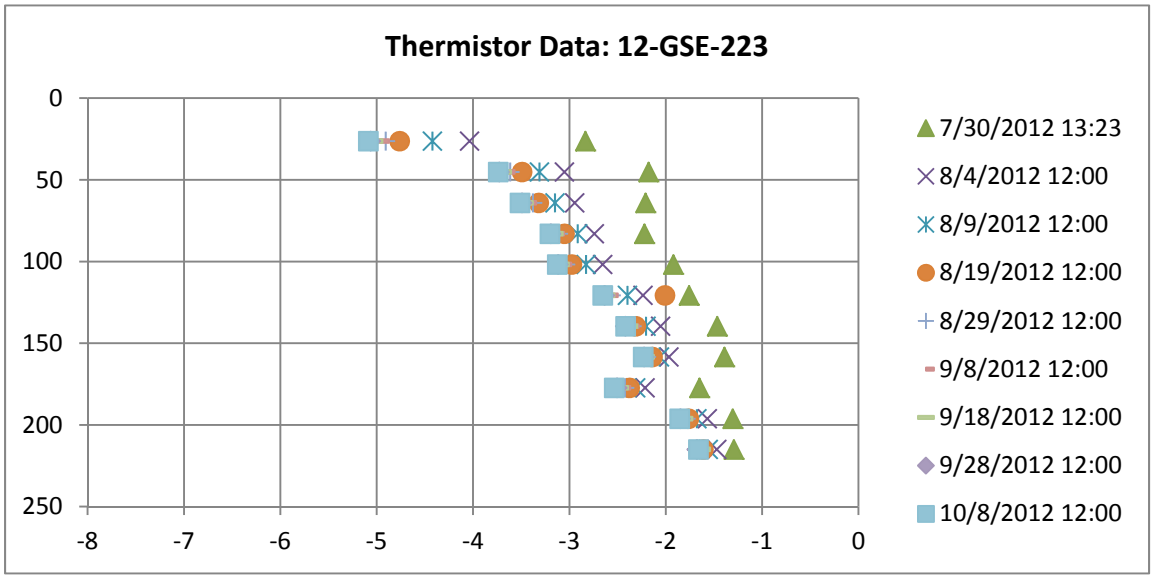
10/5/2012 12:00


Thermistor Data: 12-GSE-223
0
50
100
150
200
250
-8
-7
-6
-5
-4
-3
-2
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8/4/2012 12:00
8/9/2012 12:00
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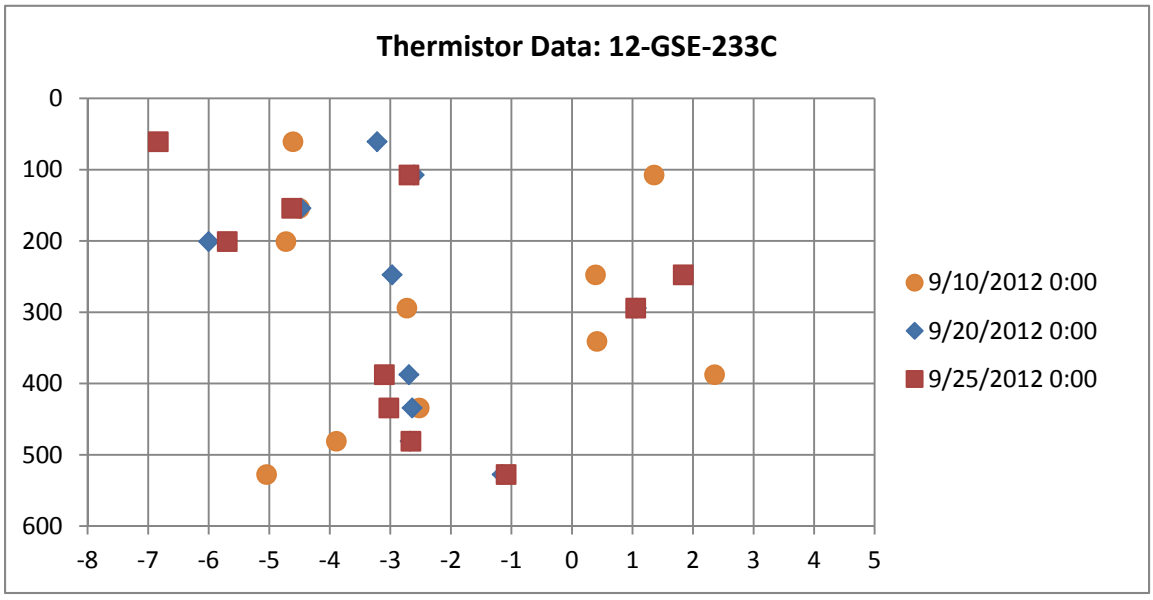
10/8/2012 12:00


Thermistor Data: 12-GSE-233C
0
100
200
300
400
500
600
-8
-7
-6
-5
-4
-3
-2
-1
0
1
2
3
4
5
9/10/2012 0:00
9/20/2012 0:00
9/25/2012 0:00

Appendix B5
Thermistor and Vibrating Wire Data (Provided on DVD)

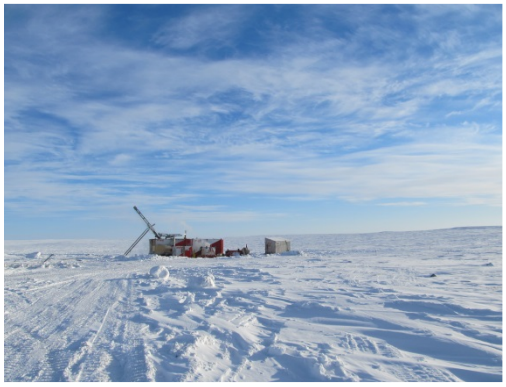
DVD not included in this version of the report.

Appendix V6-2D

Geomechanical and Hydrogeological Site Investigation

Sabina
GOLD & SILVER CORP.

SABINA GOLD & SILVER CORP.
BACK RIVER PROJECT



2013 GEOMECHANICAL AND HYDROGEOLOGICAL SITE INVESTIGATION SUMMARY

PREPARED FOR:

Sabina Gold & Silver Corp.
930 West 1st Street, Suite 202
North Vancouver, BC V7P 3N4

PREPARED BY:

Knight Piésold Ltd.
1650 Main Street West
North Bay, ON P1B 8G5 Canada
p. +1.705.476.2165 | f. +1.705.474.8095

VA101-517/3-1
Rev 0
September 23, 2013

Knight Piésold
CONSULTING
www.knightpiesold.com

ISO 9001 - FS 64925
ISO 14001 - EMS 550121
OHSAS 18001 - OHS 550122

SABINA GOLD & SILVER CORP.
BACK RIVER PROJECT

2013 GEOMECHANICAL AND HYDROGEOLOGICAL SITE INVESTIGATION SUMMARY
VA101-517/3-1

Rev	Description	Date	Approved
0	Issued in Final	September 23, 2013	

Knight Piésold Ltd.
1650 Main Street West
North Bay, Ontario Canada P1B 8G5
Telephone: (705) 476-2165
Facsimile: (705) 474-8095
www.knightpiesold.com

Knight Piésold CONSULTING

EXECUTIVE SUMMARY

Sabina Gold & Silver Corp. (Sabina) is developing the Back River Gold Project in the Kitikmeot region of Nunavut, Canada. Exploration activities have identified a series of gold ore bodies, and Sabina is currently evaluating the feasibility of mining several of these ore bodies using a combination of open pit and underground methods. This study focuses on the Goose Property (containing the Goose Main, Llama, and Umwelt deposits) and the George Property (containing the Locale 1, Locale 2, and Lone Cow Pond deposits). The Goose Property is approximately 60 km southeast of the George Property.

Knight Piésold Ltd. (KPL) was engaged by Sabina to complete the geomechanical and hydrogeological work needed to support the feasibility mine design for the proposed underground and open pit developments. The work completed included:

- A geomechanical and hydrogeological site investigation program was completed between February and June, 2013
- Characterization of the rock mass quality and discontinuity orientations in the vicinity of the deposits
- Characterization of the hydrogeological conditions in the vicinity of the deposits

ROCK MASS CHARACTERIZATION

The geomechanical site investigation program included thirty-four (34) oriented and triple-tubed diamond drillholes with associated geomechanical logging and laboratory strength testing. The program was designed by others and implemented by KPL. The encountered rock masses were classified using the RMR_{89} and NGI-Q classification systems. A summary of the rock mass characteristics for each major lithology unit is included below.

- **Greywacke** - The greywacke is generally of GOOD quality (*i.e.,* RMR_{89} values typically ranging from 60 to 75) with a mean UCS of 120 MPa.
- **Interbedded Sediments** - The interbedded sediments unit is generally of FAIR to GOOD quality (*i.e.,* RMR_{89} values ranging from 55 to 75) with a mean UCS of 110 MPa.
- **Mudstone** - The rock mass quality of the mudstone is highly variable and ranges from POOR to GOOD (*i.e.,* RMR_{89} values ranging from 35 to 70). The mudstone has a mean UCS of 60 MPa. The mudstone was observed to be of lower and more variable quality than the other lithologies.
- **Lower Iron Formation -** The lower iron formation is generally of GOOD to VERY GOOD quality (*i.e.,* RMR_{89} values typically ranging from 65 to 85) with a mean UCS of 260 MPa. The lower iron formation was observed to be of higher quality than the other lithologies.
- **Upper Iron Formation -** The upper iron formation is generally of FAIR to GOOD quality (*i.e.,* RMR_{89} values typically ranging from 55 to 80) with a mean UCS of 190 MPa.
- **Felsic Dykes -** The felsic dyke units are generally of GOOD (*i.e.,* RMR_{89} values typically ranging from 60 to 75) with a mean UCS of 130 MPa.
- **Gabbro Dykes -** The gabbro dykes are generally of FAIR to GOOD (*i.e.,* RMR_{89} values typically ranging from 55 to 75) with a mean UCS of 120 MPa.

The discontinuity data from the oriented core suggests an orthogonally jointed rock mass with three joint sets. However, all of the joint sets are not present or well defined in each of the drillholes. The observed joint sets are:

- A set striking southeast-northwest and dipping moderately to steeply to the northeast
- A set striking northeast-southwest and dipping sub-vertically
- A flat-lying joint set

HYDROGEOLOGY

The hydrogeological site investigation program included hydraulic packer testing of select geomechanical and exploration drillholes, as well as the installation of multi-point thermistor strings and vibrating wire piezometers. A summary of the encountered hydrogeological conditions is included below.

- Hydraulic packer tests were completed to assess the hydraulic conductivity of the encountered rock masses. The rock masses in the unfrozen ground below the permafrost were observed to be have low hydraulic conductivities ($1x10^{-9}$ to $2x10^{-8}$ m/s). The near-surface rock mass within the talik beneath Llama Lake was observed to have moderate hydraulic conductivities ($1x10^{-9}$ m/s to $4x10^{-6}$ m/s).
- Multi-point thermistor strings were installed to measure the temperature profile of the rock mass. The permafrost was observed to be continuous to a depth of approximately 400 to 500 mbgs at the Goose Property and more than 200 mbgs at the George Property. A talik was observed below Llama Lake. Taliks were not observed between the Goose Deposit and Goose Lake or at any of the deposits at the George Property.
- Vibrating wire piezometers were installed to measure piezometric pressures. The piezometric levels within the deep groundwater below the permafrost were observed to be near surface. These results are consistent with other permafrost areas where the deep groundwater flow is controlled by the water levels of the larger lakes that are connected to unfrozen ground below the permafrost though talik zones.

RECOMMENDATIONS

Recommendations for future work include:

- Developing a structural model for the George Property
- Continuing to collect data from the thermistor and vibrating wire piezometer installations on a quarterly basis. The installations should be maintained and the batteries charged as required. The collected data should be reviewed to confirm the preliminary conclusions presented in this report.

Additional rock mass and hydrogeological characterization may be required to support the next level of design or in response to any significant changes to the mine plan or geological models.

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ABBREVIATIONS

AMC	AMC Mining Consultants Ltd.
ASTM	American Society for Testing and Materials
DS	Direct Shear
GKM	GKM Consultants
IPI	Inflatable Packers International LLC
KPL	Knight Piésold Ltd.
LIF	Lower Iron Formation
Major	Major Drilling Group International Inc.
masl	metres above sea level
mbgs	metres below ground surface
Q'	Tunneling Quality Index
Rescan	Rescan Environmental Services Ltd.
RMR_{89}	Rock Mass Rating (1989 version)
RQD	Rock Quality Designation
Sabina	Sabina Gold & Silver Corp.
SRK	SRK Consulting (Canada) Inc.
SWiPS	Standard Wireline Packer System
TCR	Total Core Recovery
UCS	Unconfined Compressive Strength
UIF	Upper Iron Formation

1 – INTRODUCTION

1.1 PROJECT DESCRIPTION

Sabina Gold & Silver Corp. (Sabina) is developing the Back River Gold Project in the Kitikmeot region of Nunavut, Canada. The project is located approximately 520 km northeast of Yellowknife and 75 km southwest of Bathurst Inlet. The property location is shown on Figure 1.1.

Exploration activities have identified a series of gold ore bodies, and Sabina is currently evaluating the feasibility of mining several of these ore bodies using a combination of open pit and underground methods. This study focuses on the Goose Property (containing the Goose Main, Llama, and Umwelt deposits) and the George Property (containing the Locale 1, Locale 2, and Lone Cow Pond deposits). The Goose Property is approximately 60 km southeast of the George Property.

The current mine plan consists of mining the Goose Main, Umwelt, Lone Cow Pond and Locale 1 deposits with a combination of open pit and underground methods, while the Llama and Locale 2 deposits will be mined using open pit methods. The deposits are shown on Figures 1.2 and 1.3.

