BENTHIC INVERTEBRATE MONITORING PROGRAM

AT

THE FARO MINE COMPLEX, 2010

Submitted to:

ASSESSMENT AND ABANDONED MINES

ENERGY MINES AND RESOURCES

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EXECUTIVE SUMMARY

Overall, the water samples collected at the sites in this study and analyzed for the selected parameters, indicated good water quality for the support of freshwater aquatic life. Only a few of the regulated parameters had concentrations greater than recommended guidelines for the protection of freshwater aquatic life (CCME and BCWQG). Water quality was poorer at R2 and X2, and the data suggests that Buttle and Horton Creeks drain mineralized areas.

Habitat values were carefully characterized at each site with a focus on assessing good matches between exposed and reference sites. Some sites were better matches than others, however if the Reference Condition Approach is to be adopted, a far greater number of references sites will need to be included.

The benthos populations were analyzed using several metrics. The results suggest some impairment at the Rose Creek exposed sites X2 and R2; however the ecosystem appears to be fully recovered downstream on Rose Creek at R4. The metrics indicate that all the exposed sites on Vangorda Creek contain healthy benthic invertebrate communities.

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1.0 BACKGROUND

In early 2009, care and maintenance of the Faro Mine Complex (FMC) was transferred from Deloitte and Touche Inc to Denison Environmental Services, a contractor acting on behalf of the Yukon Government (YG). YG hired Minnow Environmental Inc (Minnow) to develop a long term monitoring program (LTMP) to support the planning of the comprehensive closure plan. A component of the LTMP is an Aquatic Ecosystem Monitoring Program (AEMP). The intent of the AEMP is to assess the chemical and biological conditions of the aquatic environments receiving mine drainage and is described in Minnow's report *Aquatic Ecosystem Monitoring Program, Faro Mine, Yukon (Updated 2010)* (Minnow 2010).

YG contracted Laberge Environmental Services (LES) to conduct the AEMP in the summer of 2010. This study focused on benthic invertebrate populations and some water quality but did not include any fisheries assessments. In their report Minnow based the benthic monitoring program on the Reference Condition Approach (RCA) where sites exposed to mining influences are assessed as well as several reference sites that have no impacts. The reference sites do not necessarily need to be in the vicinity of the exposed sites but should share several similar habitat characteristics.

The exposed sites suggested, X14 (R2), R4, V5, V8, VGMAIN and X2, reflect near-field and far-field conditions in the Rose and Vangorda Creek drainages. In a previous study, Minnow identified approximately 12 reference sites in the Faro region (Minnow 2009). They recommend the establishment of more reference sites as well. Based on ground-truthing and other factors eight of these reference sites were sampled in 2010.

2.0 STUDY AREA

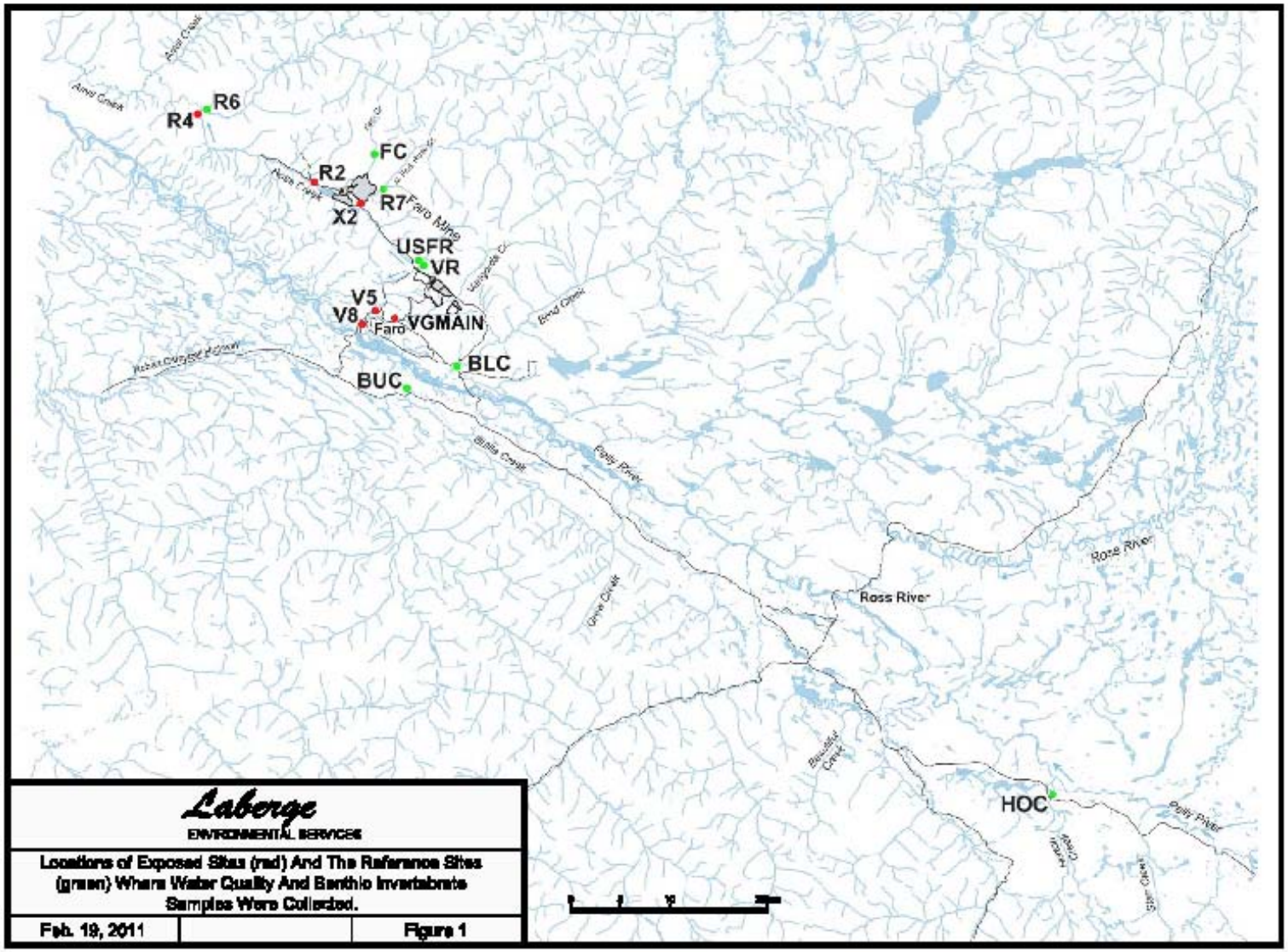
The Faro Mine Complex is located approximately 20 road kilometres north of the Town of Faro at approximately 62° 20' N and 133° 25' W (Figure 1).

The study area lies within the ecoregion Yukon Plateau - North. The mean annual temperature for this region is approximately –5°C with a summer mean of 10.5°C and a winter mean of -20°C. Northern boreal forests exist at elevations up to 1500 m asl. White and black spruce form the most common forest types with aspen and balsam poplar occupying disturbed areas. (Yukon Ecoregions Working Group, 2006).

The exposed sites to be sampled under the AEMP and the reference sites that were sampled are described in Table 1 and depicted in Figure 1. All sites lie within the Pelly River drainage.

TABLE 1 LOCATIONS OF THE BIOLOGICAL MONITORING SITES, 2010

Water-shed	Site Code	Site Description	NAD 83 Zone 8	
			Easting	Northing
EXPOSED SITES				
Rose Cr Watershed	**X2**	North Fork Rose Cr just u/s the mine access road	584068	6912783
	R2	Rose Cr just d/s X14	579223	6915018
	R4	Rose Cr just u/s of confluence with Anvil Cr	567823	6921789
Vangorda Watershed	**VGMAIN**	Vangorda Cr near the townsite but u/s of West Fork Vangorda	585675	6901505
	V5	West Fork of Vangorda Cr u/s the mine access road	586200	6902058
	V8	Vangorda Cr u/s Pelly River and u/s new bridge d/s of townsite	584851	6900647
REFENCE SITES (FROM NORTHEAST TO SOUTHWEST)				
Anvil	**R6**	Anvil Creek just upstream of confluence with Rose Creek	567882	6921803
Rose	**R7**	North Fork Rose Cr upstream Faro Cr diversion	586608	6914181
Rose	**FC**	Upper Faro Creek	583536	6916777
Vangorda	**USFR**	South Fork of Vangorda Creek upstream of Haul Road	590678	6906906
Vangorda	**VR**	Upper West Fork of Vangorda Creek upstream of Haul Road	590243	6907372
Blind	**BLC**	Blind Creek upstream of bridge	593665	6895992
Buttle	**BUC**	Buttle Creek approx 70 m downstream of Robert Campbell Hwy	601897	7104449
Horton	**HOC**	Horton Creek upstream of Robert Campbell Hwy	656437	6855443


R6
R4
FC
R2
R7
X2
Faro Mine
USFR
VR
V5
V8
Faro
VGMAIN
BLC
BUC
HOC
Ross River
Rose River
Laberge
ENVIRONMENTAL SERVICES
Locations of Exposed Sites (red) And The Reference Sites (green) Where Water Quality And Benthic Invertebrate Samples Were Collected.
Feb. 19, 2011
Figure 1

3.0 METHODS

Field work for the biological monitoring program was undertaken between August 30th and September 3rd, 2010. Sites R4 and R6 required access via helicopter. All other sites were accessed by 4x4 vehicle or on foot.

3.1 Water Quality

Water quality samples were collected in a fast flowing section of the stream prior to any other sampling activity. All sample bottles were supplied by Maxxam Analytics Inc of Burnaby, B.C. At each site, the sample bottles were rinsed three times with the sample water prior to filling. Samples were collected in one-litre plastic bottles for sulphate, alkalinity, total hardness, and nonfilterable residue analyses. Ammonia samples were collected in 120 mL plastic bottles and preserved with sulphuric acid. Samples to be analyzed for total metals and dissolved metals were collected in 120 mL plastic bottles. The total metals samples were preserved with nitric acid. The dissolved metals samples were filtered in the field prior to preservation with nitric acid. Samples were kept cool prior to shipment to Maxxam.

3.2 Habitat Characterization

Habitat assessments were made at each site using CABIN (Canadian Aquatic Biomonitoring Network) protocols. Appropriate habitat field sheets were downloaded from the CABIN website and filled out per station. A blank form is included in Appendix B. Slope was determined using survey equipment; rod, transit and tripod. Discharge was measured at each of the sites, where possible. An area with a uniform cross section was chosen and the velocity and depth were measured using a AA Price velocity meter. Ten or more readings were taken across the profile of the stream. Total discharge was calculated as the sum of these individual discharges (area x velocity). In-situ water characteristics, water temperature, pH, conductivity and total dissolved solids were measured at each site using a handheld Hanna multi-probe.

3.3 Benthic Invertebrate Sampling

3.3.1 Field Collection

As recommended by Minnow (Minnow 2010) the kick and sweep method was employed for the collection of benthic invertebrates. A D-net equipped with a 400 um mesh size was used to capture disturbed invertebrates while kicking the substrate in each stream for a duration of 3 minutes. The captured detritus and benthic invertebrates were placed in a one litre nalgene bottle and preserved with 10% formalin. These samples were sent to Cordillera Consulting, Summerland, B.C. for sorting, enumeration and identification following CABIN protocols.

3.3.2 Laboratory Analysis

At the Cordillera Consulting laboratory, each sample was elutriated and sieved to remove clay and sand and gravel. The remaining organic debris was stored in 70% ethanol until they were processed. The samples were processed following the CABIN Laboratory protocol outlined in MacDermott 2010.

The Marchant Box was used for subsampling the samples. Subsampling applied to all but one sample. The average subsample was 21 cells of the Marchant Box. The average number of invertebrates removed from each sample was 470.

Site Name	**Blind Creek**	**Buttle Creek**	**FC**	**Horton Creek**	**R2**	**R4**	**R6**
% Subsample	22	10	2	49	5	27	8
# invertebrates sorted	320	335	304	315	598	346	322
Site Name	**R7**	**V5**	**V8**	**VGMAIN**	**VR**	**USFR**	**X2**
% Subsample	5	23	100	8	19	11	5
# invertebrates sorted	381	323	639	328	386	323	1662

All samples had a sorting efficiency of greater than 95% and so have achieved the industry standard.

As a QA/QC measure regarding taxonomic efficiency, two samples (R6 and Horton Creek) were chosen randomly for re-identification by a second taxonomist. There were four occurrences of mis-enumeration in the R6 and three in Horton Creek. In both samples the enumerations did not differ by more than 10%.

There was one occurrence of questionable taxonomic resolution in the second sample and this was within acceptable limits for quality control.

4.0 RESULTS AND DISCUSSION

4.1 Water Quality

The benthic invertebrate survey results will be used to gauge the biological response to changes in chemical conditions downstream of the mine complex. Consequently it is important to collect water quality samples during biological monitoring programs to at least obtain a snapshot of the current conditions. Most of the exposed sites have many years of water chemistry data; however it is beyond the scope of this study to compare the historic data with the current set of data. Denison Environmental Services is responsible for managing the water quality programs on site and all generated data is stored in the database program emLine. All surface and groundwater data that has been collected over the decades at all sites, and are continued to be collected, are available for viewing on this database.