1.2 SCOPE OF WORK

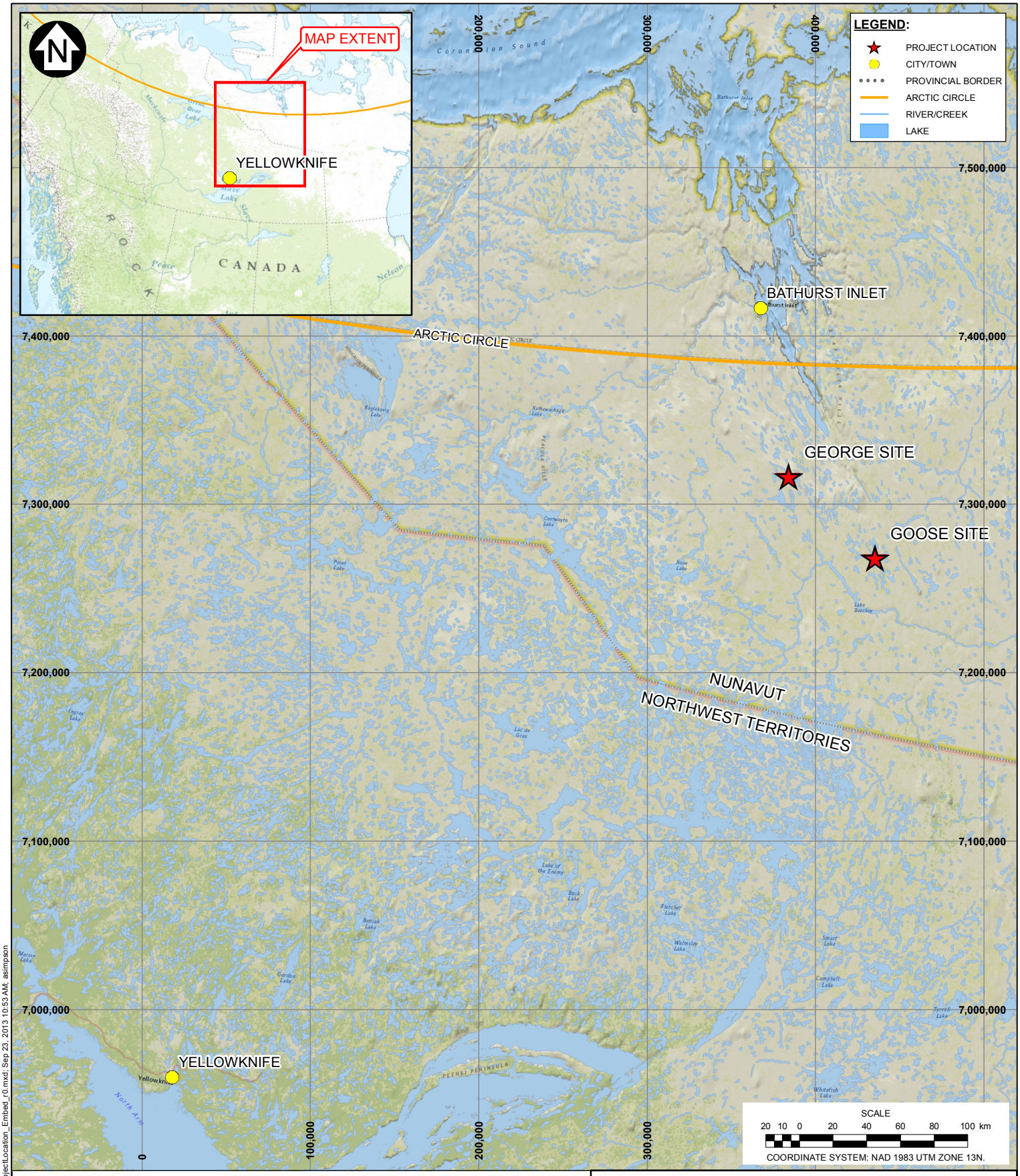
Knight Piésold Ltd. (KPL) was engaged by Sabina in February 2013 to complete the geomechanical and hydrogeological work needed to support the feasibility mine design for the proposed underground and open pit developments. The work completed included:

- A review of all available geological, structural, geomechanical and hydrogeological information
- A geomechanical and hydrogeological site investigation program
- Characterization of the rock mass quality and discontinuity orientations in the vicinity of the deposits
- Characterization of the hydrogeological conditions in the vicinity of the deposits

The information provided by others for this study included:

- 3D geological models for the Goose and George Properties (Sabina, November 2012 and updated March 2013)
- A 3D structural model for the Goose Property (Sabina, November 2012 and updated March 2013). A 3D structural model is not currently available for the George Property.
- Exploration drillhole databases for the Goose and George Properties (Sabina, January 2012)
- Preliminary mine plans (AMC Mining Consultants Ltd., November 2012, updated in April and May, 2013)
- Results of previous site investigation programs completed by SRK Consulting Ltd. (SRK, 2012a and 2012b) and Rescan Environmental Services Ltd. (Rescan, 2010) at the Goose Property

The drillhole details for the site investigation program were provided by AMC Mining Consultants Ltd. (AMC) with input and review from KPL and Sabina.



NOTES:

1. BASE MAP: NATIONAL GEOGRAPHIC TOPOGRAPHIC MAP.

2. COORDINATE GRID IS IN METRES.
COORDINATE SYSTEM: NAD 1983 UTM ZONE 13N.

3. THIS FIGURE IS PRODUCED AT A NOMINAL SCALE OF 1:33,778,035 FOR 8.5x11 (LETTER) PAPER. ACTUAL SCALE MAY DIFFER ACCORDING TO CHANGES IN PRINTER SETTINGS OR PRINTED PAPER SIZE.

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SABINA GOLD & SILVER CORP.

BACK RIVER PROJECT

PROJECT LOCATION

Knight Piésold CONSULTING

P/A NO. VA101-517/3

REF NO. 1

FIGURE 1.1

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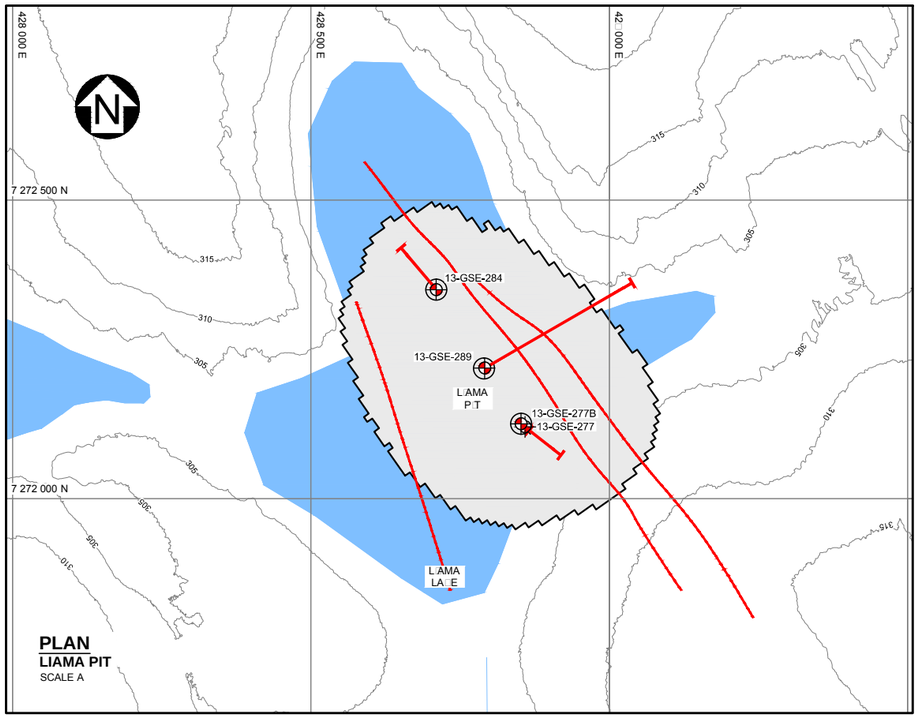
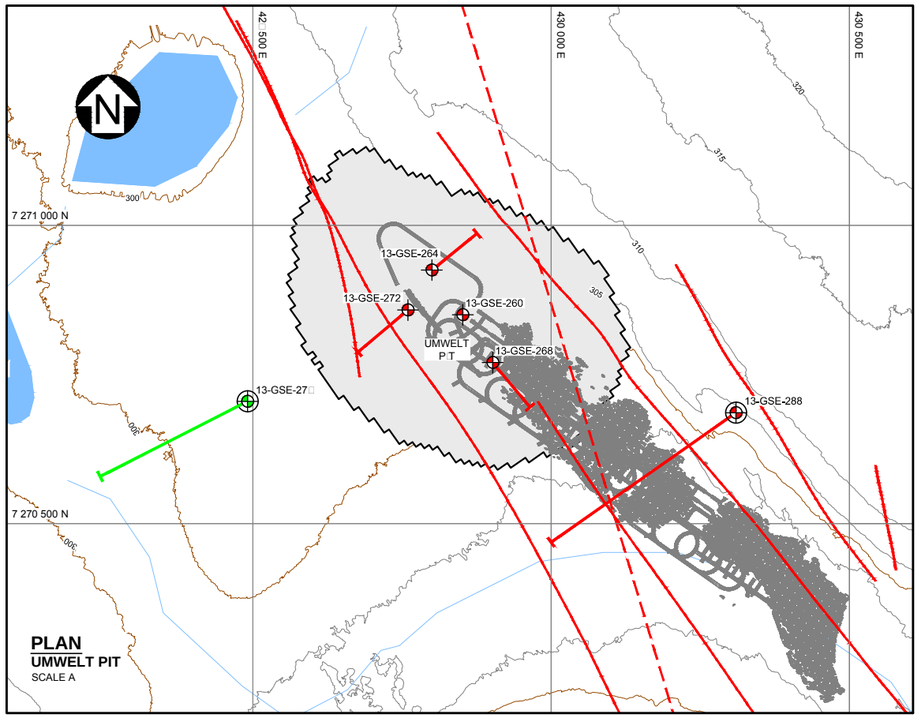


PLAN
LIAMA PIT
SCALE A



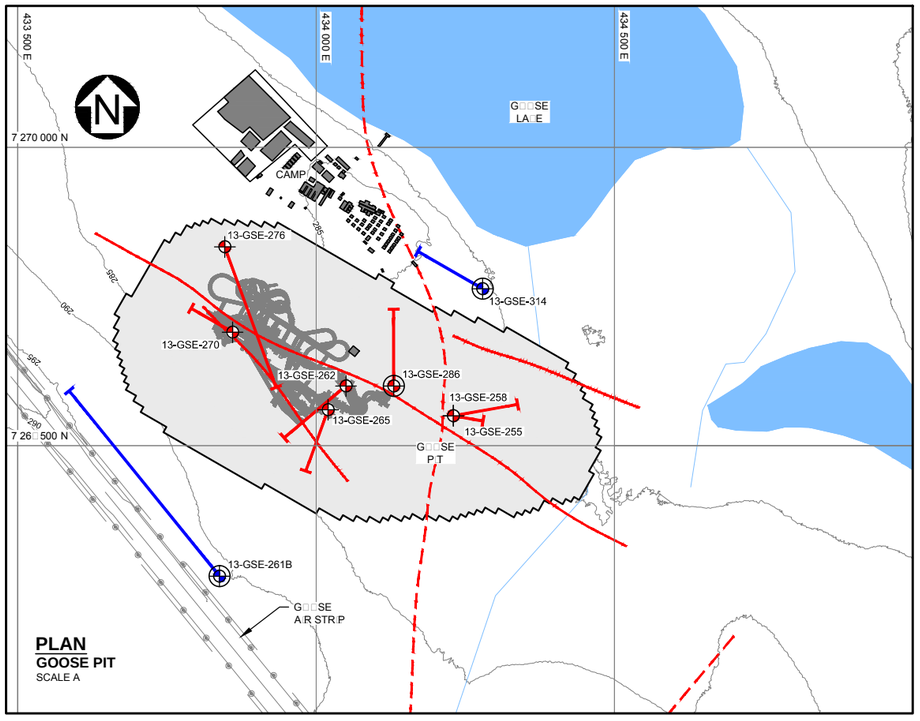
PLAN
UMWELT PIT
SCALE A

LEGEND:

- 2013 GEOMECHANICAL DRILLHOLE
- 2013 HYDROGEOLOGICAL DRILLHOLE / REPLACEMENT DRILLHOLE
- TWINNED WESTBAY / ENVIRONMENTAL DRILLHOLE
- INSTRUMENTATION INSTALLED IN DRILLHOLE
- FAULT INTERSECTION WITH SURFACE
- BUILDING / STRUCTURE
- PROPOSED OPEN PIT OUTLINE
- PROPOSED UNDERGROUND MINE

NOTES:

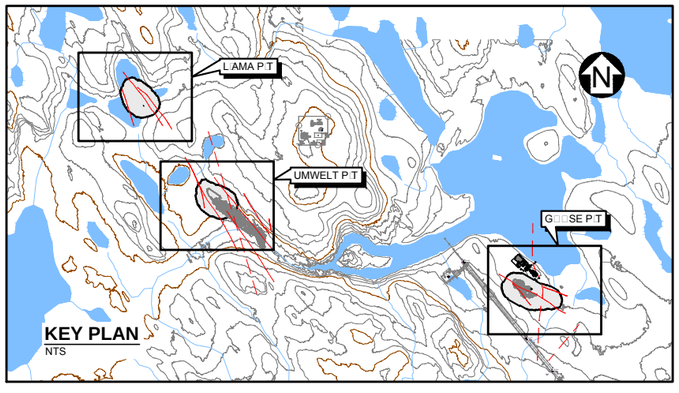
1. COORDINATE GRID IS UTM NAD83 ZONE 13.
2. LIDAR TOPOGRAPHY BASED ON INFORMATION PROVIDED BY SABINA, NOVEMBER 1, 2012.
3. CONTOUR INTERVAL IS 5 METRES.
4. APPROXIMATE WATERBODIES FROM RESCAN NTS MAPPING.
5. FAULTS AND BUILDINGS BASED ON INFORMATION PROVIDED BY SABINA, RECEIVED JANUARY 28, 2013 AND MARCH 15, 2013.
6. DRILLHOLE DETAILS BASED ON SURVEY INFORMATION PROVIDED BY SABINA.
7. PROPOSED UNDERGROUND MINE LAYOUT AND OPEN PIT SHELLS PROVIDED BY AMC, DATED MAY 8, 2013.