Under the Surface Water component of the AEMP, Minnow has identified several exposed and reference sites that should be sampled three times per year; March, May and October. Ten of these sites overlap with the Benthic Invertebrate component; X2, X14 (R2), R4, VGMAIN, V5, V8, R7, FC, VR and USFR. In addition to these sites, water samples were collected from the reference sites R6, Blind Creek, Buttle Creek and Horton Creek for the benthic survey in 2010.

In addition to total metals, Minnow recommended that ammonia, hardness, nitrate, sulphate, total dissolved solids and turbidity be analyzed. LES feels it is important to also analyze samples for dissolved metals to determine the amount of a metal that is in a potentially bioavailable form, especially in turbid waters. Following that logic, total suspended solids were also analyzed.

The in-situ parameters, water temperature, pH and conductivity were collected at each site.

Table 2 summarizes selected parameters however the complete analytical report can be examined in Appendix A. Various ions, physical attributes and only those metals where the CCME guidelines for the protection of freshwater aquatic life (CCME, 1999) have been exceeded are included in Table 2.

Water temperatures reflected the seasonal and diurnal sampling times and ranged from 3.6^{o}C at VR to 8.1 ^{o}C at USFR. All sampled waters were slightly alkaline and ranged from 7.5 at FC to 8.5 at Horton Creek. Conductivity varied considerably and ranged from 35 uS/cm at FC to 645 uS/cm at Horton Creek. Total dissolved solids, a measurement similar to conductivity, followed the same trend. Alkalinity is a measure of the buffering capacity of natural waters against changes in pH relating to the carbonate system. Total alkalinity levels also followed the same trend as conductivity.

TABLE 2 SELECTED WATER QUALITY FOR THE BENTHIC INVERTEBRATE MONITORING PROGRAM, 2010

		EXPOSED SITES						REFERENCE SITES								
Site		**X2**	**R2**	**R4**	**VGMAIN**	**V5**	**V8**	**R6**	**R7**	**FC**	**VR**	**USFR**	**BLC**	**BUC**	**HOR**	**CCME Guidelines**
Date		8/31/2010	9/2/2010	9/1/2010	9/1/2010	9/2/2010	9/1/2010	9/1/2010	8/31/2010	8/31/2010	9/2/2010	8/31/2010	9/2/2010	9/3/2010	8/30/2010	
Water temp °C		7.1	5.7	6.2	4.1	5.1	4.3	4.5	4.4	7.6	3.6	8.1	6.5	4.8	7.8	
pH field		7.9	7.9	8.3	8.3	8.5	8.4	8.5	8.1	7.6	8.0	7.9	8.2	8.3	8.5	
pH lab		8.1	8.1	8.2	8.2	8.4	8.3	8.3	8.0	7.5	7.7	7.6	8.0	8.3	8.5	6.5 to 9
Conductivity field (uS/cm)		420	503	466	201	561	510	306	177	35	69	58	175	506	645	
Conductivity lab (uS/cm)		201	541	490	407	496	446	297	176	42	75	61	174	479	620	
TSS mg/L		<1	<1	1	<1	15	1	<1	<1	<1	<1	<1	<1	<1	1	
TDS mg/L		110	370	340	270	340	310	170	120	40	56	56	110	300	380	
Nitrate mg/L		0.04	0.06	0.11	0.24	<0.02	0.16	0.05	<0.02	<0.02	<0.02	<0.02	<0.02	0.15	0.02	13
Alkalinity mg/L		88	98	100	110	190	140	130	85	21	33	24	74	220	270	
Sulphate mg/L		16	170	170	100	81	100	21	6.9	1.6	5.8	5.5	14	47	89	
Ammonia mg/L		0.008	0.13	0.030	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	1.54
Hardness ($CaCO_3$ mg/L)	**Dissolved**	94.0	253	235	192	259	225	151	83.1	14.5	31.2	25.6	78.2	253	348	
	Total	95.2	263	164	196	259	229	148	81.6	15.2	31.2	24.7	75.2	242	349	
Aluminum (ug/L)	**Dissolved**	5.1	3.3	3.1	4.5	4.3	3.9	3.3	5.0	15.7	16.2	6.9	4.8	2.4	2.5	100
	Total	16.6	6.7	3.8	4.6	**385**	10.9	8.6	9.8	27.9	18.4	12.7	8.5	11.4	4.4	100
Cadmium (ug/L)	**Dissolved**	0.005	0.038	0.020	0.042	0.024	0.028	0.009	<0.005	0.006	0.009	<0.005	0.006	0.010	0.016	
	Total	0.015	0.042	0.019	0.042	**0.092**	0.031	0.010	<0.005	**0.009**	0.007	<0.005	0.011	0.010	0.023	
Cadmium Guideline (ug/L)		0.032	0.076	0.051	0.059	0.075	0.068	0.046	0.028	0.007	0.012	0.010	0.026	0.071	0.097	
Iron (ug/L)	**Dissolved**	126	198	52	13	31	16	87	110	11	11	63	50	29	18	300
	Total	225	**390**	111	20	**862**	45	156	182	29	16	112	75	51	94	300
Selenium (ug/L)	**Dissolved**	0.24	0.20	0.44	0.30	0.98	0.55	0.69	0.21	<0.04	<0.04	<0.04	0.17	0.63	**2.06**	1
	Total	0.22	0.19	0.32	0.32	0.88	0.57	0.68	0.21	<0.04	<0.04	<0.04	0.16	0.57	**2.17**	1
Zinc (ug/L)	**Dissolved**	8.4	**41.6**	14.4	10.6	1.3	7.2	0.1	0.7	0.8	0.6	0.2	0.2	1.2	1.0	30
	Total	10.1	**45.3**	16.3	10.3	7.0	7.4	0.2	0.3	1.1	0.6	0.2	0.2	1.4	1.8	30

Note: Values are indicated in bold and shaded where the CCME guideline has been exceeded.

All of the waters were clear with a total suspended solids reading of 1 mg/L or were not detected, with the exception of V5 which was somewhat turbid with a TSS value of 15 mg/L (see Photos 9 & 10, Appendix B).

Total ammonia was only detected in the Rose Creek exposed samples. The highest concentration of 0.13 mg/L recorded at R2 is well below the CCME guideline of 1.54 mg/L for cool, alkaline waters.

Sulphate concentrations differed significantly ranging from 1.6 mg/L at FC to 170 mg/L at R2 and R4. Natural concentrations in surface waters range from 10 to 80 mg/L (CCREM, 1987). Concentrations within this array were documented at all of the reference sites, with Horton

Creek slightly exceeding 80mg/L. Concentrations at V5 and X2 were similar to natural levels however concentrations were higher at VGMAIN, V8, R2 and R4.

Hardness also varied throughout the study area. The waters at FC, USFR and VR were very soft. Moderately soft water was found at BLC, R7 and X2. Waters were hard at R6 and very hard at the remainder of the sites. The toxicity of some metals varies with the hardness of the sample waters and generally, toxicity of several metals to freshwater aquatic organisms increases as the hardness of the water decreases.

Metal concentrations were relatively low throughout the study area but concentrations for aluminum, cadmium, iron, selenium and zinc exceeded the respective CCME guidelines for the protection of freshwater aquatic life at one or more sites. The recommended guideline for aluminum was exceeded only in the total metals sample at V5, but met the guideline in the dissolved sample. The water at V5 was slightly turbid with a TSS value of 15mg/L.

The guideline for cadmium (0.017 ug/L) is very conservative but varies with the hardness of the water in question. Since the flows in the study area varied significantly in hardness, the calculation using the formula 10{0.86[log(hardness)]-3.2}, was used to determine the site specific guideline for each site. These generated values are listed in the column next to the cadmium results. The recommended guidelines for cadmium was exceeded in the total metals samples from V5 (an exposed site) and FC (a reference site).

The recommended guideline for iron was met at all of the reference sites and exceeded in the total metals samples at V5 and R2. The CCME guideline for selenium was only exceeded at the reference site, HOR in both the dissolved and total states. The concentration of zinc in the dissolved and total metals samples was exceeded at the exposed site, R2. All of the other sites met the zinc guideline.

In developing the LTMP, Minnow identified several substances which indicate they are of mine origin. The “Mine Indicator” substances tabulated in Table 3 are parameters which were elevated by five or more times above the background means in the exposed near-field stations (Minnow, 2010). Overall, concentrations of these parameters were lower at the reference sites than the exposed sites, however it appears that both Buttle and Horton Creeks drain mineralized areas. Some of the parameters were actually greater in Buttle Creek and/or Horton Creek than in some of the exposed sites. Total dissolved solids is a notable example, and Horton Creek had the highest TDS concentration in the study area. The highest levels of antimony, calcium, magnesium, molybdenum, selenium, strontium, tin and uranium were recorded at Horton Creek (Appendix A) and would be components of TDS. Also many of these ions contribute to hardness and Horton Creek had the hardest water in the study area.

TABLE 3 MINE INDICATOR SUBSTANCES AT THE BENTHIC INVERTEBRATE SITES, 2010

	Site #	Sampling Date	Nitrate (N) mg/L	Dissolved Sulphate mg/L	Ammonia (N) mg/L	Total Dissolved Solids mg/L	Total Cobalt (Co) ug/L	Total Manganese (Mn) ug/L	Total Nickel (Ni) ug/L	Total Silver (Ag) ug/L	Total Zinc (Zn) ug/L
EXPOSED SITES	**X2**	8/31/2010	0.04	16	0.008	110	0.121	40.2	0.59	<0.005	10.1
	R2	9/2/2010	0.06	**170**	0.13	370	2.44	**1640**	3.81	<0.005	**45.3**
	R4	9/1/2010	0.11	**170**	0.030	340	0.660	686	1.88	<0.005	16.3
	VGMAIN	9/1/2010	0.24	**100**	<0.005	270	0.054	3.81	0.93	<0.005	10.3
	V5	9/2/2010	<0.02	**81**	<0.005	340	0.876	78.3	3.72	0.010	7.0
	V8	9/1/2010	0.16	**100**	<0.005	310	0.054	6.38	0.99	<0.005	7.4
REFERENCE SITES	**R6**	9/1/2010	0.05	21	<0.005	170	0.036	12.7	0.29	<0.005	0.2
	R7	8/31/2010	<0.02	6.9	<0.005	120	0.025	16.4	0.23	<0.005	0.3
	FC	8/31/2010	<0.02	1.6	<0.005	40	0.022	1.02	0.23	<0.005	1.1
	VR	9/2/2010	<0.02	5.8	<0.005	56	0.014	0.78	0.17	<0.005	0.6
	USFR	8/31/2010	<0.02	5.5	<0.005	56	0.030	11.4	0.17	<0.005	0.2
	BLC	9/2/2010	<0.02	14	<0.005	110	0.027	7.75	0.34	<0.005	0.2
	BUC	9/3/2010	0.15	47	<0.005	300	0.031	15.7	0.41	<0.005	1.4
	HOR	8/30/2010	0.02	**89**	<0.005	380	0.063	16.8	1.14	<0.005	1.8
WQ Benchmarks:			13	50	0.24	500	4.0	1000	65	0.1	30.0

Note: Values are indicated in bold and shaded where the water quality benchmark has been exceeded.

There currently are no recommended national (CCME) guidelines for sulphate for the protection of aquatic life and Minnow has used a British Columbia water quality guideline for the benchmark in their reports, which has been included in Table 3. This guideline was exceeded at all of the exposed sites except at X2. The guideline was met at the references sites with the exception of Horton Creek.

Cobalt concentrations were elevated at the Rose Creek exposed sites and at V5, compared to the reference sites. Levels of cobalt were similar at VGMAIN, V8 and Horton Creek.

Likewise, there are no CCME guidelines for manganese and again Minnow has used the BC guideline for a benchmark. A high concentration of manganese was documented at R2 which exceeded the BC guideline. The level was still relatively high downstream at R4. Manganese concentrations were very low at all of the reference sites and all values were less than 20 ug/L.

All sites met the water quality benchmark for nickel. Most of the reference sites had lower concentrations than the exposed sites. However, the nickel value recorded at Horton Creek was greater than that documented at X2, VGMAIN and V8.

Zinc concentrations were significantly lower at the reference sites than at the exposed sites. The CCME guideline was exceeded at R2.

Levels of the mine indicator substances were much lower in the exposed sites of the Vangorda Creek watershed than the Rose Creek watershed. Most of the mine indicator substances appear to be contributed from V5 in the Vangorda system. The highest concentrations of most of the mine indicator substances occurred at R2, which is located downstream of the tailings facility. Target parameters to monitor any potential mine influence on the receiving waters, especially to the Rose / Anvil drainage, should include sulphate, cobalt, manganese and zinc. Although currently most metal concentrations are within CCME guidelines, the monitoring of indicator substances can help to identify potential deteriorating conditions, or conversely, indicate if conditions are improving.

4.1.1 Quality Assurance / Quality Control

A blind duplicate set of samples was collected at V5 and sent to the lab as an analytical check. A review of the data in Appendix B shows good correlation for all parameters tested. A field blank was also analyzed for all parameters with provided de-ionized water from Maxxam. Very few parameters were detected, however antimony concentrations were very high (0.48 and 0.50 ug/L in the dissolved and total metals samples respectively) and were the highest values recorded during the survey (Appendix A). Maxxam also conducts its own QA/QC program using spiked and method blanks and their assurance report is included in Appendix A.

4.2 Habitat Characteristics

Habitat field sheets were downloaded from the CABIN website and filled out per station. Data is summarized in Table 4. In order to conserve paper, the original field sheets (6 pages per site) have not been included in this report, however a blank form is included in Appendix B. Two photos of each site, looking upstream and downstream, are also included in Appendix B.

Minnow used correlation analysis to rank habitat similarity between the reference sites and the exposed sites (Minnow, 2009). Table 5 is an adaptation of the ranking for the sites sampled in 2010 and shows the best and second best matches for each of the exposed sites. VGMAIN is not included in Table 5 because 2010 represents the first year that biological monitoring was completed at this site.

According to the analysis, Blind Creek is the best match for V5, Horton Creek for V8, and R7 for X2, R2 and R4. There are a lot of similarities between Blind Creek and V5 with the major difference being it is a much larger creek with a gentle slope (Table 4). Horton Creek has a flow twice that of V8 but other attributes are similar. Horton Creek was the second best match for R4 and when reviewing Table 4, appears to be a better match than R7. R7 is a good match for X2 and both are located on the north fork of Rose Creek, which will definitely allow the monitoring of any effects of leaching or drainage off the waste rocks piles to the benthic populations downstream at X2. R2 is about three threes larger than R7, but there are some similarities in the

habitat at each site. There are habitat similarities with Horton and Blind Creeks as well, although both are located at lower elevations.

TABLE 4 **HABITAT CHARACTERISTICS, BENTHIC INVERTEBRATE MONITORING SURVEY, 2010**

	EXPOSED SITES						REFERENCE SITES							
Site Code	**VGMAIN**	**V5**	**V8**	**X2**	**R2**	**R4**	**R6**	**R7**	**FC**	**VR**	**USFR**	**BLC**	**BUC**	**HOR**
River/Stream	Vangorda Cr	Vangorda Cr	Vangorda Cr	North Fork Rose Cr	Rose Creek	Rose Creek	Anvil Creek	North Fork Rose Creek	Upper Faro Creek	upper West Fork Vangorda Creek	Upper South Fork Vangorda Creek	Blind Creek	Buttle Creek	Horton Creek
Sampling Date (D/M/Y)	1/9/2010	2/9/2010	1/9/2010	31/8/2010	2/9/2010	1/9/2010	1/9/2010	31/8/2010	31/8/2010	2/9/2010	31/8/2010	2/9/2010	3/9/2010	30/8/2010
Time	8:30	16:50	10:30	17:30	11:30	14:30	13:00	10:00	15:30	9:30	12:15	14:45	9:30	14:00
Stream Order	Second	Second	Third	Second	Third	Third	Third	Second	First	First	First	Third	Third	Third
Surrounding Land Use	Forest & residential	Forest	Forest	Forest, mining, access road	Forest	Forest	Forest	Forest, mining	Forest, mining	Forest, mining, haul road	Forest, mining, haul road	Forest, cabin, bridge	Forest, highway	Forest, mining
Dominant Surrounding Land Use	Forest	Forest	Forest	Mining	Forest	Forest	Forest	Forest	Forest	Mining	Forest	Forest	Forest	Forest
GPS Datum	NAD 83	NAD 83	NAD 83	NAD 83	NAD 83	NAD 83	NAD 83	NAD 83	NAD 83	NAD 83	NAD 83	NAD 83	NAD 83	NAD 83
Easting	585675	586200	584851	584068	579223	567823	567882	586608	5835361	590678	590243	593665	601897	656437
Northing	6901505	6902058	6900647	6912783	6915018	6921789	6921803	6914181	6916777	6906906	6907372	6895992	7104449	6855443
Elevation m	703	651	673	1077	1016	932	932	1120	1316	1220	1236	656	721	826
Habitat Type	riffle	riffle, rapids and pool/back eddy	riffle, rapids, straight run	riffle, rapids, straight run, pool/back eddy	straight run, pool/back eddy, riffle,	riffle, rapids, straight run, pool/back eddy	riffle, rapids, straight run, pool/back eddy	straight run, pool/back eddy, rapid,	riffle, rapids, straight run	riffle, rapids	riffle	riffle, rapids, straight run	riffle, rapids	riffle, straight run, pool/back eddy
Canopy Coverage (%)	0	76 - 100%	26 - 50	1 - 25	0	1 - 25	1 - 25	0	51 - 75	1 - 25	1 - 25	1 - 25	1 - 25	0
Macrophyte Coverage (%)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Streamsite Vegetation	shrubs, deciduous trees, coniferous trees, moss	deciduous trees, equisetum and moss	shrubs, deciduous trees, moss	moss, grasses, shrubs, deciduous trees, coniferous trees	equisetum , shrubs, coniferous trees	grasses, shrubs, coniferous tress	moss/grasses, shrubs, coniferous trees	grasses, shrubs, coniferous trees	moss, sedges, shrubs	grasses, shrubs	forbs, grasses, shrubs, coniferous trees	grasses, shrubs, deciduous trees	sedges, grasses, shrubs, coniferous trees	grasses, shrubs, deciduous trees, coniferous trees
Dominant Streamside Vegetation	deciduous trees	deciduous trees	deciduous trees (alder, willow, aspen)	shrubs	shrubs (mainly dwarf birch)	shrubs, mostly alder	shrubs	grasses	shrubs (willows)	shrubs	shrubs (willows - some tree like)	deciduous trees (large alders and willows)	coniferous trees	shrubs
Periphyton	1	2	1	4	4	3	4	3	1	1	1	1	3	1
Habitat sampled	riffle	riffle	riffle	riffle	straight run	riffle	riffle	straight run	rapids	riffle	rifille	riffle	riffle	riffle
Typical Depth (cm)	25.0	10.0	25.0	40.0	20.0	25.0	30.0	50.0	20.0	7 to 10	20.0	30.0	10.0	20.0
Surrounding / Interstitial Material	3	2	4	4	1	4	2	1	3	3	3	2	3	2
Water Temp oC	4.1	5.1	4.3	7.1	5.7	6.2	4.5	4.4	7.6	3.6	8.1	6.5	4.8	7.8
pH	8.32	8.48	8.39	7.87	7.93	8.29	8.51	8.13	7.61	7.95	7.91	8.22	8.32	8.46
Conductivity uS/cm	420	503	466	201	561	510	306	177	35	69	58	175	506	645
Total Dissolved Solids ppm	209	251	233	100	280	255	153	91	17	34	29	87	253	322
Slope (surveyed in the field) (%)	4.6	5.1	2.6	1.2	0.06	0.7	1.2	0.2	3.1	3.8	5.3	0.03	0.08	0.45
Bankfull Width (m)	5.8	6.4	9.3	9.5	11.8		18.7	3.7	5.4	3.1	9.4	18.5	6.5	10.4
Wetted Stream Width (m)	3.6	3.45	5.4	5.9	11.8		16.6	3.7	1.95	1.4	7.9	13.3	4.75	6.8
Bankfull-wetted depth (cm)	50	40	90	53.4	62		80	50	50	45	50	100	40	85
Average velocity (m/s)	0.29	0.58	0.28	0.54	0.44		0.43	0.37	0.18	0.22	0.37	0.70	0.32	0.46
Total Discharge (cms) Price Meter	0.259	0.1161	0.377	0.7551	1.6444		2.1204	0.5645	0.0392	0.0184	0.4517	2.3572	0.3465	0.6297
Comments			Very bouldery substrate, difficult to kick net		Flow measured at X-14	No discharge data etc as creek too pushy to safely wade.			Substrate has a lot of moss on it					

There were no matches for VR and USFR. VR is a small stream with very soft water and is unlike any of the exposed sites. USFR is a steep sloped stream also with very soft water. Although it has some similar attributes with V5 and X2, it likely does not represent a very useful reference site. FC was indicated as the second best match for X2. FC is a small creek located at a much higher elevation and has extremely soft water. The substrate at X2, mostly cobbles and boulders, is

relatively clean yet the substrate (also cobbles and boulders) at FC contains considerable moss coverage.

TABLE 5	BEST HABITAT MATCHES - REFERENCE VS EXPOSED				
	V5	**V8**	**X2**	**R2**	**R4**
R6		◊			
R7			√	√	√
FC			◊		
VR					
USFR					
BLC	√				
BUC				◊	
HOR	◊	√			◊
√ = overall best match ◊ = second best match					

4.3 Benthic Invertebrates

Unlike chemical measures, invertebrate assemblages reflect long-term exposure to varying water quality conditions and thus integrate effects of contaminants over time (Rosenberg and Resh, 1993). Benthic invertebrates have been used to monitor ecological effects of contaminants, including metals, on stream communities since the early 1900s. These organisms are useful in this respect as their abundance and taxonomic diversity respond to a wide range of impacts including sedimentation, organic loading and changes in chemical water quality. Using benthic invertebrates as biomonitoring tools offers many advantages for the following reasons; they are ubiquitous, they are abundant and easy to collect, there are a large number of species offering a spectrum of responses to environmental stress, they are generally sedentary and therefore are representative of local conditions, and they have long life cycles compared to other groups (i.e. periphyton). As such, benthic macroinvertebrates act as continuous monitors of the water they inhabit and therefore can serve as sentinels of change in local conditions.

Benthic invertebrates were collected from the six exposed sites and eight reference sites using the CABIN kick and sweep method. Minnow recommended that the reference stations they monitored in 2008 be re-sampled during the AEMP (Minnow 2010). Searching for and analyzing potential new reference sites was beyond the scope of the current project but should be undertaken prior to the next benthic invertebrate survey.

Five phyla were found throughout the study area; Arthropoda, Annelida, Mollusca, Platyhelminthes and Nematoda. A total of 89,900 organisms representing 93 different taxonomic groups were identified within these phyla. These data are presented in Appendix C.

To analyze the benthic invertebrate data various measures and indices were examined. The

number of different types of invertebrates identified has been tallied per site and is known as species richness (Table 6) and indicates the diversity or variety of the community. The assumption is that taxonomic richness increases with increasing water quality and habitat quality, availability and/or suitability. The species richness ranged from a minimum of 16 different taxa at R7 (a reference site) to 36 different taxa at V8 (an exposed site). Generally, the exposed sites were more diverse than the reference sites.

TABLE 6 RICHNESS MEASURES FOR FARO BENTHIC INVERTEBRATES, 2010

	Site:	Species Richness	EPT Richness	Ephemeroptera Richness	Plecoptera Richness	Trichoptera Richness	Chironomidae Richness	Oligochaeta Richness
EXPOSED	X2	31	14	4	5	5	2	0
	R2	21	6	1	5	0	2	0
	R4	31	20	6	9	5	1	0
	VGMAIN	31	21	5	11	5	3	0
	V5	32	18	5	10	3	2	1
	V8	36	21	6	10	5	1	1
REFERENCE	R6	28	17	9	8	0	2	0
	R7	16	8	3	5	0	1	0
	FC	24	12	5	6	1	1	0
	VR	32	20	8	10	2	3	1
	USFR	32	20	9	8	3	3	0
	Blind Creek	30	11	5	5	1	5	1
	Buttle Creek	30	12	4	5	3	2	0
	Horton Creek	23	13	6	6	1	2	0

The richness of the benthic communities can be further examined in regard to the number of different pollution sensitive and tolerant species present. Ephemeroptera (mayflies), Plecoptera (stoneflies) and Trichoptera (caddisflies) are generally regarded as invertebrates that are sensitive to pollution. The EPT richness ranged from 6 at R2 to 21 at VGMAIN and V8, all exposed sites. The exposed sites had less types of Ephemeroptera than the reference sites, but had more Plecopteran and Trichopteran taxa than the reference sites.

Based on the richness of the benthic communities the exposed sites are richer or similar to the reference sites.

Chironomids (midges) and Oligochaeta (aquatic earthworms) are generally considered to be more tolerant to poorer water quality conditions. The community at Blind Creek had five types of chironomids present, the highest in the study area. Very few Oligochaeta were identified in the study area with equal number of taxa in the exposed and reference areas.

Although the method of collecting invertebrates using a kick net is not really quantifiable since an unknown area of substrate is sampled per site and can vary between sites, the total number of organisms identified per site has nonetheless been indicated (Table 7). Abundance ranged from 639 individuals at V8 to 33,240 individuals at X2. The abundance of EPT has also been included. To put this into perspective the proportion of EPT at each community has been calculated.