PLAN
GOOSE PIT
SCALE A

Geomechanical Drillholes - Goose Property

Deposit	Sabina ID	Planning ID	Drillhole Details									Comments
			Collar Coordinates									
			Northing	Easting	Elevation (masl)	Azimuth (°)	Dip (°)	Length (m)	Abandoned Instrumentation	Packer Testing	Geomechanical Logging	
Goose	13-GSE-255	GP-GM13-01	7,269,550	434,231	282	101	-51	78.5	X	-	-	X	Limited survey data.
	13-GSE-258	GP-GM13-01B	7,269,551	434,231	283	78	-47	170.0	-	-	-	X	
	13-GSE-286	GP-GM13-02	7,269,612	434,066	283	31	-47	200.0	-	X	X	X	
	13-GSE-262	GP-GM13-03	7,269,599	434,049	281	234	-47	210.5	-	-	-	X	
	13-GSE-265	GP-GM13-04	7,269,558	434,019	282	202	-48	171.5	-	-	-	X	
	13-GSE-276	GP-GM13-05	7,269,832	433,847	283	166	-49	395.5	-	-	-	X	
	13-GSE-270	GP-GM13-06	7,269,691	433,859	282	300	-53	171.5	-	-	-	X	
	13-GSE-314	GP-GM13-07	7,269,764	434,278	280	297	-51	250.0	-	X	X	-	
	13-GSE-261B	-	7,269,381	433,838	289	317	-54	804.0	-	X	X	-	Exploration hole. Not included in total meterage.
Umwelt	13-GSE-260	UP-GM13-01	7,270,850	429,852	303	140	-55	5.0	X	-	-	-	No survey data. Drillhole details approximate.
	13-GSE-268	UP-GM13-01B	7,270,769	429,902	302	145	-55	170.0	-	-	-	X	
	13-GSE-264	UP-GM13-02	7,270,925	429,801	304	51	-54	170.0	-	-	-	X	
	13-GSE-272	UP-GM13-03	7,270,868	429,771	304	232	-46	170.5	-	-	-	X	
	13-GSE-288	UP-GM13-04	7,270,686	430,310	305	251	-42	698.0	-	X	X	X	
	13-GSE-279	WB13-04	7,270,260	430,189	297	243	-68	740.0	-	X	X	-	Westbay twin hole.
Llama	13-GSE-277	LP-GM13-01	7,272,120	428,859	302	130	-55	15.0	X	-	-	X	No survey data. Drillhole details approximate.
	13-GSE-277B	LP-GM13-01B	7,272,125	428,852	303	128	-58	160.5	-	X	X	X	
	13-GSE-284	LP-GM13-02	7,272,370	428,710	303	318	-57	161.0	-	X	X	X	
	13-GSE-289	LP-GM13-03	7,272,218	428,790	303	56	-50	500.0	-	X	X	X	
Total Meterage: 4437.5													



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SCALE A

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SABINA GOLD & SILVER CORP.

BAKER CREEK PROJECT

GOOSE PROPERTY
SITE INVESTIGATION PLAN

Knight Piésold CONSULTING

PAN: A101-517/3

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FIGURE 1.2

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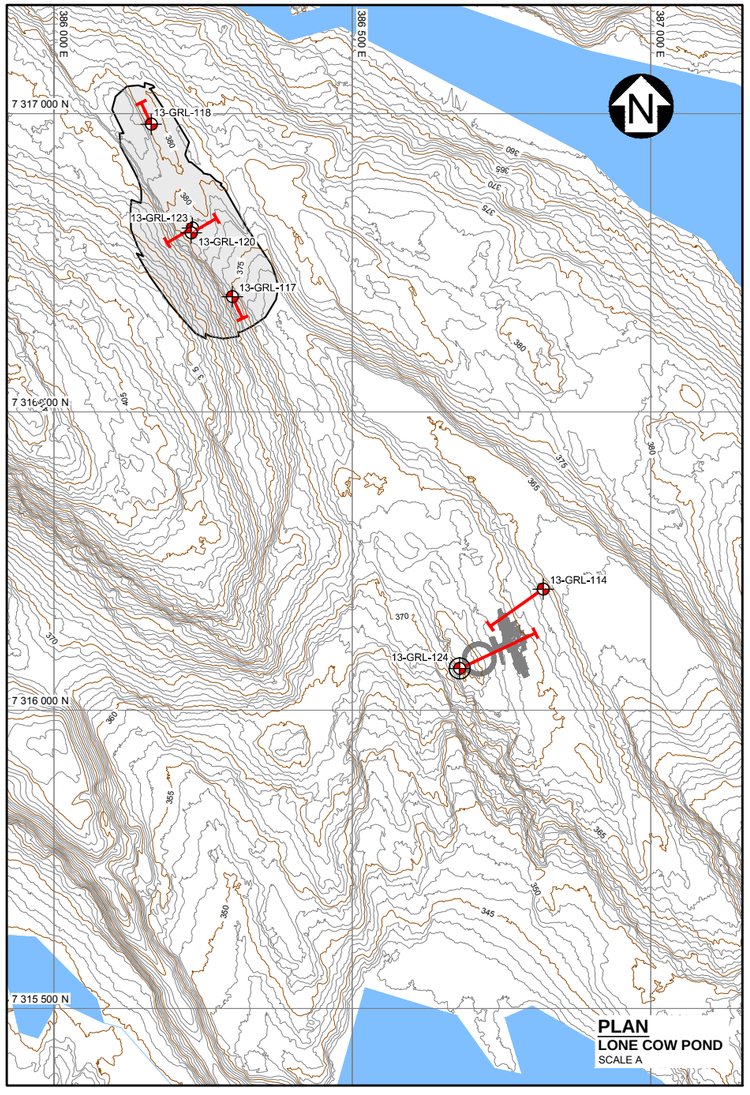

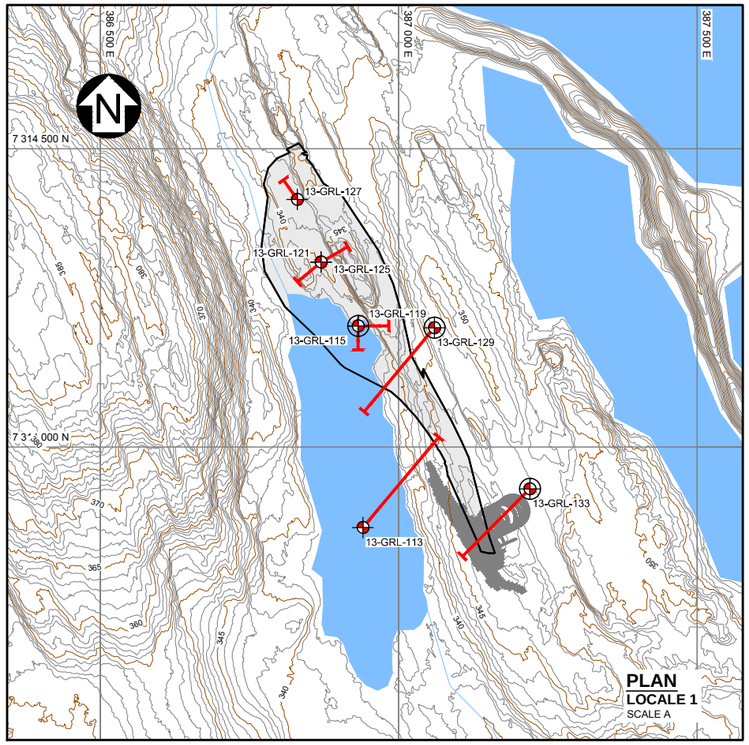

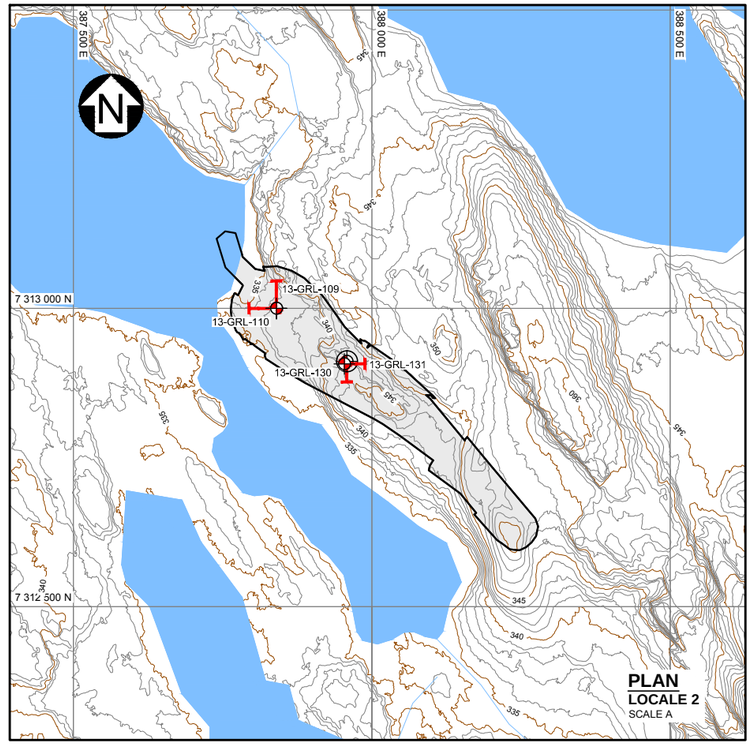

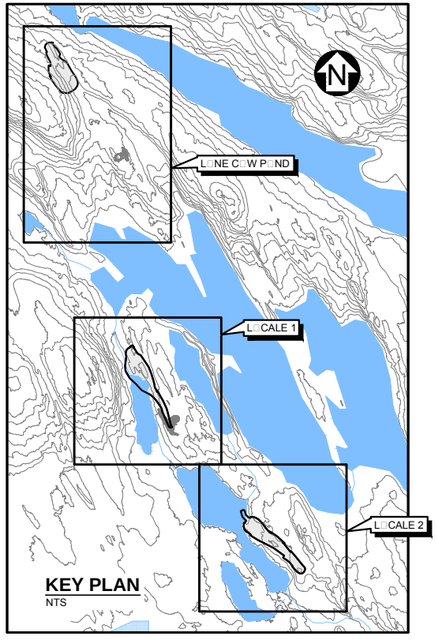

Geomechanical Drillholes - George Property

Deposit	Sabina ID	Planning ID	Drillhole Details									
			Collar Coordinates			Azimuth (°)	Dip (°)	Length (m)	Abandoned	Thermistor	Piezometer	Packer Testing	Geomechanical Logging
			Northing	Easting	Elevation (masl)								
Locale 1	13-GRL-127	L1-GM13V2-01	7,314,416	386,829	342	327	-55	71.2	-	-	-	-	X
	13-GRL-121	L1-GM13V2-02	7,314,309	386,869	340	231	-53	90.5	-	-	-	X	X
	13-GRL-129	L1-GM13V2-03	7,314,199	387,059	348	220	-52	320.0	-	X	X	X	X
	13-GRL-113	L1-GM13V2-04	7,313,865	386,940	337	44	-51	345.5	-	-	-	X	X
	13-GRL-133	L1-GM13V2-05	7,313,928	387,218	347	227	-50	281.0	-	X	-	-	X
	13-GRL-125	L1-GM13V2-06	7,314,311	386,871	340	59	-53	90.5	-	-	-	-	X
	13-GRL-115	L1-GM13V2-07	7,314,200	386,932	337	179	-52	69.5	-	X	-	X	X
	13-GRL-119	L1-GM13V2-08	7,314,202	386,932	338	88	-53	105.3	-	-	-	X	X
Locale 2	13-GRL-109	L2-GM13V2-01	7,313,000	387,840	337	3	-54	86.0	-	-	-	-	X
	13-GRL-110	L2-GM13V2-02	7,313,001	387,838	337	269	-54	81.5	-	-	-	X	X
	13-GRL-131	L2-GM13V2-03	7,312,905	387,961	344	90	-54	60.5	-	-	-	-	X
	13-GRL-130	L2-GM13V2-04	7,312,904	387,962	344	180	-54	60.5	-	X	X	X	X
Lone Cow Pond	13-GRL-118	LCP-GMV2-01	7,316,984	386,162	379	336	-55	70.0	-	-	-	-	X
	13-GRL-120	LCP-GMV2-02	7,316,804	386,237	379	61	-53	85.0	-	-	-	-	X
	13-GRL-117	LCP-GMV2-03	7,316,691	386,299	377	159	-53	70.0	-	-	-	-	X
	13-GRL-114	LCP-GMV2-04	7,316,212	386,819	365	235	-56	220.0	-	-	-	-	X
	13-GRL-124	LCP-GMV2-05	7,316,085	386,678	376	82	-59	281.0	-	X	-	-	X
	13-GRL-123	LCP-GMV2-06	7,316,807	386,231	379	240	-55	86.0	-	-	-	-	X
						Total Meterage:		2474.0					

LEGEND:

- GEOMECHANICAL DRILLHOLE
- INSTRUMENTATION INSTALLED IN DRILLHOLE
- PROPOSED UNDERGROUND MINE
- PROPOSED OPEN PIT OUTLINE

NOTES:

1. COORDINATES GRID SYSTEM NAD83 ZONE 13.
2. LIDAR TOPOGRAPHY BASED ON INFORMATION PROVIDED BY SABINA, DATED NOVEMBER 1, 2012.
3. CONTOUR INTERVAL IS 1 METRE.
4. APPROXIMATE WATERBODIES FROM RESCAN NTS MAPPING.
5. DRILLHOLE DETAILS BASED ON SURVEY INFORMATION PROVIDED BY SABINA.
6. PROPOSED UNDERGROUND MINE LAYOUT AND OPEN PIT SHELLS PROVIDED BY AMEC, DATED MAY 8, 2013.