TABLE 7	ABUNDANCE MEASURES FOR FARO BENTHIC INVERTEBRATES, 2010				
	Site:	**Abundance**	**EPT Abundance**	**% of EPT**	**% Chironomidae**
EXPOSED SITES	X2	33240	2380	7.2	89.4
	R2	11960	460	3.8	86.8
	R4	1281	1111	86.7	4.9
	VGMAIN	4110	3457	84.1	11.0
	V5	1402	903	64.4	13.3
	V8	639	405	63.4	28.8
REFERENCE SITES	R6	4030	1991	49.4	45.6
	R7	7620	1180	15.5	82.2
	FC	15200	4550	29.9	60.9
	USFR	2934	2198	74.9	20.4
	VR	2034	1676	82.4	5.7
	BLC	1459	234	16.0	68.3
	BUC	3350	1380	41.2	48.1
	HOR	641	491	76.6	11.1

Interestingly, two exposed sites had the greatest proportion of EPT in their communities, R4 and VGMAIN (86.7% and 84.1% respectively). The other exposed sites on Vangorda Creek, V5 and V8, also had high representation of EPT at 64.4% and 63.4% respectively. On the other hand, the remaining two exposed sites on Rose Creek, X2 and R2, had the lowest proportion of EPT in their benthic communities (7.2% and 3.8% respectively). Based on the abundance of chemical sensitive invertebrates it appears that the communities at R2 and X2 may be stressed. However, some of the reference sites also had low percentage of EPT; R7, BLC and FC.

Chironomids occur in most types of aquatic ecosystem and the range of conditions under which they are found is more extensive than that of any other group of aquatic insects (Merrit and Cummins, 1984). Benthic surveys of small unpolluted streams in North America, Europe and Great Britain indicate that chironomids comprise no more than 20% of the total insect community of riffle habitats in which the rock substrate is free of filamentous algae or aquatic mosses (Winner et al, 1980). The proportion of chironomids in the benthic population at each site has been calculated and is included in Table 7. Chironomids formed less than 20% of the communities at the exposed sites R4, VGMAIN and V5, and at the reference sties VR, Horton Creek and USFR. Higher representation of chironomids may be partially explained at R2, R7 and Blind Creek by the fact that actual riffle habitats are not prevalent at these sites.

Table 8 shows dominance measures at each site, indicating the first, second and third most

abundant invertebrates per site. *Baetis sp*. of the order Ephemeroptera, was the first dominant taxa at R4, VGMAIN, V5, V8, R6 and USFR. Mayflies are sensitive to metals in the aquatic environment and a study using mesocosms to determine the effects of concentrations of copper and zinc on benthic invertebrates in a pristine stream, documented *Baetis sp* as being the taxon showing the greatest response. They emigrated in greater abundance and at a greater rate following exposure than other invertebrates including other genera of Ephemeroptera, indicating that they were most sensitive to increases in metal concentrations (Richardson and Kiffney, 2000). *Baetis sp* was the second dominant taxon at Horton Creek and the third dominant taxon at X2. Their dominance and subdominance at these sites implies that the habitat conditions here are generally in a healthy state for the support of lotic organisms. *Baetis sp.* was the third most abundant organism throughout the study area forming 7.5% of all invertebrates collected.

Micropsectra sp. a Dipteran chironomid, was the first dominant taxa at X2, R2, R7 and FC. R2 was heavily dominated by *Microspectra sp.* where it formed 79.4% of the population. *Microspectra sp*. are indicative of nutrient-poor water (phosphate and orthophosphate levels were very low, see Appendix A) that is well buffered (alkalinity was 98 mg/L as $CaCO_3$) (Johnson et al, 1993). They were the third dominant taxon at R6 and USFR. *Microspectra sp.* was the most abundant organism collected in the study area comprising 39.6% of the total invertebrates collected.

Heptageniidae, a family of Ephemeroptera was the dominant taxon at Horton Creek. VR and Buttle Creek were dominated by Capniidae and Zapada sp. respectively, members of Plecoptera (stoneflies). The community at Blind Creek was dominated by Rheosmittia sp. a member of Chironomidae of the order Diptera. Mayflies, stoneflies and Diptera were second and third dominant groups at many of the sites. Of note, Ostracoda (seed shrimps) were the second dominant taxa at R2. Ostracods are found in all types of aquatic habitat, generally with sandy or muddy substrates (Pennak 1989). The substrate at R2 is fairly fine composed of sand and small gravels. Naididae, a family of Oligochaeta, was the third dominant group at VR.

Several indices were also examined in attempts to further characterize the benthic populations at the exposed and reference sites (Table 9). The Shannon-Weaver index indicates how evenly distributed the taxa are within a population. A perfectly homogeneous population would have a score of zero indicating that there is only one type of organism present. A perfectly heterogeneous population would have a score of 1 where all of the taxa in the population would be equally represented. The scores ranged from 0.01 at R2, which was heavily dominated by one taxon, *Microspectra sp*. (see Table 8), to 0.44 at Blind Creek and V5.

TABLE 8 **DOMINANCE MEASURES AT THE EXPOSED AND REFERENCE SITES, FARO MINE COMPLEX, 2010**

	Site:	Total Abundance per Site	1st Dominant Taxon	Taxon belongs to Order:	1st Dominant Abundance	% 1 Dominant Taxon	2nd Dominant Taxon	Taxon belongs to Order:	2nd Dominant Abundance	% 2 Dominant Taxa	3rd Dominant Taxon	Taxon belongs to Order:	3rd Dominant Abundance	% 3 Dominant Taxa
EXPOSED	X2	33240	Micropsectra sp.	Diptera (Chir)	15000	45.13%	Tvetenia sp.	Diptera (Chir)	14000	42.12%	Baetis sp.	Ephemeroptera	1260	3.79%
	R2	11960	Micropsectra sp.	Diptera (Chir)	9500	79.43%	Ostracoda	*	400	3.34%	Pagastia sp.	Diptera (Chir)	400	3.34%
	R4	1281	Baetis sp.	Ephemeroptera	430	33.57%	Heptageniidae	Ephemeroptera	356	27.79%	Ephemerellidae	Ephemeroptera	67	5.23%
	VGMAIN	4110	Baetis sp.	Ephemeroptera	1238	30.12%	Zapada sp.	Plecoptera	888	21.61%	Capniidae	Plecoptera	375	9.12%
	V5	1402	Baetis sp.	Ephemeroptera	217	15.48%	Prosimulium sp.	Diptera (Sim)	191	13.62%	Diamesa sp.	Ephemeroptera	148	10.56%
	V8	639	Baetis sp.	Ephemeroptera	118	18.47%	Orthocladius sp.	Diptera (Chir)	88	13.77%	Diamesa sp.	Diptera (Chir)	84	13.15%
REFERENCE	R6	4030	Baetis sp.	Ephemeroptera	1313	32.58%	Orthocladius sp.	Diptera (Chir)	1300	32.26%	Micropsectra sp.	Diptera (Chir)	500	12.41%
	R7	7620	Micropsectra sp.	Diptera (Chir)	4200	55.12%	Orthocladius sp.	Diptera (Chir)	1780	23.36%	Ephemerellidae	Ephemeroptera	320	4.20%
	FC	15200	Micropsectra sp.	Diptera (Chir)	5700	37.50%	Cardiocladius sp.	Diptera (Chir)	3200	21.05%	Zapada sp.	Plecoptera	2100	13.82%
	USFR	2934	Baetis sp.	Ephemeroptera	973	33.16%	Zapada sp.	Plecoptera	418	14.25%	Micropsectra sp.	Diptera (Chir)	373	12.71%
	VR	2034	Capniidae	Plecoptera	637	31.32%	Heptageniidae	Ephemeroptera	274	13.47%	Naididae	Haplotaxida	195	9.59%
	Blind Creek	1459	Rheosmittia sp.	Diptera (Chir)	282	19.33%	Saetheria sp.	Diptera (Chir)	168	11.51%	Hydrobaenus sp.	Diptera (Chir)	159	10.90%
	Buttle Creek	3350	Zapada sp.	Plecoptera	610	18.21%	Zavrelia sp.	Diptera (Chir)	450	13.43%	Stempellinella sp.	Diptera (Chir)	370	11.04%
	Horton Creek	641	Heptageniidae	Ephemeroptera	106	16.54%	Baetis sp.	Ephemeroptera	90	14.04%	Taeniopterygidae	Plecoptera	78	12.17%

* Ostracoda is actually a Class of the Subphylum Crustacea, and the organisims could not be identified any lower than Class.
(Chir) = Chironomidae (Sim) = Simuliidae

TABLE 9 DIVERSITY AND WATER QUALITY INDICES				
	Site:	**Shannon-Weaver H' (log 10)**	**Hilsenhoff Biotic Index**	**Water Quality Type**
EXPOSED SITES	X2	0.12	5.80	Fairly Poor
	R2	0.01	6.55	Poor
	R4	0.35	2.34	Excellent
	VGMAIN	0.39	2.75	Excellent
	V5	0.44	2.81	Excellent
	V8	0.42	3.30	Excellent
REFERENCE SITES	R6	0.30	4.86	Good
	R7	0.17	5.62	Fair
	FC	0.31	4.69	Good
	VR	0.39	1.66	Excellent
	USFR	0.39	3.72	Excellent
	Blind Creek	0.44	3.44	Excellent
	Buttle Creek	0.43	4.11	Very Good
	Horton Creek	0.41	2.27	Excellent

In addition, the Hilsenhoff Biotic Index was calculated which is based on the various tolerances of individual taxa to indicate the quality of water at each community (Table 9). The classification of the biotic index versus water quality is indicated in Table 10 below, taken from Hauer and Lamberti, 2006.

TABLE 10 WATER QUALITY BASED ON BIOTIC INDEX VALUES	
Hilsenhoff Biotic Index	**Water Quality**
0.00 to 3.75	Excellent
3.76 to 4.25	Very good
4.26 to 5.00	Good
5.01 to 5.75	Fair
5.76 to 6.50	Fairly poor
6.51 to 7.25	Poor
7.26 to 10.00	Very Poor

Based on the biotic index, the water quality at R2 is poor, at X2 is fairly poor, fair at R7, good at R6 and FC, very good at Buttle Creek and excellent at the rest of the sites, which includes four of the exposed sites.

A summary of selected parameters for the exposed sites are tabulated in Table 11. This table indicates that the ecological settings at the exposed sites R4, VGMAIN, V5 and V8 are in a healthy state at this point in time. However the environment at X2 and R2 appears to be somewhat compromised.

TABLE 11	SUMMARY OF SELECTED ATTRIBUTES				
Site	**EPT Richness**	**% of EPT**	**% Chironomidae**	**1st Dominant Taxon**	**Water Quality Type**
X2	14	7.2	89.4	Micropsectra sp.	Fairly Poor
R2	6	3.8	86.8	Micropsectra sp.	Poor
R4	20	86.7	4.9	Baetis sp.	Excellent
VGMAIN	21	84.1	11.0	Baetis sp.	Excellent
V5	18	64.4	13.3	Baetis sp.	Excellent
V8	21	63.4	28.8	Baetis sp.	Excellent

4.3.1 Comparisons with Past Data

Numerous biological monitoring surveys have been undertaken on the Rose and Vangorda watersheds over the decades as a component of the various water licenses. The collection methodology for these studies was the use of “artificial” substrate samplers. The substrate used in these samplers actually consisted of the indigenous substrate present at the site and generally was composed of large gravels and small cobbles. As an entirely different collection approach was used for the 2010 study, realistic comparisons can not be made with any of the historic data. While Minnow was developing the LTMP they experimented with the use of Hess samplers along side the use of artificial substrate samplers at the Vangorda sites in 2007 and included the kick net method as well, at the Rose Creek sites in 2008 (Minnow 2009). Several of these sites coincide with the sites examined in 2010 and some of this data is examined in Table 12. During the sampling program in 2008, Minnow collected replicates at some of the sites. The number of replicates is indicated in brackets following the data in each cell for 2008. Only one replicate was collected during the other surveys.

Environment Canada conducts benthic invertebrate sampling throughout the Yukon and a few of the reference sites had been sampled using the kick and sweep method. Specifically, as a component of the Yukon Benthic Invertebrate Reference Site Program, Horton Creek was sampled in 2000. Samples were also collected from Horton Creek in 2007 as part of a baseline selenium project. Benthic invertebrates were collected from Buttle Creek in 2009 as part of the Yukon Placer Secretariat Project. These data have also been included in Table 12.

TABLE 12	**COMPARISONS WITH PAST KICK & SWEEP DATA**					
Year Sampled		2010 (1)	2009 (2)	2008 (n)	2007 (1)	2000 (1)
X2	Abundance	33240		2192 (3)		
	%EPT	7.2		20.8 (3)		
R2	Abundance	11960		511 (3)		
	%EPT	3.8		68.8 (3)		
R7	Abundance	7620		1238 (2)		
	%EPT	15.5		41.9 (2)		
FC	Abundance	15200		610 (1)		
	%EPT	29.9		42.6 (1)		
USFR	Abundance	2934		1970 (1)		
	%EPT	74.9		74.9 (1)		
VR	Abundance	2034		502 (1)		
	%EPT	82.4		62.4 (1)		
BLC	Abundance	1459		604 (3)		
	%EPT	16.0		54.8 (3)		
BUC	Abundance	3350	301	1865 (1)		
	%EPT	41.2	28.2	85.5 (1)		
HOR	Abundance	641		102 (1)	188	25
	%EPT	76.6		70.6 (1)	74.5	48.0

Due to the limited data available, no trends or conclusions can be drawn from this data set. It should be noted that a partial explanation for the lower numbers documented at most of the sties in 2008 may have been influenced by the weather conditions encountered during late summer in 2008. Very high rainfall events produced high stage in the streams in the area, often exceeding the discharges measured at freshet in 2008 (Burns, 2009). This can create scour of the streambed displacing organisms in the process.

5.0 RECOMMENDATIONS

Water quality samples should be collected during benthic invertebrate sampling programs. The data should be examined along with the CCME guidelines for the protection of freshwater aquatic life and with the water quality benchmarks established by Minnow.

As an assessment tool for the biological monitoring program, it is recommended that stream sediment samples be collected during future benthic invertebrate surveys. Metals in mine effluent as well as in any leachate can precipitate in receiving streams or become adsorbed onto sediment of the substrate. Eventually, sediment-bound metals can be released into surrounding water because of bioturbation or resuspension, and assimilated by organisms (Faria et al, 2007). Organisms may also assimilate contaminants directly from the sediments. Some evidence suggests that uptake rates of metals may be higher from sediments than from the water column (Richardson and Kiffney, 2000). Since benthic invertebrates are in close and direct contact with the stream sediments, it is important to analyze that component of their habitat as well.

Minnow has recommended the use of the Reference Condition Approach (RCA) as a stream assessment tool for monitoring the health of the receiving waters at the Faro Mine Complex. For this approach to be truly effective, a significant increase in the number of reference sites is required to strengthen the statistical power of the various analyses. RCA stream sampling was initiated in the Yukon in the early 1990s. In 2006, a decision was made to use RCA to monitor watershed health under the new Fish Habitat Management system for Yukon Placer Mining. An initial Yukon RCA model and Yukon stream data was uploaded to CABIN in 2006 (Thompson and Bailey, 2010). Since then the model has been revised twice and currently there are 258 reference sites in the data base. It is recommended that arrangements be made to access the Yukon RCA model to determine appropriate reference sites for the exposed sites at the Faro Mine Complex. The model uses habitat variables to predict each test site to a reference group with a certain probability. The reference group which receives the highest probability is the group of reference sites to be used for the assessment of the test site. A sub set of this group could be sampled when the exposed sites are sampled during the next benthic invertebrate monitoring program, however, the data from all of the reference sites in the group would be used to assess the test sites. In addition, the data from the reference sites sampled in the 2010 and 2008 studies should be added to the Yukon CABIN data base.

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APPENDIX A

WATER QUALITY ANALYTICAL REPORT, 2010

Your Project #: FARO BENTHICS
Your C.O.C. #: 08322000, 08322001

Attention: Bonnie Burns
LABERGE ENVIRONMENTAL SERVICES
WHITEHORSE
405 Ogilvie Street
PO Box 21072
Whitehorse, YT
CANADA Y1A 6P7

Report Date: 2010/09/17

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B081318
Received: 2010/09/07, 09:59

Sample Matrix: Water
Samples Received: 16

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Alkalinity - Water	15	2010/09/08	2010/09/08	BRN SOP-00264 R4.0	Based on SM2320B
Alkalinity - Water	1	2010/09/08	2010/09/09	BRN SOP-00264 R4.0	Based on SM2320B
Chloride by Automated Colourimetry	16	N/A	2010/09/10	BRN-SOP 00234 R3.0	Based on EPA 325.2
Conductance - water	15	N/A	2010/09/08	BRN SOP-00264 R2.0	Based on SM-2510B
Conductance - water	1	N/A	2010/09/09	BRN SOP-00264 R2.0	Based on SM-2510B
Hardness Total (calculated as CaCO3)	16	N/A	2010/09/14		
Hardness (calculated as CaCO3)	16	N/A	2010/09/14		
Na, K, Ca, Mg, S by CRC ICPMS (diss.)	16	N/A	2010/09/14	BRN SOP-00206	Based on EPA 200.8
Elements by ICPMS Low Level (dissolved)	16	N/A	2010/09/14	BRN SOP-00206	Based on EPA 200.8
Na, K, Ca, Mg, S by CRC ICPMS (total)	16	N/A	2010/09/14	BRN SOP-00206	Based on EPA 200.8
Elements by ICPMS Low Level (total)	12	N/A	2010/09/13	BRN SOP-00206	Based on EPA 200.8
Elements by ICPMS Low Level (total)	4	N/A	2010/09/14	BRN SOP-00206	Based on EPA 200.8
Ammonia-N	16	N/A	2010/09/08	BBY6SOP-00044	Based on EPA 350.1
Nitrate + Nitrite (N)	16	N/A	2010/09/10		Based on USEPA 353.2
Nitrite (N) by CFA	16	N/A	2010/09/10	BRN SOP-00233 R1.0	EPA 353.2
Nitrogen - Nitrate (as N)	16	N/A	2010/09/12	BBY6SOP-00010	Based on EPA 353.2
Filter and HNO3 Preserve for Metals	16	N/A	2010/09/07	BRN WI-00006 R1.0	Based on EPA 200.2
pH Water	15	N/A	2010/09/08	BRN SOP-00264 R4.0	Based on SM-4500H+B
pH Water	1	N/A	2010/09/09	BRN SOP-00264 R4.0	Based on SM-4500H+B
Orthophosphate by Konelab	16	N/A	2010/09/08	BRN SOP-00235 R5.0	SM 4500 P F
Sulphate by Automated Colourimetry	14	N/A	2010/09/10	BRN-SOP 00243 R1.0	Based on EPA 375.4
Sulphate by Automated Colourimetry	1	N/A	2010/09/13	BRN-SOP 00243 R1.0	Based on EPA 375.4
Sulphate by Automated Colourimetry	1	N/A	2010/09/16	BRN-SOP 00243 R1.0	Based on EPA 375.4
Total Dissolved Solids (Filt. Residue)	16	N/A	2010/09/11	BRN SOP 00276 R4.0	SM 2540C
Carbon (Total Organic)	16	N/A	2010/09/09	BRN SOP-00224 R4.0	Based on SM-5310C
Total Phosphorus	16	N/A	2010/09/08	BRN SOP-00236 R4.0	SM 4500
Total Suspended Solids-LowLevel	16	N/A	2010/09/09	BRN SOP-00277 R5.0	Based on SM-2540 D

* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

../2

Your Project #: FARO BENTHICS
Your C.O.C. #: 08322000, 08322001

Attention: Bonnie Burns
LABERGE ENVIRONMENTAL SERVICES
WHITEHORSE
405 Ogilvie Street
PO Box 21072
Whitehorse, YT
CANADA Y1A 6P7

Report Date: 2010/09/17

CERTIFICATE OF ANALYSIS

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.

ASHLEY NIVISON, BBY Customer Service
Email: ashley.nivison@maxxamanalytics.com
Phone# (604) 639-2616 Ext:230

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Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

LABERGE ENVIRONMENTAL SERVICES
Client Project #: FARO BENTHICS

Maxxam Job #: B081318
Report Date: 2010/09/17

RESULTS OF CHEMICAL ANALYSES OF WATER

Maxxam ID		W77418		W77419	W77420		
Sampling Date		2010/08/31 17:30		2010/09/02 11:30	2010/09/01 14:30		
COC Number		08322000		08322000	08322000		
	Units	**X2 NORTH FORK ROSE CREEK**	**QC Batch**	**R2 ROSE CREEK D/S TAILINGS**	**R4 ROSE CREEK U/S ANVIL CR**	**RDL**	**QC Batch**
ANIONS							
Nitrite (N)	mg/L	<0.005 (1)	4251207	<0.005 (1)	<0.005 (1)	0.005	4251207
Calculated Parameters							
Filter and HNO3 Preservation	N/A	FIELD	ONSITE	FIELD	FIELD	N/A	ONSITE
Nitrate (N)	mg/L	0.04	4237944	0.06	0.11	0.02	4237944
Misc. Inorganics							
Alkalinity (Total as CaCO3)	mg/L	88	4244216	98	100	0.5	4244216
Total Organic Carbon (C)	mg/L	2.1	4245026	2.2	2.2	0.5	4245026
Alkalinity (PP as CaCO3)	mg/L	<0.5	4244216	<0.5	<0.5	0.5	4244216
Bicarbonate (HCO3)	mg/L	110	4244216	120	120	0.5	4244216
Carbonate (CO3)	mg/L	<0.5	4244216	<0.5	<0.5	0.5	4244216
Hydroxide (OH)	mg/L	<0.5	4244216	<0.5	<0.5	0.5	4244216
Anions							
Orthophosphate (P)	mg/L	0.001	4241094	0.002	0.001	0.001	4241094
Dissolved Sulphate (SO4)	mg/L	16	4256465	170	170	0.5	4253935
Dissolved Chloride (Cl)	mg/L	<0.5	4252526	<0.5	<0.5	0.5	4252526
Nutrients							
Ammonia (N)	mg/L	0.008	4242697	0.13	0.030	0.005	4242697
Nitrate plus Nitrite (N)	mg/L	0.04 (1)	4250958	0.06 (1)	0.11 (1)	0.02	4250958
Total Phosphorus (P)	mg/L	0.005	4241087	0.004	0.003	0.002	4241087
Physical Properties							
Conductivity	uS/cm	201	4244215	541	490	1	4244215
pH	pH Units	8.06	4244213	8.08	8.16		4244213
Physical Properties							
Total Suspended Solids	mg/L	<1	4242670	<1	1	1	4242670
Total Dissolved Solids	mg/L	110	4247638	370	340	10	4247638

RDL = Reportable Detection Limit
(1) Samples arrived to laboratory past recommended hold time.

LABERGE ENVIRONMENTAL SERVICES
Client Project #: FARO BENTHICS

Maxxam Job #: B081318
Report Date: 2010/09/17

RESULTS OF CHEMICAL ANALYSES OF WATER

Maxxam ID		W77421		W77422	W77423	W77424		
Sampling Date		2010/09/01 08:30		2010/09/02 16:50	2010/09/01 10:30	2010/08/30 14:00		
COC Number		08322000		08322000	08322000	08322000		
	Units	**VGMAIN EAST FORK VANGORDA CR**	**QC Batch**	**V5 WEST FORK VANGORDA CR**	**V8 VANGORDA CREEK D/S FARO**	**HORTON CREEK**	**RDL**	**QC Batch**
ANIONS								
Nitrite (N)	mg/L	<0.005 (1)	4251207	<0.005 (1)	<0.005 (1)	<0.005 (1)	0.005	4251207
Calculated Parameters								
Filter and HNO3 Preservation	N/A	FIELD	ONSITE	FIELD	FIELD	FIELD	N/A	ONSITE
Nitrate (N)	mg/L	0.24	4237944	<0.02	0.16	0.02	0.02	4237944
Misc. Inorganics								
Alkalinity (Total as CaCO3)	mg/L	110	4244216	190	140	270	0.5	4244216
Total Organic Carbon (C)	mg/L	2.3	4245026	4.3	2.9	3.7	0.5	4245026
Alkalinity (PP as CaCO3)	mg/L	<0.5	4244216	3.2	<0.5	7.1	0.5	4244216
Bicarbonate (HCO3)	mg/L	130	4244216	220	170	310	0.5	4244216
Carbonate (CO3)	mg/L	<0.5	4244216	3.9	<0.5	8.5	0.5	4244216
Hydroxide (OH)	mg/L	<0.5	4244216	<0.5	<0.5	<0.5	0.5	4244216
Anions								
Orthophosphate (P)	mg/L	0.001	4241094	0.001	0.001	0.001	0.001	4241094
Dissolved Sulphate (SO4)	mg/L	100	4267798	81	100	89	0.5	4253935
Dissolved Chloride (Cl)	mg/L	<0.5	4252526	0.6	<0.5	<0.5	0.5	4252526
Nutrients								
Ammonia (N)	mg/L	<0.005	4242697	<0.005	<0.005	<0.005	0.005	4242697
Nitrate plus Nitrite (N)	mg/L	0.24 (1)	4250958	<0.02 (1)	0.16 (1)	0.02 (1)	0.02	4250958
Total Phosphorus (P)	mg/L	0.003	4241087	0.003	0.004	0.003	0.002	4241087
Physical Properties								
Conductivity	uS/cm	407	4244215	496	446	620	1	4244215
pH	pH Units	8.20	4244213	8.36	8.29	8.45		4244213
Physical Properties								
Total Suspended Solids	mg/L	<1	4242670	15	1	1	1	4242670
Total Dissolved Solids	mg/L	270	4247638	340	310	380	10	4247638

RDL = Reportable Detection Limit
(1) Samples arrived to laboratory past recommended hold time.