SCALE A 200 100 0 200 400 600 800 1000 m

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SABINA GOLD & SILVER CORP.

BACK RIVER PROJECT

GEORGE PROPERTY
SITE INVESTIGATION PLAN

Knight Piésold CONSULTING

PAN: A101-517/3

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FIGURE 1.3

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2 – GEOLOGICAL SETTING

2.1 GENERAL

The geological setting of the ore bodies is important for open pit and underground mine design. Background information on the main lithologies, mineralization, alteration and large-scale structure is provided below. Unless otherwise noted, the information is summarised from Davis (2005), Sabina (2012, 2013a and 2013b) and AMC (2013).

2.2 MAIN LITHOLOGIES

The Back River Gold project is located within the northeastern corner of the Slave Structural Province. The Back River deposits are hosted by the metamorphosed greywackes, mudstones and banded iron formation of the Beechey Lake Group. These rocks have been subjected to multiple compressive deformation events resulting in the formation of multiple synclines and anticlines. These formations were then intruded by felsic dykes of the Regan Intrusive Suite and younger gabbro dykes.

The lithologies that make up the deposits at Back River are described below. The identifying codes used by Sabina for each lithology are indicated in brackets.

- **Greywacke (1a)** - The Greywacke is the most common rock type observed and both overlays and underlies the deposits. It is fine to medium grained and massive to poorly bedded. The Greywacke can locally show a weak foliation.
- **Interbedded Sediments (1c)** - The Interbedded Sediments consist of thinly bedded to laminated greywacke, siltstone and mudstone. Individual beds range in thickness from millimetres to centimetres. The interbedded sediments have a similar spatial distribution to the Greywacke.
- **Iron Formation (2d, 2c, 2dc)** - Several different banded iron formations are observed at Back River. The most common formations are as follows:
  - **Silicate Iron Formation (2d)** - Banded unit consisting of chert and iron silicates. Traces of magnetite (<2%) may be present in the iron silicates.
  - **Oxide Iron Formation (2c)** - Banded unit consisting of magnetite (>10%) and chert, with lesser amounts of iron silicate. In some instances, the magnetite bands have been replaced with sulphide mineralization.

  Sabina has grouped the iron formations into two stratigraphic horizons (the Upper and Lower Iron Formations) which are separated by the Middle Mudstone Sequence. The Upper Iron Formation (UIF) largely consists of the Silicate Iron Formation, while the Lower Iron Formation (LIF) largely consists of the Oxide Iron Formation. It should be noted that the UIF - Middle Mudstone - LIF sequence is not as well defined at the George Property, with the Middle Mudstone sequence not always being observed.
- **Mudstone (3a and 3c)** - The Mudstone occurs within the Greywacke and Interbedded Sediments, as well as in a layer separating the Upper and Lower Iron Formations that is referred to as the Middle Mudstone. The Mudstone is fine grained and moderately to strongly foliated. Mudstone that has undergone a significant amount of deformation, such as the Middle Mudstone, has a phyllitic nature and strong foliation.

- **Felsic Dykes and Quartz-Feldspar Porphyry Intrusion (4a)** - At the Goose Property, these dykes cross-cut the Greywacke, Interbedded Sediments, Iron Formation and Mudstone. The dykes are thought to be associated with the mineralization. At the George Property, a quartz-feldspar porphyry intrusion of generally similar composition has been observed immediately to the west of the Lone Cow Pond deposit. Both the intrusion and the dykes are a fine to medium grained.
- **Gabbro/Diorite Dykes (8)** - The Gabbro Dykes cross-cut all of the other lithologies and form the youngest unit observed at the Goose and George Properties. The dykes are fine to coarse grained and commonly display aphanitic chilled margins.

2.3 MINERALIZATION

The mineralization at Back River is primarily hosted by the Oxide and Silicate Iron Formations where they are intersected by the Felsic Dykes and/or quartz veins. Mineral-rich fluids are believed to have been introduced along the dykes and veins and the gold precipitated out when the fluids reached the iron formations. The mineralization has been observed to be most prominent within the Oxide Iron Formation of the LIF and especially where it has been concentrated within an anticline. The mineralization at the Goose Property is typically associated with the Felsic Dykes, while the mineralization at the George Property is typically associated with quartz veining.

2.4 ALTERATION

The alteration associated with tectonic activity and from hydrothermal fluids is expected have a local impact on the rock mass characteristics. Notable alteration packages observed at the Goose and George Properties include:

- **Chlorite** - Chloritic alteration is pervasive throughout the Greywacke and Interbedded Sediments. It is also found within most of the other lithological units. Chlorite can reduce the intact strength of the rock and can also act as a low-friction surface coating on discontinuities. Both of these influences will reduce the rock mass quality.
- **Graphite** - Predominantly found within the Mudstone. Graphite can act as a low-friction surface coating on discontinuities and reduce the rock mass quality.
- **Silica** - Predominantly found in the vicinity of the Felsic Dykes and Silicate Iron Formation. Silicification can have a positive effect on rock mass quality by increasing the intact rock strength.
- **Actinolite and Grunerite** - Amphiboles that are found in most lithological units and can have a positive effect on rock mass quality by increasing the intact rock strength.

Instances of garnet, hematite and carbonate alteration are also observed throughout the deposit rock masses. The hematitic alteration is typically associated with the iron formations.

2.5 LARGE-SCALE STRUCTURE

2.5.1 Folding of the Deposits

Several deformation events are thought to have occurred at Back River, resulting in the folding of the deposits. The number and sequence of the events is not fully known, but there are thought to be in

the order of two to three deformation events for each property. The current understanding of the deformation events is as follows:

- **Goose Property:**
    - A compressional environment in the northeast-southwest direction resulted in intermediate scale folding with a regional northwest trend.
    - A second compressional environment in the east-west direction resulted in larger-scale folds with a north to northwest trend. These folds were superimposed on the previous deformation.

    As a result of these events, the dominant folds at the Llama and Umwelt deposits trend northwest-southeast, plunge moderately to the southeast and are tight. The folding at Goose Main is more complex. In the immediate vicinity of the current proposed mine at Goose Main, the folds trend southeast-northwest, plunge moderately to the northwest and are tight.
- **George Property:**
    - A compressional environment in the northeast-southwest direction resulted in folding with a northwest trend.
    - A second compressional environment in the northwest-southeast direction resulted in further folding, as well as shearing and drag folding.
    - A third compressional environment in the southeast-northwest direction, resulted in longitudinal folding and the development of a sub-horizontal deformation cleavage. The third event is thought to have been much weaker than the previous events.

As a result of these events, the dominant folds trend southeast-northwest, plunge to the northwest and are tight to isoclinal.

2.5.2 Faults

Evidence of faulting has been observed at both the Goose and George Properties. This assessment is based on exploration drilling, surface mapping and geophysical surveys. Two main fault orientations have been identified:

- Sub-parallel to the ore bodies (northwest-southeast to north-south) and steeply dipping.
- Perpendicular to the ore bodies (northeast-southwest) and steeply dipping. At Goose Main, faulting has offset the limbs of the anticline.

2.5.3 Dykes

As previously described, the following dykes have been observed at Back River:

- **Felsic Dykes** - These dykes strike sub-parallel to the ore bodies in each deposit and are steeply dipping. At Goose Main, the dykes have been folded with the ore body.
- **Gabbro Dykes** - These dykes strike southeast-northwest and are steeply dipping to sub-vertical.

3 – SITE INVESTIGATION PROGRAM

3.1 GENERAL

The geomechanical site investigation program was designed to support the design of the proposed open pits and underground mines. The field program was completed between February 2013 and June 2013 and included the following:

- Thirty-four (34) oriented and triple-tubed diamond drillholes with associated geomechanical logging. This included 18 drillholes at the George Property and 16 drillholes at the Goose Property. Select drillholes were used for hydraulic conductivity testing and/or the installation of instrumentation.
- One (1) dedicated hydrogeology diamond drillhole (13-GSE-314) was used for hydraulic conductivity testing and the installation of instrumentation. This drillhole was specifically intended to determine if a thawed zone (talik) existed between the Goose Main deposit and Goose Lake.
- One (1) exploration diamond drillhole (13-GSE-261B) was used for hydraulic conductivity testing and the installation of instrumentation.
- One (1) Westbay Twin diamond drillhole (13-GSE-279) was used for hydraulic conductivity testing and installation of instrumentation. This drillhole was used to collect ground temperature and hydrogeological data to support the installation of a Westbay well by Rescan.

Three drillholes (13-GSE-255, 13-GSE-160, and 13-GSE-277) had to be abandoned and re-drilled during the program due to various complications. In the end, the program (not including exploration drillhole 13-GSE-261B) totalled 6,911 m (4,437 m drilled at the Goose Property, and 2,474 m drilled at the George Property).

The drilling was carried out by Major Drilling Group International Inc. (Major) under the direct supervision of KPL and Sabina site staff. The triple-tubed geomechanical drillholes were NQ3 diameter, while all other drillholes were NQ diameter. Core photos and geology logs for all of the drillholes in the geomechanical program were provided by Sabina and are included as Appendices A1 and A2, respectively. The drillholes associated with the geomechanical and hydrogeological site investigation program are shown on Figures 1.2 and 1.3.

3.2 ORIENTED CORE DRILLING AND LOGGING

3.2.1 Program Design

The site investigation program was designed by AMC and KPL, with assistance from Sabina exploration staff. The objective of the program was to characterize the encountered rock masses and determine their engineering characteristics through detailed geomechanical logging, hydraulic conductivity testing and the installation of instrumentation. It should be noted that the site investigation program was initially designed using the November 2011 mine design and was adjusted to accommodate changes to the design in March and April 2013.

3.2.2 Oriented Core Drilling

Core orientation was undertaken on each geomechanical drillhole to determine discontinuity orientations within all encountered rock units. Core orientation was completed with the

electronic Reflex ACT III tool. Difficulties in obtaining consistent orientation data can arise when drilling in highly fractured, broken or poor quality rock. Orientation statistics (such as the percentage of each run oriented and the angular difference between orientation lines) were compiled for each geomechanical drillhole and are summarized in Appendix B. Overall, the core orientation parameters met KPL's targets throughout the program.

3.2.3 Drill Supervision

Seven (7) Sabina technicians were trained as drill supervisors by KPL staff. These technicians supervised the geomechanical drilling and were responsible for orienting the drill core. The technicians also collected the orientation statistics and measured total core recovery (TCR), Rock Quality Designation (RQD) and discontinuity orientations at the drill. Time permitting, the drill supervisors also completed basic geomechanical logging.

3.2.4 Geomechanical Logging

The detailed geomechanical logging was completed at a centralized location by KPL staff. Rock mass parameters were input directly into KPL's electronic logging spreadsheet. Standard logging procedures were modified to meet the specific project conditions and requirements. Detailed logging parameters were collected to characterize downhole variations in the rock mass quality using both the Rock Mass Rating (RMR_{89}) system (Bieniawski, 1989) and the Tunnelling Quality Index (Q) system (Barton et. al., 1974). Background information on the RMR_{89} and NGI-Q systems is included in Appendices C1 and C2 respectively.

Field estimates of Uniaxial Compressive Strength (UCS) were made by KPL staff with the assistance of a Schmidt Hammer. The Schmidt Hammer values were collected using procedures adapted from ASTM standards (ASTM D5873).

The final geomechanical logs are included in Appendix A3.

3.3 LABORATORY TESTING

Core samples were collected from the geomechanical drillholes to allow for laboratory strength testing. Samples were collected for the following types of testing:

- **Uniaxial Compressive Strength (UCS) -** UCS tests are used to determine intact rock strength.
- **Triaxial Compressive Strength -** Triaxial compression tests are used to determine the intact rock strength under prescribed levels of confinement.
- **Brazilian (Indirect) Tensile Strength -** Brazilian tests are used to estimate the intact tensile strength of the rock.
- **Direct Shear (DS) Strength -** DS testing is undertaken to determine the shear strength of representative joints or discontinuities in the rock mass.

Laboratory samples were collected based on recommended quantities provided by AMC for each of the main lithologies. Standard procedure was to collect, prepare, and ship more samples then were required. This type of oversampling accommodates sample substitutions, breakage and/or changes in the planned testing program. In the case of the Felsic Dykes and Gabbro Dykes, the sample goals were not met due to the limited occurrences of these lithological units.

Sample selection for lab testing involved the following:

- Identifying samples that were representative of the overall rock mass
- Selecting samples that do not have any obvious weaknesses or features that are likely to cause anomalous results (i.e., planar fabrics, large clasts, voids, etc.)
- Selecting samples from a range of drillholes and depths
- Selecting DS samples with a typical range of joint roughness and discontinuity orientations

The final sample selection process was completed by AMC. The laboratory testing was carried out by the accredited rock mechanics lab at Queen's University in Kingston, Ontario and the lab report is included in Appendix D1.