LABERGE ENVIRONMENTAL SERVICES
Client Project #: FARO BENTHICS

Maxxam Job #: B081318
Report Date: 2010/09/17

RESULTS OF CHEMICAL ANALYSES OF WATER

Maxxam ID		W77425	W77426	W77427	W77428		
Sampling Date		2010/09/03 09:30	2010/09/02 14:45	2010/08/31 10:00	2010/08/31 12:15		
COC Number		08322000	08322000	08322000	08322000		
	Units	**BUTTLE CREEK**	**BLIND CREEK**	**R7 NORTH FORK ROSE CREEK**	**USFR UPPER SOUTH FORK VANGORDA CREEK**	**RDL**	**QC Batch**
ANIONS							
Nitrite (N)	mg/L	<0.005 (1)	<0.005 (1)	<0.005 (1)	<0.005 (1)	0.005	4251207
Calculated Parameters							
Filter and HNO3 Preservation	N/A	FIELD	FIELD	FIELD	FIELD	N/A	ONSITE
Nitrate (N)	mg/L	0.15	<0.02	<0.02	<0.02	0.02	4237944
Misc. Inorganics							
Alkalinity (Total as CaCO3)	mg/L	220	74	85	24	0.5	4244216
Total Organic Carbon (C)	mg/L	3.8	3.2	1.9	1.8	0.5	4245026
Alkalinity (PP as CaCO3)	mg/L	1.8	<0.5	<0.5	<0.5	0.5	4244216
Bicarbonate (HCO3)	mg/L	260	90	100	30	0.5	4244216
Carbonate (CO3)	mg/L	2.1	<0.5	<0.5	<0.5	0.5	4244216
Hydroxide (OH)	mg/L	<0.5	<0.5	<0.5	<0.5	0.5	4244216
Anions							
Orthophosphate (P)	mg/L	0.002	0.002	0.002	0.001	0.001	4241094
Dissolved Sulphate (SO4)	mg/L	47	14	6.9	5.5	0.5	4253935
Dissolved Chloride (Cl)	mg/L	<0.5	<0.5	<0.5	<0.5	0.5	4252526
Nutrients							
Ammonia (N)	mg/L	<0.005	<0.005	<0.005	<0.005	0.005	4242697
Nitrate plus Nitrite (N)	mg/L	0.15 (1)	<0.02 (1)	<0.02 (1)	<0.02 (1)	0.02	4250958
Total Phosphorus (P)	mg/L	0.004	0.005	0.004	0.005	0.002	4241087
Physical Properties							
Conductivity	uS/cm	479	174	176	61	1	4244215
pH	pH Units	8.32	8.00	8.02	7.56		4244213
Physical Properties							
Total Suspended Solids	mg/L	<1	<1	<1	<1	1	4242670
Total Dissolved Solids	mg/L	300	110	120	56	10	4247638

RDL = Reportable Detection Limit
(1) Samples arrived to laboratory past recommended hold time.

LABERGE ENVIRONMENTAL SERVICES
Client Project #: FARO BENTHICS

Maxxam Job #: B081318
Report Date: 2010/09/17

RESULTS OF CHEMICAL ANALYSES OF WATER

Maxxam ID		W77429	W77507	W77508	W77509	W77510		
Sampling Date		2010/09/02 09:30	2010/08/31 15:30	2010/09/01 13:00	2010/09/02	2010/09/03		
COC Number		08322000	08322001	08322001	08322001	08322001		
	Units	**VR UPPER WEST FORK VANGORDA CREEK**	**FC UPPER FARO CREEK**	**R6 ANVIL CR U/S ROSE CREEK**	**BD BLIND DUPLICATE**	**FB FIELD BLANK**	**RDL**	**QC Batch**
ANIONS								
Nitrite (N)	mg/L	<0.005 (1)	<0.005 (1)	<0.005 (1)	<0.005 (1)	<0.005 (1)	0.005	4251207
Calculated Parameters								
Filter and HNO3 Preservation	N/A	FIELD	FIELD	FIELD	FIELD	FIELD	N/A	ONSITE
Nitrate (N)	mg/L	<0.02	<0.02	0.05	<0.02	<0.02	0.02	4237944
Misc. Inorganics								
Alkalinity (Total as CaCO3)	mg/L	33	21	130	180	1.0	0.5	4244216
Total Organic Carbon (C)	mg/L	2.1	2.7	2.7	3.4	<0.5	0.5	4245026
Alkalinity (PP as CaCO3)	mg/L	<0.5	<0.5	<0.5	3.0	<0.5	0.5	4244216
Bicarbonate (HCO3)	mg/L	40	25	160	220	1.3	0.5	4244216
Carbonate (CO3)	mg/L	<0.5	<0.5	<0.5	3.6	<0.5	0.5	4244216
Hydroxide (OH)	mg/L	<0.5	<0.5	<0.5	<0.5	<0.5	0.5	4244216
Anions								
Orthophosphate (P)	mg/L	0.001	0.001	0.002	0.001	<0.001	0.001	4241094
Dissolved Sulphate (SO4)	mg/L	5.8	1.6	21	81	<0.5	0.5	4253935
Dissolved Chloride (Cl)	mg/L	<0.5	<0.5	<0.5	0.9	<0.5	0.5	4252526
Nutrients								
Ammonia (N)	mg/L	<0.005	<0.005	<0.005	<0.005	0.008	0.005	4242697
Nitrate plus Nitrite (N)	mg/L	<0.02 (1)	<0.02 (1)	0.05 (1)	<0.02 (1)	<0.02 (1)	0.02	4250958
Total Phosphorus (P)	mg/L	0.004	0.004	0.005	0.004	<0.002	0.002	4241087
Physical Properties								
Conductivity	uS/cm	75	42	297	487	2	1	4244215
pH	pH Units	7.67	7.46	8.29	8.36	5.93		4244213
Physical Properties								
Total Suspended Solids	mg/L	<1	<1	<1	17	<1	1	4242670
Total Dissolved Solids	mg/L	56	40	170	290	<10	10	4247638

RDL = Reportable Detection Limit
(1) Samples arrived to laboratory past recommended hold time.

Maxxam Job #: B081318
Report Date: 2010/09/17

LABERGE ENVIRONMENTAL SERVICES
Client Project #: FARO BENTHICS

LOW LEVEL DISSOLVED METALS IN WATER (WATER)

Maxxam ID		W77418		W77419	W77420		
Sampling Date		2010/08/31 17:30		2010/09/02 11:30	2010/09/01 14:30		
COC Number		08322000		08322000	08322000		
	Units	**X2 NORTH FORK ROSE CREEK**	**QC Batch**	**R2 ROSE CREEK D/S TAILINGS**	**R4 ROSE CREEK U/S ANVIL CR**	**RDL**	**QC Batch**
Misc. Inorganics							
Dissolved Hardness (CaCO3)	mg/L	94.0	4238668	253	235 (1)	0.5	4238668
Dissolved Metals by ICPMS							
Dissolved Aluminum (Al)	ug/L	5.1	4256011	3.3	3.1	0.2	4256011
Dissolved Antimony (Sb)	ug/L	0.07	4256011	0.09	0.10	0.02	4256011
Dissolved Arsenic (As)	ug/L	0.62	4256011	0.39	0.26	0.02	4256011
Dissolved Barium (Ba)	ug/L	49.6	4256011	43.9	61.2	0.02	4256011
Dissolved Beryllium (Be)	ug/L	<0.01	4256011	<0.01	<0.01	0.01	4256011
Dissolved Bismuth (Bi)	ug/L	<0.005	4256011	<0.005	<0.005	0.005	4256011
Dissolved Boron (B)	ug/L	<50	4256011	<50	<50	50	4256011
Dissolved Cadmium (Cd)	ug/L	0.005	4256011	0.038	0.020	0.005	4256011
Dissolved Chromium (Cr)	ug/L	<0.1	4256011	<0.1	0.1	0.1	4256011
Dissolved Cobalt (Co)	ug/L	0.094	4256011	2.49	0.724	0.005	4256011
Dissolved Copper (Cu)	ug/L	0.45	4256011	0.40	0.48	0.05	4256011
Dissolved Iron (Fe)	ug/L	126	4256011	198	52	1	4256011
Dissolved Lead (Pb)	ug/L	0.116	4256011	0.042	0.024	0.005	4256011
Dissolved Lithium (Li)	ug/L	4.1	4256011	8.4	6.8	0.5	4256011
Dissolved Manganese (Mn)	ug/L	34.6	4256011	1690	739	0.05	4256011
Dissolved Molybdenum (Mo)	ug/L	0.56	4256011	0.50	0.59	0.05	4256011
Dissolved Nickel (Ni)	ug/L	0.53	4256011	3.94	1.87	0.02	4256011
Dissolved Selenium (Se)	ug/L	0.24	4263052	0.20	0.44	0.04	4256011
Dissolved Silicon (Si)	ug/L	4650	4263052	3700	3700 (1)	100	4256011
Dissolved Silver (Ag)	ug/L	<0.005	4256011	<0.005	<0.005	0.005	4256011
Dissolved Strontium (Sr)	ug/L	122	4256011	273	247	0.05	4256011
Dissolved Thallium (Tl)	ug/L	0.003	4256011	0.091	0.035	0.002	4256011
Dissolved Tin (Sn)	ug/L	<0.01	4256011	<0.01	<0.01	0.01	4256011
Dissolved Titanium (Ti)	ug/L	<0.5	4256011	<0.5	<0.5	0.5	4256011
Dissolved Uranium (U)	ug/L	1.07	4256011	1.41	1.37	0.002	4256011
Dissolved Vanadium (V)	ug/L	<0.2	4256011	<0.2	<0.2	0.2	4256011
Dissolved Zinc (Zn)	ug/L	8.4	4256011	41.6	14.4	0.1	4256011
Dissolved Zirconium (Zr)	ug/L	<0.1	4256011	<0.1	<0.1	0.1	4256011

RDL = Reportable Detection Limit
(1) Dissolved greater than total. Reanalysis yields similar results

LABERGE ENVIRONMENTAL SERVICES
Client Project #: FARO BENTHICS

Maxxam Job #: B081318
Report Date: 2010/09/17

LOW LEVEL DISSOLVED METALS IN WATER (WATER)

Maxxam ID		W77418		W77419	W77420		
Sampling Date		2010/08/31 17:30		2010/09/02 11:30	2010/09/01 14:30		
COC Number		08322000		08322000	08322000		
	Units	**X2 NORTH FORK ROSE CREEK**	**QC Batch**	**R2 ROSE CREEK D/S TAILINGS**	**R4 ROSE CREEK U/S ANVIL CR**	**RDL**	**QC Batch**
Dissolved Calcium (Ca)	mg/L	27.6	4260271	73.8	69.6 (1)	0.05	4240748
Dissolved Magnesium (Mg)	mg/L	6.07	4240748	16.7	15.0	0.05	4240748
Dissolved Potassium (K)	mg/L	0.64	4240748	1.65	1.56	0.05	4240748
Dissolved Sodium (Na)	mg/L	2.22	4240748	5.51	4.69	0.05	4240748
Dissolved Sulphur (S)	mg/L	<10	4240748	66	54	10	4240748

RDL = Reportable Detection Limit
(1) Dissolved greater than total. Reanalysis yields similar results

LABERGE ENVIRONMENTAL SERVICES
Client Project #: FARO BENTHICS

Maxxam Job #: B081318
Report Date: 2010/09/17

LOW LEVEL DISSOLVED METALS IN WATER (WATER)

Maxxam ID		W77421		W77422		W77423		
Sampling Date		2010/09/01 08:30		2010/09/02 16:50		2010/09/01 10:30		
COC Number		08322000		08322000		08322000		
	Units	**VGMAIN EAST FORK VANGORDA CR**	**QC Batch**	**V5 WEST FORK VANGORDA CR**	**QC Batch**	**V8 VANGORDA CREEK D/S FARO**	**RDL**	**QC Batch**
Misc. Inorganics								
Dissolved Hardness (CaCO3)	mg/L	192	4238668	259	4238668	225	0.5	4238668
Dissolved Metals by ICPMS								
Dissolved Aluminum (Al)	ug/L	4.5	4256011	4.3	4256011	3.9	0.2	4256011
Dissolved Antimony (Sb)	ug/L	0.11	4256011	0.10	4256011	0.12	0.02	4256011
Dissolved Arsenic (As)	ug/L	0.40	4256011	0.61	4256011	0.47	0.02	4256011
Dissolved Barium (Ba)	ug/L	44.2	4256011	63.0	4256011	50.0	0.02	4256011
Dissolved Beryllium (Be)	ug/L	<0.01	4256011	<0.01	4256011	<0.01	0.01	4256011
Dissolved Bismuth (Bi)	ug/L	<0.005	4256011	<0.005	4256011	<0.005	0.005	4256011
Dissolved Boron (B)	ug/L	<50	4256011	<50	4256011	<50	50	4256011
Dissolved Cadmium (Cd)	ug/L	0.042	4256011	0.024	4256011	0.028	0.005	4256011
Dissolved Chromium (Cr)	ug/L	<0.1	4256011	<0.1	4256011	<0.1	0.1	4256011
Dissolved Cobalt (Co)	ug/L	0.047	4256011	0.075	4256011	0.038	0.005	4256011
Dissolved Copper (Cu)	ug/L	0.58	4263052	0.63	4256011	0.71	0.05	4256011
Dissolved Iron (Fe)	ug/L	13	4256011	31	4256011	16	1	4256011
Dissolved Lead (Pb)	ug/L	0.019	4256011	0.018	4256011	0.015	0.005	4256011
Dissolved Lithium (Li)	ug/L	3.4	4256011	3.9	4256011	4.2	0.5	4256011
Dissolved Manganese (Mn)	ug/L	2.87	4256011	13.4	4256011	4.28	0.05	4256011
Dissolved Molybdenum (Mo)	ug/L	0.59	4256011	1.44 (1)	4263052	0.90	0.05	4256011
Dissolved Nickel (Ni)	ug/L	0.86	4256011	1.39	4256011	1.09	0.02	4256011
Dissolved Selenium (Se)	ug/L	0.30	4256011	0.98	4256011	0.55	0.04	4256011
Dissolved Silicon (Si)	ug/L	3640	4256011	4650	4256011	4020	100	4256011
Dissolved Silver (Ag)	ug/L	<0.005	4256011	<0.005	4256011	<0.005	0.005	4256011
Dissolved Strontium (Sr)	ug/L	194	4256011	249	4256011	223	0.05	4256011
Dissolved Thallium (Tl)	ug/L	0.011	4263052	<0.002	4256011	0.010	0.002	4256011
Dissolved Tin (Sn)	ug/L	<0.01	4256011	<0.01	4256011	<0.01	0.01	4256011
Dissolved Titanium (Ti)	ug/L	<0.5	4256011	<0.5	4256011	<0.5	0.5	4256011
Dissolved Uranium (U)	ug/L	3.43	4256011	3.37	4256011	3.64	0.002	4256011
Dissolved Vanadium (V)	ug/L	<0.2	4256011	<0.2	4256011	<0.2	0.2	4256011
Dissolved Zinc (Zn)	ug/L	10.6	4256011	1.3	4256011	7.2	0.1	4256011
Dissolved Zirconium (Zr)	ug/L	<0.1	4256011	<0.1	4256011	<0.1	0.1	4256011

RDL = Reportable Detection Limit
(1) Dissolved greater than total. Reanalysis yields similar results

Maxxam Job #: B081318
Report Date: 2010/09/17

LABERGE ENVIRONMENTAL SERVICES
Client Project #: FARO BENTHICS

LOW LEVEL DISSOLVED METALS IN WATER (WATER)

Maxxam ID		W77421		W77422		W77423		
Sampling Date		2010/09/01 08:30		2010/09/02 16:50		2010/09/01 10:30		
COC Number		08322000		08322000		08322000		
	Units	**VGMAIN EAST FORK VANGORDA CR**	**QC Batch**	**V5 WEST FORK VANGORDA CR**	**QC Batch**	**V8 VANGORDA CREEK D/S FARO**	**RDL**	**QC Batch**
Dissolved Calcium (Ca)	mg/L	46.0	4240748	63.2	4240748	52.4	0.05	4240748
Dissolved Magnesium (Mg)	mg/L	18.7	4240748	24.7	4240748	22.8	0.05	4240748
Dissolved Potassium (K)	mg/L	0.77	4240748	1.02	4240748	0.91	0.05	4240748
Dissolved Sodium (Na)	mg/L	2.91	4240748	3.47	4240748	3.36	0.05	4240748
Dissolved Sulphur (S)	mg/L	37	4240748	28	4240748	36	10	4240748

RDL = Reportable Detection Limit

Maxxam Job #: B081318
Report Date: 2010/09/17

LABERGE ENVIRONMENTAL SERVICES
Client Project #: FARO BENTHICS

LOW LEVEL DISSOLVED METALS IN WATER (WATER)

Maxxam ID		W77424	W77425		W77426	W77427		
Sampling Date		2010/08/30 14:00	2010/09/03 09:30		2010/09/02 14:45	2010/08/31 10:00		
COC Number		08322000	08322000		08322000	08322000		
	Units	**HORTON CREEK**	**BUTTLE CREEK**	**QC Batch**	**BLIND CREEK**	**R7 NORTH FORK ROSE CREEK**	**RDL**	**QC Batch**
Misc. Inorganics								
Dissolved Hardness (CaCO3)	mg/L	348	253	4238668	78.2	83.1	0.5	4238668
Dissolved Metals by ICPMS								
Dissolved Aluminum (Al)	ug/L	2.5	2.4	4256011	4.8	5.0	0.2	4256011
Dissolved Antimony (Sb)	ug/L	0.16	0.07	4256011	0.08	0.07	0.02	4256011
Dissolved Arsenic (As)	ug/L	0.50	0.25	4256011	0.58	0.62	0.02	4256011
Dissolved Barium (Ba)	ug/L	79.6	92.6	4256011	58.6	48.4	0.02	4256011
Dissolved Beryllium (Be)	ug/L	<0.01	<0.01	4256011	<0.01	<0.01	0.01	4256011
Dissolved Bismuth (Bi)	ug/L	<0.005	<0.005	4256011	<0.005	<0.005	0.005	4256011
Dissolved Boron (B)	ug/L	<50	<50	4256011	<50	<50	50	4256011
Dissolved Cadmium (Cd)	ug/L	0.016	0.010	4256011	0.006	<0.005	0.005	4256011
Dissolved Chromium (Cr)	ug/L	<0.1	<0.1	4256011	<0.1	<0.1	0.1	4256011
Dissolved Cobalt (Co)	ug/L	0.046	0.028	4256011	0.022	0.025	0.005	4256011
Dissolved Copper (Cu)	ug/L	0.38	0.39	4256011	0.45	0.39	0.05	4256011
Dissolved Iron (Fe)	ug/L	18	29	4256011	50	110	1	4256011
Dissolved Lead (Pb)	ug/L	<0.005	<0.005	4256011	0.007	0.011	0.005	4256011
Dissolved Lithium (Li)	ug/L	4.7	3.5	4256011	1.7	3.6	0.5	4256011
Dissolved Manganese (Mn)	ug/L	15.9	15.3	4256011	5.11	12.9	0.05	4256011
Dissolved Molybdenum (Mo)	ug/L	2.39	0.72	4256011	0.70	0.53	0.05	4256011
Dissolved Nickel (Ni)	ug/L	0.98	0.45	4256011	0.37	0.25	0.02	4256011
Dissolved Selenium (Se)	ug/L	2.06	0.63	4256011	0.17	0.21	0.04	4256011
Dissolved Silicon (Si)	ug/L	4520	3720	4256011	3700	3900	100	4256011
Dissolved Silver (Ag)	ug/L	<0.005	<0.005	4256011	<0.005	<0.005	0.005	4256011
Dissolved Strontium (Sr)	ug/L	367	238	4256011	98.6	110	0.05	4256011
Dissolved Thallium (Tl)	ug/L	<0.002	<0.002	4256011	<0.002	<0.002	0.002	4256011
Dissolved Tin (Sn)	ug/L	0.01	<0.01	4256011	<0.01	<0.01	0.01	4256011
Dissolved Titanium (Ti)	ug/L	<0.5	<0.5	4256011	0.6	<0.5	0.5	4256011
Dissolved Uranium (U)	ug/L	5.32	2.37	4256011	0.575	0.940	0.002	4256011
Dissolved Vanadium (V)	ug/L	<0.2	<0.2	4256011	<0.2	<0.2	0.2	4256011
Dissolved Zinc (Zn)	ug/L	1.0	1.2	4256011	0.2	0.7 (1)	0.1	4263052
Dissolved Zirconium (Zr)	ug/L	<0.1	<0.1	4256011	<0.1	<0.1	0.1	4256011

RDL = Reportable Detection Limit
(1) Dissolved greater than total. Reanalysis yields similar results

LABERGE ENVIRONMENTAL SERVICES
Maxxam Job #: B081318
Client Project #: FARO BENTHICS
Report Date: 2010/09/17

LOW LEVEL DISSOLVED METALS IN WATER (WATER)

Maxxam ID		W77424	W77425		W77426	W77427		
Sampling Date		2010/08/30 14:00	2010/09/03 09:30		2010/09/02 14:45	2010/08/31 10:00		
COC Number		08322000	08322000		08322000	08322000		
	Units	**HORTON CREEK**	**BUTTLE CREEK**	**QC Batch**	**BLIND CREEK**	**R7 NORTH FORK ROSE CREEK**	**RDL**	**QC Batch**
Dissolved Calcium (Ca)	mg/L	77.1	76.8	4240748	22.1	24.7	0.05	4240748
Dissolved Magnesium (Mg)	mg/L	37.8	14.9	4240748	5.56	5.17	0.05	4240748
Dissolved Potassium (K)	mg/L	1.20	2.04	4240748	0.78	0.51	0.05	4240748
Dissolved Sodium (Na)	mg/L	4.80	4.69	4240748	2.86	2.00	0.05	4240748
Dissolved Sulphur (S)	mg/L	31	16	4240748	<10	<10	10	4240748

RDL = Reportable Detection Limit

Maxxam Job #: B081318
Report Date: 2010/09/17

LABERGE ENVIRONMENTAL SERVICES
Client Project #: FARO BENTHICS

LOW LEVEL DISSOLVED METALS IN WATER (WATER)

Maxxam ID		W77428	W77429	W77507	W77508		
Sampling Date		2010/08/31 12:15	2010/09/02 09:30	2010/08/31 15:30	2010/09/01 13:00		
COC Number		08322000	08322000	08322001	08322001		
	Units	**USFR UPPER SOUTH FORK VANGORDA CREEK**	**VR UPPER WEST FORK VANGORDA CREEK**	**FC UPPER FARO CREEK**	**R6 ANVIL CR U/S ROSE CREEK**	**RDL**	**QC Batch**
Misc. Inorganics							
Dissolved Hardness (CaCO3)	mg/L	25.6	31.2	14.5	151	0.5	4238668
Dissolved Metals by ICPMS							
Dissolved Aluminum (Al)	ug/L	6.9	16.2	15.7	3.3	0.2	4256011
Dissolved Antimony (Sb)	ug/L	0.03	0.03	0.02	0.11	0.02	4256011
Dissolved Arsenic (As)	ug/L	0.28	0.21	0.10	0.47	0.02	4256011
Dissolved Barium (Ba)	ug/L	26.6	30.9	18.4	71.6	0.02	4256011
Dissolved Beryllium (Be)	ug/L	<0.01	<0.01	0.01	<0.01	0.01	4256011
Dissolved Bismuth (Bi)	ug/L	<0.005	<0.005	<0.005	<0.005	0.005	4256011
Dissolved Boron (B)	ug/L	<50	<50	<50	<50	50	4256011
Dissolved Cadmium (Cd)	ug/L	<0.005	0.009	0.006	0.009	0.005	4256011
Dissolved Chromium (Cr)	ug/L	<0.1	<0.1	<0.1	<0.1	0.1	4256011
Dissolved Cobalt (Co)	ug/L	0.014	0.008	0.017	0.024	0.005	4256011
Dissolved Copper (Cu)	ug/L	0.31	0.49	0.39	0.41	0.05	4256011
Dissolved Iron (Fe)	ug/L	63	11	11	87	1	4256011
Dissolved Lead (Pb)	ug/L	0.022	0.024	0.017	<0.005	0.005	4256011
Dissolved Lithium (Li)	ug/L	0.9	0.5	2.5	2.2	0.5	4256011
Dissolved Manganese (Mn)	ug/L	1.83	0.53	0.65	8.22	0.05	4256011
Dissolved Molybdenum (Mo)	ug/L	0.25	0.13	0.06	1.16	0.05	4256011
Dissolved Nickel (Ni)	ug/L	0.20	0.19	0.27	0.27	0.02	4256011
Dissolved Selenium (Se)	ug/L	<0.04	<0.04	<0.04	0.69	0.04	4256011
Dissolved Silicon (Si)	ug/L	2910	3950	5940	3810	100	4256011
Dissolved Silver (Ag)	ug/L	<0.005	<0.005	<0.005	<0.005	0.005	4256011
Dissolved Strontium (Sr)	ug/L	52.3	56.2	31.4	128	0.05	4256011
Dissolved Thallium (Tl)	ug/L	<0.002	<0.002	<0.002	<0.002	0.002	4256011
Dissolved Tin (Sn)	ug/L	<0.01	<0.01	<0.01	<0.01	0.01	4256011
Dissolved Titanium (Ti)	ug/L	<0.5	<0.5	<0.5	<0.5	0.5	4256011
Dissolved Uranium (U)	ug/L	0.283	0.338	0.073	1.74	0.002	4256011
Dissolved Vanadium (V)	ug/L	<0.2	<0.2	<0.2	<0.2	0.2	4256011
Dissolved Zinc (Zn)	ug/L	0.2	0.6	0.8	0.1	0.1	4256011
Dissolved Zirconium (Zr)	ug/L	<0.1	<0.1	<0.1	<0.1	0.1	4256011