3.4 HYDROGEOLOGY

3.4.1 General

The hydrogeological component of the site investigation program was designed to improve the understanding of the hydrogeological regime in the vicinity of the proposed open pits and underground mines. The program was designed by KPL and expanded upon previous studies completed at the Goose Property (described in Section 3.4.2). The objectives of the hydrogeological investigations were to characterize the following:

- The hydraulic conductivity of the encountered geological units and structures
- The distribution and depth of permafrost, including identifying regions of thawed ground (taliks) associated with surface water bodies
- Piezometric pressures within potential taliks and below the base of the permafrost

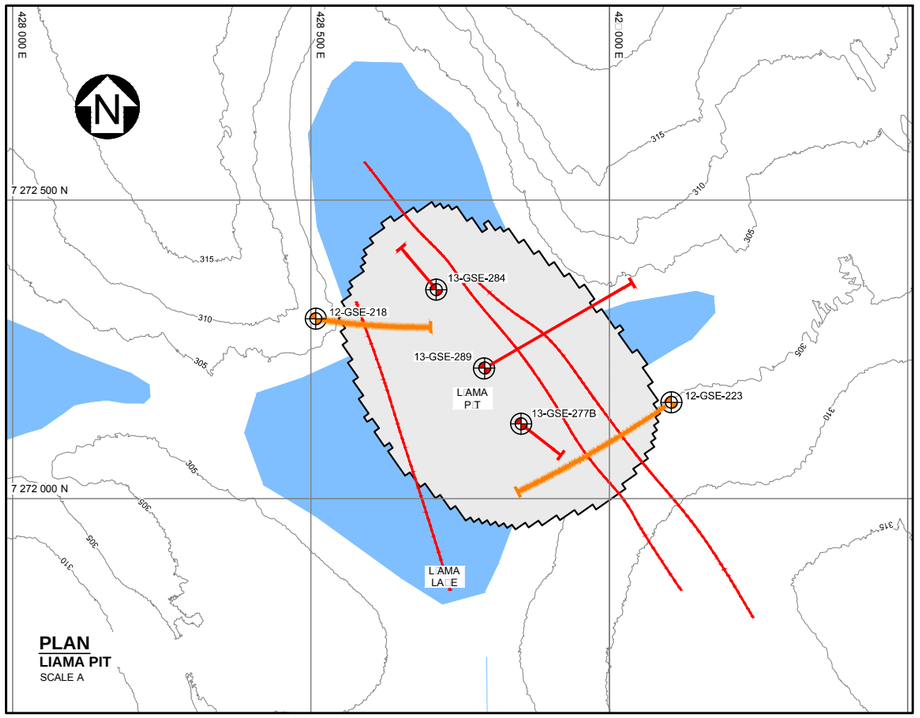
In order to accomplish these objectives, KPL completed hydraulic packer testing and installed multi-point thermistor strings and vibrating wire piezometers. More extensive testing and instrumentation was completed at the Goose Property than the George Property due to the greater depth of the proposed mining there and the presence of larger lakes that increase the potential for talik zones.

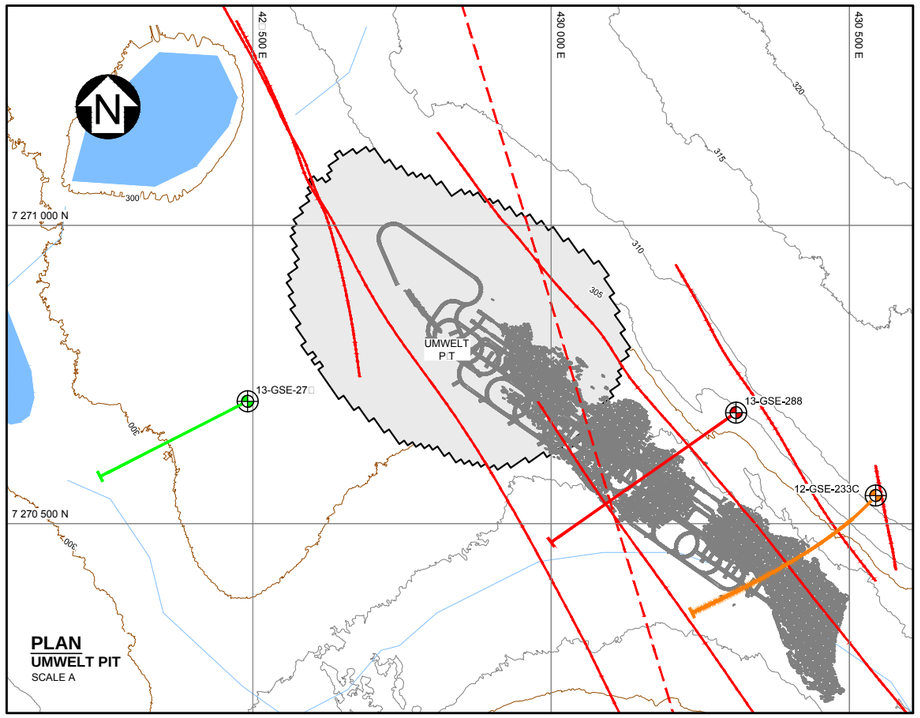
3.4.2 Background and Previous Hydrogeological Investigations

Hydrogeological site investigations have been completed at the Goose Property as part of previous studies. These investigations have included:

- **1997** - A shallow multi-point thermistor string was installed at the Goose Main Deposit in drillhole 97GO-14 (Rescan, 2010).
- **2008** - A multi-point thermistor string to evaluate the depth of the permafrost was installed in the southern portion of the Goose Main deposit in drillhole 08-GSE-009 (SRK, 2012a).
- **2010** - A shallow multi-point thermistor string was installed by SRK at the Goose Main deposit in drillhole 11-SRK-GL-010 (SRK, 2011).
- **2012** - Multi-point thermistor strings and single point vibrating wire piezometers were installed by SRK in two drillholes (12-GSE-218 and 12-GSE-223) at the Llama deposit and in one drillhole (12-GSE-233C) at the Umwelt deposit (SRK, 2012b). Packer testing was also conducted on select drillholes at all of the deposits on the Goose Property (SRK, 2012b).

The locations of the instrumentation installed at the Goose Property are shown on Figure 3.1. Previous hydrogeological investigations have not been carried out at the George Property.



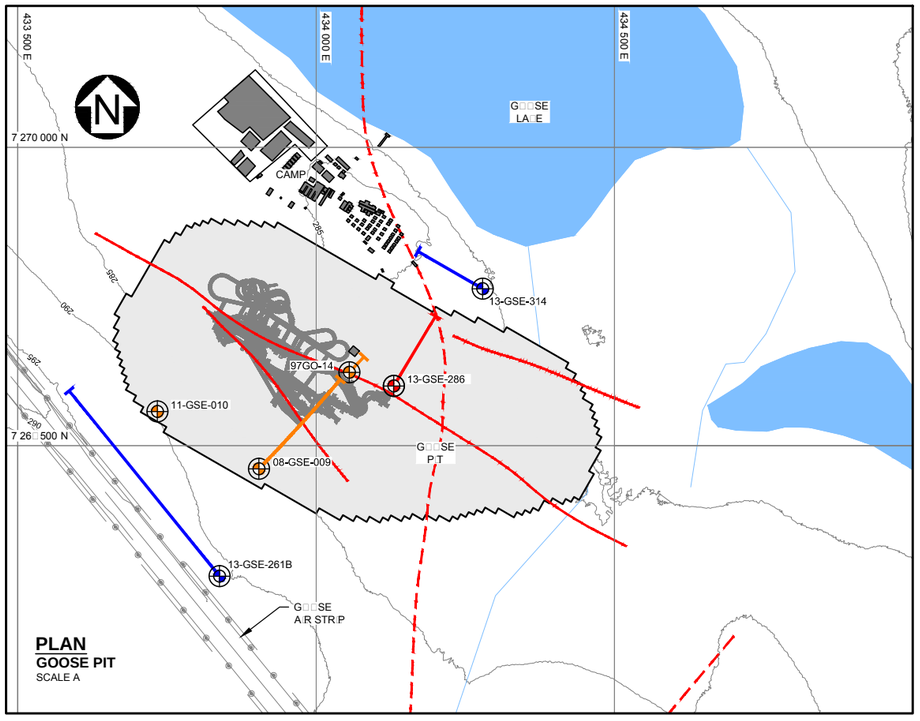


LEGEND:

- 2013 GE□MECHAN□CAL DR□LLH□LE
- 2013 H□DR□GE□L□G□AL DR□LLH□LE □R E□PL□RAT□N DR□LLH□LE
- TW□NNED WESTBA□EN□□R□NMENTAL DR□LLH□LE
- H□ST□R□CAL GE□MECHAN□CAL □R E□PL□RAT□N DR□LLH□LE
- □NSTRUMENTAT□N □NSTALLED □N DR□LLH□LE
- □AULT □NTERSECT□N W□TH SUR□ACE
- BU□LD□NG □STRUCTURE
- PR□P□SED □PEN P□T □UTL□NE
- PR□P□SED UNDERGR□UND M□NE

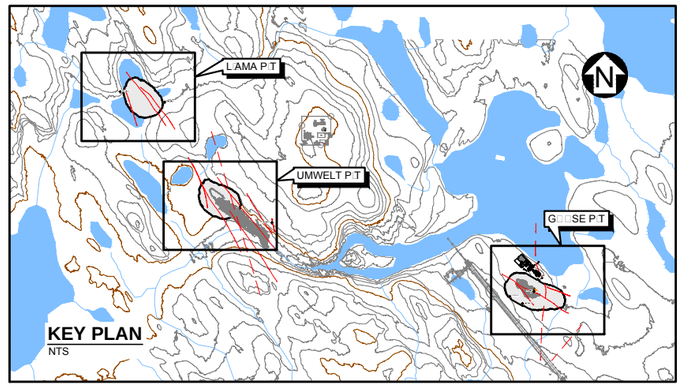
NOTES:

1. C□□RD□NATE GR□D □S UTM □NAD83□□□NE 13.
2. L□DAR □T□P□GRAPH□ BASED □N □N□□RMAT□□N PR□□□DED B□ SAB□NA, N□□EMBER □, 2012.
3. C□NT□UR □NTER□AL □S 5 METRES.
4. APPR□□□MATE WATERB□□D□ES □R□M RESCAN NTS MAPP□NG.
5. □AULTS AND BU□LD□NGS BASED □N □N□□RMAT□□N PR□□□DED B□ SAB□NA, RECE□□ED □ANUAR□ 28, 2013 AND MARCH 15, 2013.
6. DR□LLH□LE DETA□LS BASED □N SUR□E□ □N□□RMAT□□N PR□□□DED B□ SAB□NA.
7. PROPOSED OPEN PIT SHELLS PROVIDED BY AMC, DATED MAY 8, 2013.



Historical Instrumentation - Goose Property

Deposit	Drillhole ID	Drillhole Details					
		Collar Coordinates					
		Northing	Easting	Elevation (masl)	Azimuth (°)	Dip (°)	Length (m)
Goose	97G0-14	7,269,623	434,056	282	43	-45	50.9
	08-GSE-009	7,269,461	433,904	286	41	-57	383.0
	11-SRK-GL-010	7,269,557	433,734	294	-	90	~ 20.0
	13-GSE-261B	7,269,381	433,838	289	317	-54	804.0
	13-GSE-286	7,269,612	434,066	283	31	-47	200.0
	13-GSE-314	7,269,764	434,278	280	297	-51	250.0
Umwelt	12-GSE-233C	7,270,547	430,544	311	236	-57	679.0
	13-GSE-279	7,270,260	430,189	297	243	-68	740.0
	13-GSE-288	7,270,686	430,310	305	251	-42	698.0
Llama	12-GSE-218	7,272,301	428,508	307	94	-50	302.0
	12-GSE-223	7,272,161	429,104	306	239	-42	401.0
	13-GSE-277B	7,272,125	428,852	303	128	-58	160.5
	13-GSE-284	7,272,370	428,710	303	318	-57	161.0
	13-GSE-289	7,272,218	428,790	303	56	-50	500.0



100 50 0 100 200 300 400 500 m
SCALE A

RE□	DATE	DESCR□PT□ON	DES□GNED	DRAWN	CH□□D	APP□D
0	23SEP□3	SSUED W□TH REP□RT	DD	S□R□ASM	BDP	RAM

SAB□NA G□LD □ S□L□ER C□RP.

BAC□ R□□ER PR□□ECT

GOOSE PROPERTY
HISTORICAL INSTRUMENTATION

Knight Piésold CONSULTING

P□N□: □A101-517□3

RE□N□: 1

FIGURE 3.1

RE□ 0

SA□ED: □1/01/2051 7:03 A Acad□□GS-803 rD□23/2013 10:06:51 AM, SR□CHARD PR□NTED: □23/2013 10:23:32 AM, La□o□1, SR□CHARD
RE□□LE S□: P□ FCAMP □ALT WATR PLNT P□P□5m MAE□GO □MAGE □LE S□:

As part of the preparations for the hydrogeological site investigations, the available data from the thermistors installed in 2008 and 2012 were reviewed. The data suggested that the base of the permafrost was at a depth of approximately 400 meters below ground surface (mbgs), and this depth was used for planning purposes.

3.4.3 Packer Testing

Hydraulic packer testing was undertaken to characterize the hydraulic conductivity of the encountered lithologies and large-scale structures. As the permafrost is considered impermeable, the packer testing targeted potential talik zones and unfrozen ground below the expected base of the permafrost. These regions were identified based on experience, a review of the available data from previous investigations and observations made by the drillers and drill supervisors.

A total of 34 packer tests were completed as follows:

- **Goose Property** - Packer testing was completed in eight (8) drillholes. Targets included the unfrozen ground below the base of the permafrost, a potential talik below Llama Lake and a potential talik between the Goose Main deposit and Goose Lake. A total of 23 tests were completed.
- **George Property** - Packer testing was completed in seven (7) drillholes adjacent or passing under lakes in the vicinity of the deposits. A total of 11 tests were completed.

The packer testing was completed under the supervision of KPL staff using a hydraulic Standard Wireline Packer System (SWiPS) supplied by Inflatable Packers International (IPI). The tests were completed while advancing the drillhole. Brine (with an approximate concentration of 20% $CaCl_2$) was used as the predominant drilling fluid for all drillholes. A polymer based drilling additive (AMC 1300) was also used in several drillholes due to the encountered drilling conditions. In all cases, the drillhole was flushed with brine for at least 15 minutes prior to testing in an attempt to remove any drilling additives (if used) or debris that could potentially influence the test results. Even so, the effects of drilling may still result in estimated hydraulic conductivities lower than the true values.

Prior to testing, the packer was assembled on surface and visually inspected to check all components were present and in good working order. After packer insertion, a test was performed to confirm the packer was seated properly and that a seal sufficient for testing had been achieved. Any leakage that could not be eliminated was recorded and accounted for during the analysis of the collected data.

Constant head tests and a single Lugeon test were completed over intervals typically ranging from approximately 20 m to 100 m in length. A mechanical flow meter with an accuracy of 2% over the flow range of 0.5 to 83 L/min was used to measure the injection rate for the constant head tests. The injection rate was calculated based on the volume of water discharged from a small graduated container when the flow rates were too low to measure reliably with the flow meter. A pressure transducer (manufactured by In-Situ Inc.) was installed in a housing unit below the packer tool to monitor the pressure during testing. Manual water level readings were taken prior to and following testing to monitor the water level recovery from drilling and testing.

3.4.4 Thermistor and Vibrating Wire Piezometer Installations

Multi-point thermistors and vibrating wire piezometers were installed in select drillholes at each deposit. The thermistors were intended to characterise the ground temperature profile, while the piezometers were intended to observe the piezometric pressures in the unfrozen ground below the base of the permafrost. In several instances, additional vibrating wire piezometers were installed to confirm the presence of permafrost by recording the pressure increase associated with the piezometer freezing.

A total of 13 thermistors and piezometers were installed:

- **Goose Property** - Instrumentation was installed in eight (8) drillholes. A multi-point thermistor was installed in each drillhole with a single piezometer at the base of each installation. A second piezometer was installed in the three deep installations (one at each deposit) to confirm the presence of permafrost.
- **George Property** - Instrumentation was installed in five (5) drillholes. A multi-point thermistor string was installed in each drillhole. A single piezometer was installed at the base of two of the installations.

The locations of the installations are shown on Figures 1.2 and 1.3 and the installation details are summarized in Table 3.1. The depths at which the thermistors and vibrating wire piezometers were installed were selected based on observations made during drilling, the results of the packer testing and the expected depth of permafrost.

The thermistors and vibrating wire piezometers were installed using 1-inch PVC pipe as a guide and tremie pipe. After the instrumentation was lowered into the drillhole, a validation check was performed to confirm that the transducers were working as expected. The drillhole was then flushed with fresh water through the PVC pipe in order to reduce the salinity of the drillhole fluid and reduce the time required to freeze the installation in place. For installations with a vibrating wire piezometer, the lower 20 m to 30 m of the drillhole was also filled with a cement grout to seal the piezometer in place. In the case of drillhole 13-GRL-115, the entire installation was grouted due to its shallow location beneath a lake.

The thermistors and vibrating wire piezometers were manufactured by Geokon Inc. and supplied by GKM Consultants Inc. (GKM). The specifications and calibration forms for the thermistors and vibrating wire piezometers are included in Appendix E. Each installation was connected to a CR800 data logger in a fibreglass enclosure to allow for the collection of data at regular intervals. The data loggers were manufactured by Campbell Scientific (Canada) Corp. and supplied by GKM.

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TABLE 3.1

SABINA GOLD & SILVER CORP.
BACK RIVER PROJECT

2013 GEOMECHANICAL AND HYDROGEOLOGICAL SITE INVESTIGATION SUMMARY
SUMMARY OF INSTRUMENTATION INSTALLATION DETAILS

Print Sep/19/13 10:08:44

Property	Deposit	Sabina Hole ID	Planning Hole ID	Datalogger ID	Date Installed	Depth of Installation	Thermistors			Piezometers		
						mbgs	ID	Length (m)	No. Sensors	ID	Serial Number	Length (m)
Goose	Goose	13-GSE-261B	-	DL13	29-Mar-13	652.1	TH13	560	25	Pz06a	1146011	660
										Pz13a	1302358	560
		13-GSE-286	GP-GM13-02	DL01	07-Apr-13	199.9	TH01	210	10	Pz01	1302370	210
		13-GSE-314	GP-GM13-07	DL02	06-May-13	200.2	TH02	210	10	Pz02	1302371	210
	Umwelt	13-GSE-279	WB13-04	DL12	13-Apr-01	524.6	TH12	560	25	Pz12a	1146013	560
										Pz12b	1302357	560
		13-GSE-288	UP-GM13-04	DL03	29-Apr-13	549.3	TH03	560	25	Pz03a	1302355	560
	Llama	13-GSE-277B	LP-GM13-01B	DL04	01-Apr-13	157.6	TH04	265	10	Pz04	1302369	265
		13-GSE-284	LP-GM13-02	DL05	09-Apr-13	158.2	TH05	390	10	Pz05	1302368	390
		13-GSE-289	LP-GM13-03	DL06	28-Apr-13	499.9	TH06	660	25	Pz06b	1146012	660
										Pz13b	1302359	560
George	Locale 1	13-GRL-115	L1-GM13-07	DL09	17-May-13	64	TH09	210	10	-	-	-
		13-GRL-129	L1-GM13-03	DL08	05-Jun-13	196.7	TH08	390	10	Pz08	1302367	390
		13-GRL-133	L1-GM13-05	DL11	11-Jun-13	196.5	TH11	210	10	-	-	-
	Locale 2	13-GRL-130	L2-GM13-04	DL10	02-Jun-13	57.9	TH10	210	10	Pz10	1302372	210
	Lone Cow Pond	13-GRL-124	LCP-GM13-05	DL07	30-May-13	196.55	TH07	210	10	-	-	-

I:\1\01\00517\03\A\Report\Report 1, Rev 0 - SI Report\Tables\[Table 3.1 Summary of Installation Details.xlsx]Table 3.1

NOTES:

1. DEPTH OF INSTALLATION REFERS TO THE DISTANCE FROM GROUND SURFACE ALONG HOLE TO THE DEEPEST THERMISTOR OR PIEZOMETER SENSOR.

REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D
0	23SEP'13	ISSUED WITH REPORT VA101-517/3-1	RGM	CHS	RAM

4 – ROCK MASS CHARACTERISTICS

4.1 GENERAL

One of the main objectives of the site investigation program was to obtain information on the geomechanical characteristics of the encountered rock masses. Rock mass characteristics are divided between intact material properties and the characteristics of the discontinuities. This section describes the work completed to characterize the geomechanical properties of the rock masses in the vicinity of the proposed open pits and underground mines.

4.2 INTACT ROCK STRENGTH

UCS tests were completed as part of the laboratory testing coordinated by AMC. The laboratory testing report, including the results of the UCS testing, is included as Appendix D1. The results of the laboratory testing will be reported by AMC.

The Schmidt hammer rebound number for each tested UCS sample was compared to the laboratory result and a correlation between the two was developed for both the Goose and the George Properties. The Schmidt hammer correlations are included as Appendix D2, and were was used to calibrate the rebound numbers collected during logging. The calibrated values were used to provide a continuous UCS estimate along each drillhole. This estimate was also used to update the RMR_{89} values determined during the detailed geomechanical logging.

The laboratory UCS results suggest that the intact rock strengths at Back River generally range from 50 to >250 MPa.

4.3 DISCONTINUITY ORIENTATIONS

4.3.1 Oriented Core Drillholes

Prior to analysis, the drillhole orientation data collected during the program were corrected for any significant drillhole deviation (> 5°) using the results of multi-shot non-magnetic deviation surveys completed by Sabina. The drillhole orientation data were filtered to exclude discontinuities from runs with run-on-run consistency in the FAIR (± 20 to 35°) or POOR (> ± 35°) ranges. In addition, all discontinuities flagged as possible mechanical breaks were removed from the data set.

The drillhole orientation data were also reviewed for directional bias. Despite deliberate efforts to limit the potential for directional bias during the program, some bias is inevitable due to the limited number of drillholes at each deposit. As a result, a Terzaghi correction was applied to the data.

The filtered data represents the majority of the orientation data and stereonets organized by property and deposit are presented in Appendix F. All orientation data has been summarized and presented using DIPS (Rocscience Inc., 2012a).

4.3.2 Dominant Discontinuity Orientations

In general, similar trends are observed in the discontinuity data from the Goose and George Properties, though there are local variations between the different deposits. Three main joint sets are identifiable in the filtered orientation data:

- A joint set striking southeast-northwest and dipping moderately to steeply to the northeast. The dip of the discontinuities often varies through the vertical, resulting in concentrations of poles on both sides of the stereonets. This effect is most pronounced at the George Property. This set corresponds to the dominant large-scale structural trends (e.g. the trend of the synclines/anticlines, ore bodies and some faults).
- A joint set striking northeast-southwest and dipping sub-vertically. The dip of the discontinuities varies through the vertical, resulting in concentrations of poles on both sides of the stereonets. This set corresponds to the orientation of the cross-cutting faults, but it is not present in some drillholes and is not always well-defined.
- A flat-lying joint set.

Notable variations to the above trends include:

- **Umwelt Deposit** - The southeast-northwest striking joint set is shallower dipping than at the other deposits. The northeast-southwest striking joint set was not observed.
- **Llama Deposit** - The orientation data from this deposit is more scattered than the data from other deposits and the joint sets are not as well defined. This is likely a result of the reduced rock mass quality encountered below Llama Lake. The northeast-southwest striking joint set was not observed.
- **Locale 2 Deposit** - The northeast-southwest striking joint set is more prominent than at the other deposits.

4.4 ROCK MASS QUALITY

The geomechanical logging and estimates of intact rock strength were used to determine the quality of the encountered rock masses using the RMR_{89} and NGI-Q rock mass classification systems. Plots illustrating the downhole variation in recovery, RQD, RMR_{89} and Q' are included in Appendix G. Distributions of the individual RMR_{89} and Q' parameters for each drillhole are included in Appendix H. The typical rock mass characteristics for each of the major lithological units encountered are summarized below and detailed in Appendix I:

- **Greywacke** - The greywacke is generally of GOOD quality (*i.e.,* RMR_{89} values typically ranging from 60 to 75) with a mean UCS of 120 MPa. Discontinuities typically have rough to smooth surfaces spaced 60 to 600 mm apart. Most have thin infill (commonly chlorite or calcite) or no infill and show slight to no weathering. Aperture typically ranges from <0.1 mm to 1.0 mm.

- **Interbedded Sediments** - The interbedded sediments unit is generally of FAIR to GOOD quality (*i.e.,* RMR_{89} values ranging from 55 to 75) with a mean UCS of 110 MPa. Discontinuities typically have rough to smooth surfaces spaced 60 to 600 mm apart. Most have thin infill (mostly chlorite) or no infill and show slight to no weathering. Aperture typically ranges from <0.1 mm to 1.0 mm.

- **Mudstone** - The rock mass quality of the mudstone is highly variable, and ranges from POOR to GOOD (*i.e.,* RMR_{89} values ranging from 35 to 70). The mudstone has a mean UCS of 60 MPa. Discontinuities typically have rough to smooth surfaces spaced <60 to 600 mm apart. Most have thin infill (commonly graphite or chlorite) or no infill and show slight to no weathering. Aperture typically ranges from <0.1 mm to 1.0 mm.
- **Lower Iron Formation -** The lower iron formation is generally of GOOD to VERY GOOD quality (*i.e.,* RMR_{89} values typically ranging from 65 to 85) with a mean UCS of 260 MPa. Discontinuities typically have rough to smooth surfaces spaced 60 to 2000 mm apart. Most have thin infill (commonly chlorite or calcite) or no infill and show slight to no weathering. Aperture typically ranges from <0.1mm to 1.0 mm.
- **Upper Iron Formation -** The upper iron formation is generally of FAIR to GOOD quality (*i.e.,* RMR_{89} values typically ranging from 55 to 80) with a mean UCS of 190 MPa. Discontinuities typically have rough to smooth surfaces spaced 60 to 600 mm apart. Most have thin infill (commonly chlorite) or no infill and show slight to no weathering. Aperture typically ranges from <0.1 mm to 1.0 mm.
- **Felsic Dykes -** The felsic dyke units are generally of GOOD (*i.e.,* RMR_{89} values typically ranging from 60 to 75) with a mean UCS of 130 MPa. Discontinuities typically have rough to smooth surfaces spaced 60 to 600 mm apart. Most have thin infill (commonly chlorite or iron oxide) or no infill and show slight to no weathering. Aperture typically ranges from <0.1 mm to 1.0 mm.
- **Gabbro Dykes -** The gabbro dykes are generally of FAIR to GOOD (*i.e.,* RMR_{89} values typically ranging from 55 to 75) with a mean UCS of 120 MPa. Discontinuities typically have rough to smooth surfaces spaced 60 to 600 mm apart. Most have thin infill (commonly chlorite or calcite) or no infill and show slight to no weathering. Aperture typically ranges from <0.1 mm to 1.0 mm.

5 – HYDROGEOLOGY

5.1 GENERAL

The site investigation program was designed to obtain information on the hydrogeological regime in the vicinity of the proposed open pits and underground mines. This section describes the work completed to characterize the hydrogeological regime at the Goose and George Properties.

5.2 HYDRAULIC CONDUCTIVITY

The results of the packer testing are summarized below, in Tables 5.1 and 5.2 and on the downhole plots included in Appendix G. The individual test results are included in Appendix J1.

- **Goose Property:**
  - The results of the packer testing below the suspected base of the permafrost indicate low rock mass permeabilities, with recorded hydraulic conductivities ranging from less than $1x10^{-9}$ to $2x10^{-8}$ m/s. The results are consistent with those obtained during previous programs.
  - The results of the packer testing within the potential talik between Goose Lake and the Goose Main deposit indicate low rock mass permeabilities, with estimated hydraulic conductivity values less than $1x10^{-9}$ m/s.
  - The results of the packer testing within the potential talik below Llama Lake indicate moderate permeability below the lake that decreased with depth. The estimated hydraulic conductivity values ranged from less than $1x10^{-9}$ m/s to $4x10^{-6}$ m/s. The increased hydraulic conductivity values closer to the lake bottom are likely due to the more fractured rock mass in this area.
- **George Property:** The results of the packer testing within the potential taliks in the vicinity of the deposits indicate low rock mass permeabilities, with recorded hydraulic conductivities ranging from less than $1x10^{-9}$ to $4x10^{-9}$ m/s.

It should be noted that a hydraulic conductivity value of $1x10^{-9}$ m/s was considered the lower bound for reliable measurements. Calculated hydraulic conductivity values less than then this lower bound were assigned a value of $<1x10^{-9}$ m/s.

5.3 STATUS OF INSTRUMENTATION

A total of thirteen multi-point thermistor strings and vibrating wire piezometer installations were completed. Data from each instrument are collected by Sabina staff and sent to KPL for review.

It should be noted that, at the time of writing, a relativity short period of time has elapsed since the instrumentation was installed at the Goose and George Properties (in approximately April and June 2013, respectively). As such, the vibrating wire piezometers may still be coming to equilibrium with their surrounding conditions and a longer data set will be required to confirm the results presented in this report.

A review of the collected data suggests that individual thermistor sensors or their leads were either damaged during installation or subsequently malfunctioned. These sensors are reporting temperatures beyond the expected range. The drillholes most affected are 13-GSE-261B, 13-GSE-279, 13-GSE-288 and 13-GSE-289 at the Goose Property (shown on Figure 1.2). In all cases, it is still possible to recognize trends in the data.

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TABLE 5.1

SABINA GOLD & SILVER CORP.
BACK RIVER PROJECT

2013 GEOMECHANICAL AND HYDROGEOLOGICAL SITE INVESTIGATION SUMMARY
GOOSE PROPERTY - HYDRAULIC CONDUCTIVITY TESTING SUMMARY

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Deposit	Drillhole	Date of Testing	Test #	Test Interval (m along hole)		Test Interval[1] (masl)		Calculated Hydraulic Conductivity	Notes
				From	To	From	To		
Llama	13-GSE-277B	29-Mar-13	1	22.3	45.0	284	265	3E-07	
		29-Mar-13	2	44.8	75.0	265	239	3E-08	
		30-Mar-13	3	71.8	120.0	242	201	1E-08	
		31-Mar-13	4	119.8	160.5	201	166	1E-08	5
	13-GSE-284	05-Apr-13	1	28.7	51.4	278	259	4E-06	
		05-Apr-13	2	46.8	81.5	263	234	2E-06	
		09-Apr-13	3	81.5	161.0	234	167	3E-06	
		10-Apr-13	4	130.8	161.0	192	167	5E-08	
	13-GSE-289	13-Apr-13	1	16.8	56.0	289	257	2E-06	
		14-Apr-13	2	55.8	86.0	257	232	7E-07	
		16-Apr-13	3	85.8	112.6	232	211	3E-08	
		18-Apr-13	4	109.8	234.5	213	116	1E-09	
		28-Apr-13	5	235.8	500.0	115	-77	< 1E-09	4
Umwelt	13-GSE-279	09-Apr-13	1	498.0	569.0	-173	-237	1E-08	2, 6
		10-Apr-13	2	567.0	632.0	-235	-293	1E-08	
		12-Apr-13	3	626.0	749.0	-288	-394	< 1E-09	4
	13-GSE-288	25-Apr-13	1	559.3	660.1	-90	-141	<1E-09	3, 4
Goose	13-GSE-261B	23-Mar-13	1	622.3	651.0	-217	-240	2E-08	
		24-Mar-13	2	652.3	705.0	-241	-281	1E-09	
	13-GSE-286	07-Apr-13	1	150.3	200.0	171	136	-	7
	13-GSE-314	03-May-13	1	9.3	83.0	272	211	<1E-09	2, 3, 4
		04-May-13	2	81.3	155.0	212	156	<1E-09	2, 4
		06-May-13	3	153.3	251.0	157	87	<1E-09	2, 3, 4

I:\1\01\00517\03\A\Report\Report 1, Rev A - SI Report\Tables\[Table 5.1 Goose Property Hydraulic Conductivity Testing Summary.xlsx]Table 1

NOTES:

1. ELEVATIONS OF TEST INTERVALS CALCULATED BASED ON GYRO SURVEY DATA PROVIDED BY SABINA GOLD & SILVER CORP.
2. AMC 1300 (A POLYMER BASED DRILLING ADDITIVE) USED DURING DRILLING AND/OR TO REMOVE CUTTINGS FROM DRILLHOLE.
3. THE APPLIED PRESSURE FOR THE TEST EXCEEDED THE TYPICALLY RECOMMENDED PRESSURE RANGE OF 0.98 TO 1.64 PSI/M BASED ON THE TOP OF THE TEST INTERVAL (READ AND STACEY, 2009). THE HYDRAULIC CONDUCTIVITY VALUE DOES NOT APPEAR TO BE AFFECTED BY THE HIGHER APPLIED PRESSURE.
4. HYDRAULIC CONDUCTIVITY VALUES CALCULATED AS LESS THAN 1E-09 M/S WERE CONSIDERED TOO LOW TO RELIABLY MEASURE AND WERE ASSIGNED < 1E-09 M/S.
5. TEST RESULTS UNCERTAIN BECAUSE OF SMALL HEAD APPLIED AND NOISE IN TRANSDUCER DATA.
6. HEAD APPLIED DURING TEST WAS NOT WELL CONSTRAINED.
7. TEST RESULTS NOT CONCLUSIVE.

REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D
0	23SEP'13	ISSUED WITH REPORT VA101-517/3-1	CHS	BDP	RAM

Knight Piésold CONSULTING

TABLE 5.2

SABINA GOLD & SILVER CORP.
BACK RIVER PROJECT

2013 GEOMECHANICAL AND HYDROGEOLOGICAL SITE INVESTIGATION SUMMARY
GEORGE PROPERTY - HYDRAULIC CONDUCTIVITY TESTING SUMMARY

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Deposit	Drillhole	Date of Testing	Test #	Test Interval (m along hole)		Test Interval[1] (masl)		Calculated Hydraulic Conductivity	Notes
				From	To	From	To		
Locale 1	13-GRL-113	09/05/2013	1	13.8	48.5	326	298	4E-09	2,3
		09/05/2013	2	49.8	80.0	297	273	2E-09	
		14/05/2013	3	73.8	345.5	278	68	< 1E-09	2,4
	13-GRl-115	16/05/2013	1	16.8	42.5	324	304	2E-09	3
		17/05/2013	2	40.8	69.5	305	283	2E-09	2
	13-GRL-119	20/05/2013	1	10.8	105.3	329	254	1E-09	2,3
	13-GRL-121	25/05/2013	1	31.8	90.5	314	268	< 1E-09	3,4
Locale 2	13-GRL-110	05/05/2013	1	13.8	57.5	326	291	< 1E-09	3,4
		06/05/2013	2	19.8	81.5	321	271	< 1E-09	3,4
	13-GRL-129	02/06/2013	1	16.8	320.0	334	96	< 1E-09	3,4
	13-GRL-130	05/06/2013	1	13.8	60.5	333	295	<1E-09	4

I:\1\01\00517\03\A\Report\Report 1, Rev A - SI Report\Tables\[Table 5.2 George Property Hydraulic Conductivity Testing Summary.xlsx]Table 1

NOTES:

1. ELEVATIONS OF TEST INTERVALS CALCULATED BASED ON GYRO SURVEY DATA PROVIDED BY SABINA GOLD & SILVER CORP.

2. AMC 1300 (A POLYMER BASED DRILLING ADDITIVE) USED DURING DRILLING AND/OR TO REMOVE CUTTINGS FROM DRILLHOLE.

3. THE APPLIED PRESSURE FOR THE TEST EXCEEDED THE TYPICALLY RECOMMENDED PRESSURE RANGE OF 0.98 TO 1.64 PSI/M BASED ON THE TOP OF THE TEST INTERVAL (READ AND STACEY, 2009). THE HYDRAULIC CONDUCTIVITY VALUE DOES NOT APPEAR TO BE AFFECTED BY THE HIGHER APPLIED PRESSURE.

4. HYDRAULIC CONDUCTIVITY VALUES CALCULATED AS LESS THAN 1E-09 M/S WERE CONSIDERED TOO LOW TO RELIABLY MEASURE AND WERE ASSIGNED < 1E-09 M/S.

REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D
0	23SEP'13	ISSUED WITH REPORT VA101-517/3-1	DBR	CHS	RAM

In addition, the data available to date from the vibrating wire piezometers installed in drillholes 13-GSE-277B and 13-GSE286 suggests that these sensors or their leads were either damaged during installation or subsequently malfunctioned. The sensor in 13-GSE-277B indicates values that are not believed to be representative based on the available temperature and packer testing data. The sensor in 13-GSE-286 indicates values that are outside the range of the sensor and are not representative of the site conditions.

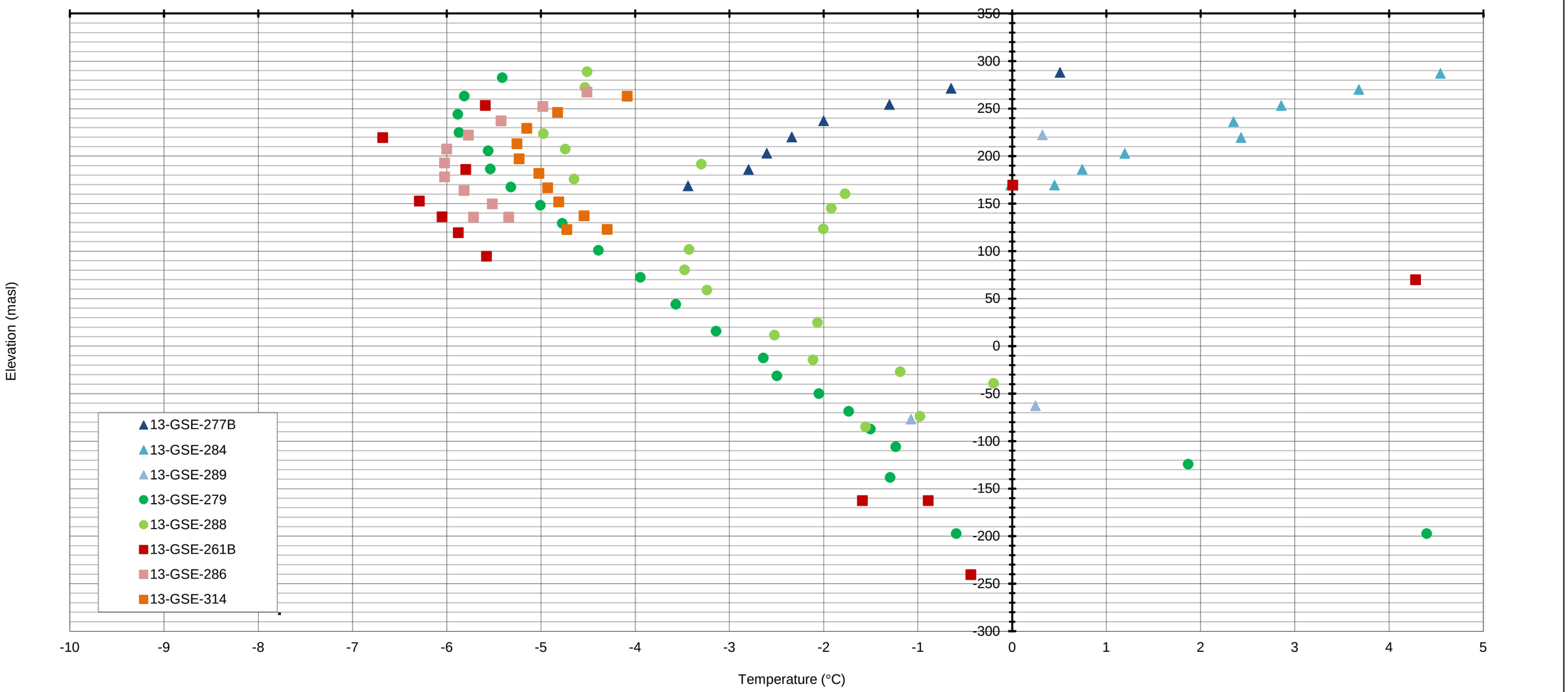
During the breakup of the ice on Llama Lake in mid-June 2013, the cables for the instrumentation at 13-GSE-284 and 13-GSE-289 were damaged beyond repair and these installations were decommissioned. The data obtained from these installations prior to the damage still provided insight on the site conditions.

5.4 TEMPERATURE PROFILES

The temperature data from the installations are summarized below and on Figures 5.1 and 5.2. Time series data from each individual installation are included in Appendix J2.

- **Goose Property:**
  - In general the thermistor data at the Goose Property indicate continuous permafrost to an elevation of about -100 to -200 meters above sea level (masl) or approximately 400 mbgs to 500 mbgs. These depths are based on an extrapolation of the data to the zero degree isotherm. The vibrating wire piezometers installed within drillholes 13-GSE-288 and 13-GSE 314 reported piezometric levels above ground surface. These values are likely a result of the sensors freezing and support the depth of permafrost estimates from the thermistors.
  - The thermistor data from drillhole 13-GSE-314 at the Goose Main deposit indicate continuous permafrost between the deposit and Goose Lake. The vibrating wire piezometer data from this drillhole supports the depth of permafrost estimate.
  - The thermistor data from the installations at the Llama deposit indicate the presence of unfrozen ground below Llama Lake to an elevation of about 150 masl or approximately 150 mbgs. The data from the uppermost of the two vibrating wire piezometer installed in drillhole 13-GSE-289 support the assertion that there is a talik below the lake.
  - The results are consistent with those obtained during previous programs.
- **George Property:**
  - The thermistor data indicate continuous permafrost conditions to depths greater than 200 mbgs (the depth of the deepest sensors). An extrapolation of the data to the zero degree isotherm suggests that the permafrost extends to more than 500 mbgs. Talik zones were not observed based on the thermistor data.
  - The data from the vibrating wire piezometer installed in drillholes 13-GRL-129 and 13-GRL-130 support the depth of permafrost estimates from the thermistors.

It should be noted that the actual permafrost boundary will vary from the zero degree isotherm depending on the salinity of the groundwater. The deep groundwater at Back River is expected to have a high concentration of total dissolved solids (salinity), which will lower the freezing point of the water. Groundwater quality will be evaluated by Rescan based on sampling from a Westbay installation at the Umwelt deposit.



NOTES:

1. THE MEASUREMENT INTERVAL IS 6 HOURS.
2. SUMMARY PLOT OF THERMISTOR DATA FOR GOOSE PROPERTY INSTALLATIONS BASED ON SELECTED DATE WITH CONCURRENT DOWNLOADED MEASUREMENTS.
3. TEMPERATURE BOUNDS DISPLAYED WERE CONSTRAINED FROM -10ºC TO 5ºC FOR PLOT. COMPLETE PLOTS OF THERMISTOR DATA PROVIDED IN APPENDIX J2.
4. THERMISTOR ELEVATIONS BASED ON MEASURED DOWNHOLE DEPTHS AND GYRO SURVEY DATA FOR DRILLHOLES PROVIDED BY SABINA GOLD & SILVER CORP.

REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D
0	23SEP'13	ISSUED WITH REPORT	RGM	BDP	RAM

SABINA GOLD & SILVER CORP.

BACK RIVER PROJECT

GOOSE PROPERTY - SUMMARY OF TEMPERATURE DATA
ELEVATION VS. TEMPERATURE (MAY 23, 2013)

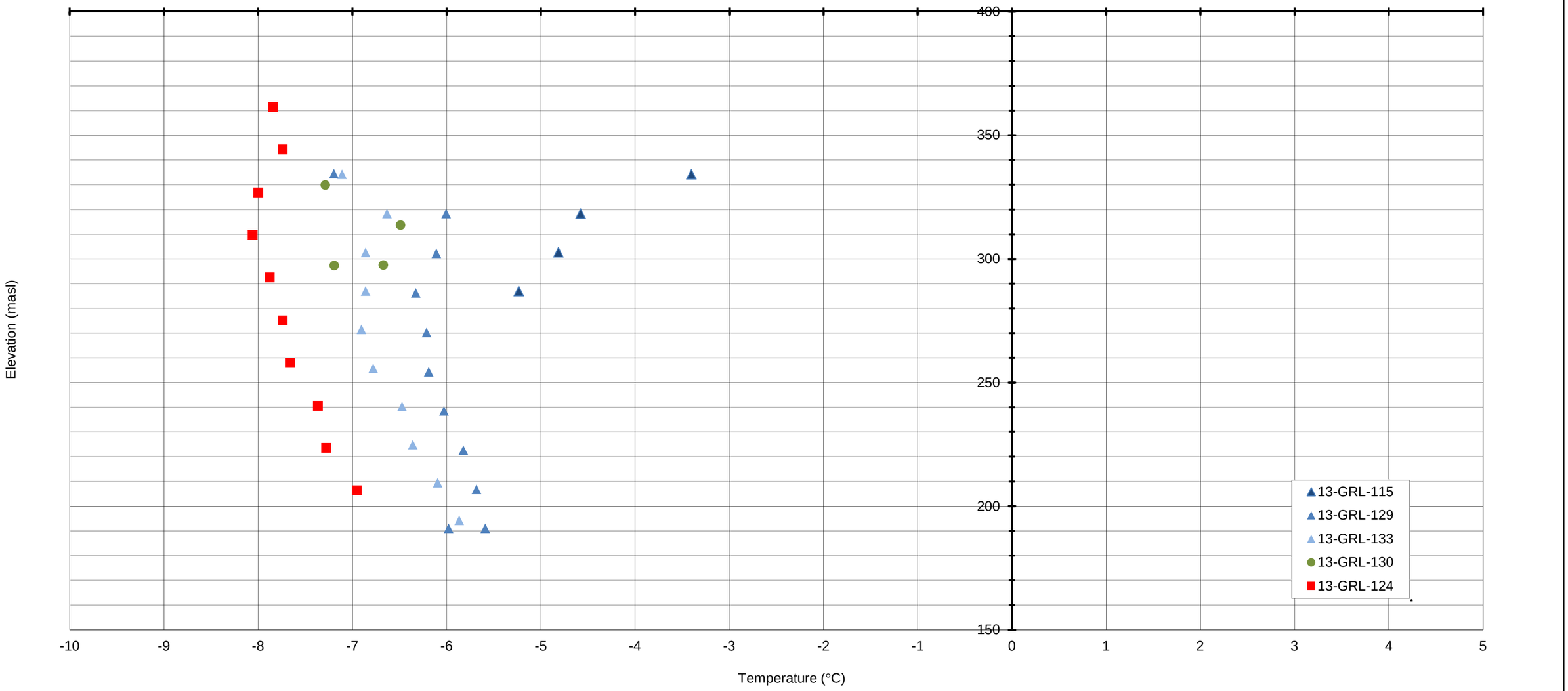
Knight Piésold CONSULTING

P/A NO. VA101-517/3

REF. NO. 1

FIGURE 5.1

REV 0



NOTES:

1. THE MEASUREMENT INTERVAL IS 6 HOURS.
2. SUMMARY PLOT OF THERMISTOR DATA FOR GOOSE PROPERTY INSTALLATIONS BASED ON SELECTED DATE WITH CONCURRENT DOWNLOADED MEASUREMENTS.
3. TEMPERATURE BOUNDS DISPLAYED WERE CONSTRAINED FROM -10ºC TO 5ºC FOR PLOT. COMPLETE PLOTS OF THERMISTOR DATA PROVIDED IN APPENDIX J2.
4. THERMISTOR ELEVATIONS BASED ON MEASURED DOWNHOLE DEPTHS AND GYRO SURVEY DATA FOR DRILLHOLES PROVIDED BY SABINA GOLD & SILVER CORP.

REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D
0	23SEP'13	ISSUED WITH REPORT	RGM	BDP	RAM

SABINA GOLD & SILVER CORP.

BACK RIVER PROJECT

GEORGE PROPERTY - SUMMARY OF TEMPERATURE DATA
DEPTH VS. TEMPERATURE (JULY 21, 2013)

Knight Piésold CONSULTING

P/A NO. VA101-517/3

REF. NO. 1

FIGURE 5.2

REV 0

5.5 PIEZOMETRIC LEVELS

The data from the piezometer installations is summarized below. The data from each individual installation are included in Appendix J3.

- **Goose Property:**
  - The uppermost of the two sensors installed in drillholes 13-GSE-261B and 13-GSE-279 report piezometric levels close to ground surface. These results are consistent with other permafrost areas where the deep groundwater flow is controlled by the water levels of the larger lakes that are connected to unfrozen ground below the permafrost though talik zones.
  - The piezometric levels recorded at the deeper of the two sensors installed in drillholes 13-GSE-261B, 13-GSE-279 and 13-GSE-289 reported pressures that gradually declined with time to levels that are not considered representative and may indicate sensor damage. Ongoing monitoring will be carried out to further assess this data.
  - The shallower of the two vibrating wire piezometers installed in 13-GSE-289 at the Llama deposit reports piezometric levels close to ground surface and are thought to be located within a talik below Llama Lake.
  - The vibrating wire piezometers installed in 13-GESE-284, 13-GSE-288 and 13-GSE-314 report piezometric levels higher than ground surface. These piezometric levels are likely a result of the sensors being installed within the permafrost.
- **George Property:**
  - The vibrating wire piezometer in drillhole 13-GRL-130 reports piezometric levels higher than ground surface. These piezometric levels are likely a result of the sensor being installed within the permafrost.
  - The vibrating wire piezometer in drillhole 13-GRL-129 is currently reporting a value close to ground surface, however the temperature of the thermistor for the vibrating wire piezometer is reported as about -6^{o}C. Ongoing data review is required to better constrain the interpretation of the data from this installation.

6 – CONCLUSIONS AND RECOMMENDATIONS

6.1 CONCLUSIONS

Knight Piésold Ltd. was engaged by Sabina to complete the geomechanical and hydrogeological work needed to support the feasibility mine design for the proposed underground and open pit developments. A geomechanical and hydrogeological site investigation program was completed between February and June, 2013. General comments are provided below.

- The encountered rock masses were classified using the RMR_{89} and NGI-Q classification systems. The deposit rock masses were generally observed to be of FAIR to GOOD quality. The Mudstone was observed to be of lower and more variable quality than the other lithologies, while the Lower Iron Formation was observed to be of higher quality.
- The discontinuity data suggests an orthogonally jointed rock mass with three joint sets. However, all of the joint sets are not present or well defined in each of the drillholes. The observed joint sets are:
  - A set striking southeast-northwest and dipping moderately to steeply to the northeast
  - A set striking northeast-southwest and dipping sub-vertically
  - A flat-lying joint set
- Hydraulic packer tests were completed to assess the hydraulic conductivity of the encountered rock masses. The rock masses in the unfrozen ground below the permafrost were observed to be have low hydraulic conductivities. The near-surface rock mass within the talik beneath Llama Lake was observed to have moderate hydraulic conductivities.
- Multi-point thermistor strings were installed to measure the temperature profile of the rock mass. The permafrost was observed to be continuous to a depth of approximately 400 to 500 mbgs at the Goose Property and more than 200 mbgs at the George Property. A talik was observed below Llama Lake. Taliks were not observed between the Goose Deposit and Goose Lake or at any of the deposits at the George Property.
- Vibrating wire piezometers were installed to measure piezometric pressures. The piezometric levels within the deep groundwater below the permafrost were observed to be near surface. These results are consistent with other permafrost areas where the deep groundwater flow is controlled by the water levels of the larger lakes that are connected to unfrozen ground below the permafrost though talik zones.

6.2 RECOMMENDATIONS

Recommendations for future work include:

- Developing a structural model for the George Property
- Continuing to collect data from the thermistor and vibrating wire piezometer installations on a quarterly basis. The installations should be maintained and the batteries charged as required. The collected data should be reviewed to confirm the preliminary conclusions presented in this report.
- Additional rock mass and hydrogeological characterization may be required to support the next level of design or in response to any significant changes to the mine plan or geological models

7 – REFERENCES

AMC Mining Consultants (Canada) Ltd. (2013). *Technical Report for Sabina Gold & Silver Corp.* Vancouver, B.C.

ASTM. (1997). D5873-95 - *Standard Test Method for Determination of Rock Hardness by Rebound Hammer Method*, Annual Book of Standards. West Conshohocken, PA.

Barton, N.R., Lien, R., and J. Lunde. (1974). *Engineering Classification of Rock Masses for the Design of Tunnel Support, Rock Mechanics*, 6(4), p. 189-239.

Bieniawski, Z.T. (1989). *Engineering Rock Mass Classifications*. Wiley, New York.

Carter, D., and Pacor, P. (2006). *2005 Technical Report on the Back River Project, Nunavut.* Dundee Precious Metals Inc. Vancouver, B.C.

Davis, Brett. (2005). *Structural Geological Assessment of the Back River Project, Nunavut, Northern Canada.* RSG Global, Perth.

Hoek, E., Wood, D. and Sha, S. (1992). *A modified Hoek-Brown criterion for jointed rock masses*. Rock Characterization. Proceedings of ISRM Symposium EUROCK'92 (ed. J. Hudson), Chester, UK, pp. 209-213. British Geotechnical Society, London.

Rescan Environmental Services Ltd. (2010). *Thermistor Data Summary, Back River Project*. Memorandum prepared for Sabina Gold and Silver Corporation. Vancouver, B.C.

Rocscience Inc. (2012a). *DIPS User's Guide*. Toronto, Ontario.

Sabina Gold & Silver Corp. (2012). *2012 Back River Core Logging Guide - Lithological Descriptions*. Internal training document.

Sabina Gold & Silver Corp. (2013a). Personal Communication with N. Forslund. Geologist, Sabina Gold & Silver Corp. Vancouver, B.C.

Sabina Gold & Silver Corp. (2013b). Personal Communication with R. Toews. Project Geologist, Sabina Gold & Silver Corp. Vancouver, BC

SRK Consulting Ltd. (2010). *Sabina Gold and Silver Corporation Goose Lake Project Airstrip Desktop Study*. Memorandum prepared for Sabina Gold and Silver Corporation. Vancouver, B.C., October 25, 2010.

SRK Consulting Ltd. (2011). *Sabina Gold and Silver Corporation Goose Lake Project All-Weather Airstrip and Access Road Geotechnical Field Investigation*. Report prepared for Sabina Gold and Silver Corporation. Vancouver, B.C., December 2011.

SRK Consulting Ltd. (2012b). *Back River 2012 Geotechnical and Hydrogeological Drilling Program Factual Data Report*. Report prepared for Sabina Gold & Silver Corporation. Vancouver, B.C., November 2012.

SRK Consulting Ltd. (2012a). *Preliminary Economic Assessment Report for the Back River Gold Project, Nunavut Territory, Canada*. Report prepared for Sabina Gold & Silver Corp. Vancouver, B.C., June 29, 2012.

8 – CERTIFICATION

This report was prepared, reviewed and approved by the undersigned.

Prepared:

For Glen Mayberry
Geological Engineering

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100141409
SEP 23 2013
PROVINCE OF ONTARIO

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