RDL = Reportable Detection Limit

Maxxam Job #: B081318
Report Date: 2010/09/17

LABERGE ENVIRONMENTAL SERVICES
Client Project #: FARO BENTHICS

LOW LEVEL DISSOLVED METALS IN WATER (WATER)

Maxxam ID		W77428	W77429	W77507	W77508		
Sampling Date		2010/08/31 12:15	2010/09/02 09:30	2010/08/31 15:30	2010/09/01 13:00		
COC Number		08322000	08322000	08322001	08322001		
	Units	**USFR UPPER SOUTH FORK VANGORDA CREEK**	**VR UPPER WEST FORK VANGORDA CREEK**	**FC UPPER FARO CREEK**	**R6 ANVIL CR U/S ROSE CREEK**	**RDL**	**QC Batch**
Dissolved Calcium (Ca)	mg/L	8.07	9.34	4.29	42.2	0.05	4240748
Dissolved Magnesium (Mg)	mg/L	1.31	1.90	0.92	11.0	0.05	4240748
Dissolved Potassium (K)	mg/L	0.26	0.33	0.14	1.07	0.05	4240748
Dissolved Sodium (Na)	mg/L	1.54	1.59	1.97	1.77	0.05	4240748
Dissolved Sulphur (S)	mg/L	<10	<10	<10	<10	10	4240748

RDL = Reportable Detection Limit

Maxxam Job #: B081318
Report Date: 2010/09/17

LABERGE ENVIRONMENTAL SERVICES
Client Project #: FARO BENTHICS

LOW LEVEL DISSOLVED METALS IN WATER (WATER)

Maxxam ID		W77509	W77510		
Sampling Date		2010/09/02	2010/09/03		
COC Number		08322001	08322001		
	Units	**BD BLIND DUPLICATE**	**FB FIELD BLANK**	**RDL**	**QC Batch**
Misc. Inorganics					
Dissolved Hardness (CaCO3)	mg/L	248	<0.5	0.5	4241126
Dissolved Metals by ICPMS					
Dissolved Aluminum (Al)	ug/L	4.1	0.8	0.2	4256011
Dissolved Antimony (Sb)	ug/L	0.11	0.48	0.02	4256011
Dissolved Arsenic (As)	ug/L	0.60	<0.02	0.02	4256011
Dissolved Barium (Ba)	ug/L	63.9	0.05	0.02	4256011
Dissolved Beryllium (Be)	ug/L	<0.01	<0.01	0.01	4256011
Dissolved Bismuth (Bi)	ug/L	<0.005	<0.005	0.005	4256011
Dissolved Boron (B)	ug/L	<50	<50	50	4256011
Dissolved Cadmium (Cd)	ug/L	0.024	<0.005	0.005	4256011
Dissolved Chromium (Cr)	ug/L	<0.1	<0.1	0.1	4256011
Dissolved Cobalt (Co)	ug/L	0.058	<0.005	0.005	4256011
Dissolved Copper (Cu)	ug/L	0.60	0.14	0.05	4256011
Dissolved Iron (Fe)	ug/L	33	<1	1	4256011
Dissolved Lead (Pb)	ug/L	0.013	0.009	0.005	4256011
Dissolved Lithium (Li)	ug/L	4.0	<0.5	0.5	4256011
Dissolved Manganese (Mn)	ug/L	12.6	<0.05	0.05	4256011
Dissolved Molybdenum (Mo)	ug/L	1.38	<0.05	0.05	4256011
Dissolved Nickel (Ni)	ug/L	1.12	<0.02	0.02	4256011
Dissolved Selenium (Se)	ug/L	0.96	<0.04	0.04	4256011
Dissolved Silicon (Si)	ug/L	4420	<100	100	4256011
Dissolved Silver (Ag)	ug/L	<0.005	<0.005	0.005	4256011
Dissolved Strontium (Sr)	ug/L	250	<0.05	0.05	4256011
Dissolved Thallium (Tl)	ug/L	0.002	<0.002	0.002	4256011
Dissolved Tin (Sn)	ug/L	<0.01	<0.01	0.01	4256011
Dissolved Titanium (Ti)	ug/L	<0.5	<0.5	0.5	4256011
Dissolved Uranium (U)	ug/L	3.28	0.010	0.002	4256011
Dissolved Vanadium (V)	ug/L	<0.2	<0.2	0.2	4256011
Dissolved Zinc (Zn)	ug/L	1.1	0.2	0.1	4256011
Dissolved Zirconium (Zr)	ug/L	<0.1	<0.1	0.1	4256011
Dissolved Calcium (Ca)	mg/L	61.6	<0.05	0.05	4240748
Dissolved Magnesium (Mg)	mg/L	22.7	<0.05	0.05	4240748

RDL = Reportable Detection Limit

Maxxam Job #: B081318
Report Date: 2010/09/17

LABERGE ENVIRONMENTAL SERVICES
Client Project #: FARO BENTHICS

LOW LEVEL DISSOLVED METALS IN WATER (WATER)

Maxxam ID		W77509	W77510		
Sampling Date		2010/09/02	2010/09/03		
COC Number		08322001	08322001		
	Units	**BD BLIND DUPLICATE**	**FB FIELD BLANK**	**RDL**	**QC Batch**
Dissolved Potassium (K)	mg/L	0.97	<0.05	0.05	4240748
Dissolved Sodium (Na)	mg/L	3.26	<0.05	0.05	4240748
Dissolved Sulphur (S)	mg/L	27	<10	10	4240748

RDL = Reportable Detection Limit

LABERGE ENVIRONMENTAL SERVICES
Client Project #: FARO BENTHICS

Maxxam Job #: B081318
Report Date: 2010/09/17

LOW LEVEL TOTAL METALS IN WATER (WATER)

Maxxam ID		W77418	W77419	W77420	W77421	W77422		
Sampling Date		2010/08/31 17:30	2010/09/02 11:30	2010/09/01 14:30	2010/09/01 08:30	2010/09/02 16:50		
COC Number		08322000	08322000	08322000	08322000	08322000		
	Units	**X2 NORTH FORK ROSE CREEK**	**R2 ROSE CREEK D/S TAILINGS**	**R4 ROSE CREEK U/S ANVIL CR**	**VGMAIN EAST FORK VANGORDA CR**	**V5 WEST FORK VANGORDA CR**	**RDL**	**QC Batch**
Calculated Parameters								
Total Hardness (CaCO3)	mg/L	95.2	263	164	196	259	0.5	4238518
Total Metals by ICPMS								
Total Aluminum (Al)	ug/L	16.6	6.7	3.8	4.6	385	0.2	4255841
Total Antimony (Sb)	ug/L	0.06	0.09	0.12	0.10	0.10	0.02	4255841
Total Arsenic (As)	ug/L	0.67	0.43	0.29	0.40	1.27	0.02	4255841
Total Barium (Ba)	ug/L	47.8	42.5	60.3	42.0	79.8	0.02	4255841
Total Beryllium (Be)	ug/L	<0.01	<0.01	<0.01	<0.01	0.03	0.01	4255841
Total Bismuth (Bi)	ug/L	<0.005	<0.005	<0.005	<0.005	0.006	0.005	4255841
Total Boron (B)	ug/L	<50	<50	<50	<50	<50	50	4255841
Total Cadmium (Cd)	ug/L	0.015	0.042	0.019	0.042	0.092	0.005	4255841
Total Chromium (Cr)	ug/L	<0.1	<0.1	0.1	<0.1	0.9	0.1	4255841
Total Cobalt (Co)	ug/L	0.121	2.44	0.660	0.054	0.876	0.005	4255841
Total Copper (Cu)	ug/L	0.51	0.47	0.45	0.72	1.92	0.05	4255841
Total Iron (Fe)	ug/L	225	390	111	20	862	1	4255841
Total Lead (Pb)	ug/L	0.505	0.352	0.171	0.079	1.99	0.005	4255841
Total Lithium (Li)	ug/L	4.1	8.2	6.7	3.4	4.6	0.5	4255841
Total Manganese (Mn)	ug/L	40.2	1640	686	3.81	78.3	0.05	4255841
Total Molybdenum (Mo)	ug/L	0.53	0.53	0.57	0.55	1.09	0.05	4255841
Total Nickel (Ni)	ug/L	0.59	3.81	1.88	0.93	3.72	0.02	4255841
Total Selenium (Se)	ug/L	0.22	0.19	0.32	0.32	0.88	0.04	4255841
Total Silicon (Si)	ug/L	5100	4480	2400	4940	5200	100	4255841
Total Silver (Ag)	ug/L	<0.005	<0.005	<0.005	<0.005	0.010	0.005	4255841
Total Strontium (Sr)	ug/L	118	270	252	184	254	0.05	4255841
Total Thallium (Tl)	ug/L	0.002	0.092	0.034	0.010	0.011	0.002	4255841
Total Tin (Sn)	ug/L	0.01	<0.01	<0.01	<0.01	<0.01	0.01	4255841
Total Titanium (Ti)	ug/L	0.6	<0.5	<0.5	<0.5	13.1	0.5	4255841
Total Uranium (U)	ug/L	1.12	1.53	1.57	3.58	4.06	0.002	4255841
Total Vanadium (V)	ug/L	<0.2	<0.2	<0.2	<0.2	1.1	0.2	4255841
Total Zinc (Zn)	ug/L	10.1	45.3	16.3	10.3	7.0	0.1	4255841
Total Zirconium (Zr)	ug/L	<0.1	<0.1	<0.1	<0.1	0.2	0.1	4255841
Total Calcium (Ca)	mg/L	28.1	77.5	42.1	48.4	64.1	0.05	4240749

RDL = Reportable Detection Limit

LABERGE ENVIRONMENTAL SERVICES
Maxxam Job #: B081318
Client Project #: FARO BENTHICS
Report Date: 2010/09/17

LOW LEVEL TOTAL METALS IN WATER (WATER)

Maxxam ID		W77418	W77419	W77420	W77421	W77422		
Sampling Date		2010/08/31 17:30	2010/09/02 11:30	2010/09/01 14:30	2010/09/01 08:30	2010/09/02 16:50		
COC Number		08322000	08322000	08322000	08322000	08322000		
	Units	**X2 NORTH FORK ROSE CREEK**	**R2 ROSE CREEK D/S TAILINGS**	**R4 ROSE CREEK U/S ANVIL CR**	**VGMAIN EAST FORK VANGORDA CR**	**V5 WEST FORK VANGORDA CR**	**RDL**	**QC Batch**
Total Magnesium (Mg)	mg/L	6.05	17.0	14.3	18.3	24.0	0.05	4240749
Total Potassium (K)	mg/L	0.62	1.65	1.50	0.75	1.12	0.05	4240749
Total Sodium (Na)	mg/L	2.19	5.63	4.42	2.89	3.38	0.05	4240749
Total Sulphur (S)	mg/L	<10	69	52	39	27	10	4240749

RDL = Reportable Detection Limit

LABERGE ENVIRONMENTAL SERVICES
Client Project #: FARO BENTHICS

Maxxam Job #: B081318
Report Date: 2010/09/17

LOW LEVEL TOTAL METALS IN WATER (WATER)

Maxxam ID		W77423	W77424	W77425	W77426	W77427		
Sampling Date		2010/09/01 10:30	2010/08/30 14:00	2010/09/03 09:30	2010/09/02 14:45	2010/08/31 10:00		
COC Number		08322000	08322000	08322000	08322000	08322000		
	Units	**V8 VANGORDA CREEK D/S FARO**	**HORTON CREEK**	**BUTTLE CREEK**	**BLIND CREEK**	**R7 NORTH FORK ROSE CREEK**	**RDL**	**QC Batch**
Calculated Parameters								
Total Hardness (CaCO3)	mg/L	229	349	242	75.2	81.6	0.5	4238518
Total Metals by ICPMS								
Total Aluminum (Al)	ug/L	10.9	4.4	11.4	8.5	9.8	0.2	4255841
Total Antimony (Sb)	ug/L	0.11	0.16	0.06	0.07	0.06	0.02	4255841
Total Arsenic (As)	ug/L	0.45	0.45	0.24	0.61	0.69	0.02	4255841
Total Barium (Ba)	ug/L	47.2	77.8	91.6	56.6	45.7	0.02	4255841
Total Beryllium (Be)	ug/L	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	4255841
Total Bismuth (Bi)	ug/L	<0.005	<0.005	<0.005	<0.005	<0.005	0.005	4255841
Total Boron (B)	ug/L	<50	<50	<50	<50	<50	50	4255841
Total Cadmium (Cd)	ug/L	0.031	0.023	0.010	0.011	<0.005	0.005	4255841
Total Chromium (Cr)	ug/L	<0.1	<0.1	<0.1	<0.1	<0.1	0.1	4255841
Total Cobalt (Co)	ug/L	0.054	0.063	0.031	0.027	0.025	0.005	4255841
Total Copper (Cu)	ug/L	0.68	0.42	0.35	0.48	0.36	0.05	4255841
Total Iron (Fe)	ug/L	45	94	51	75	182	1	4255841
Total Lead (Pb)	ug/L	0.095	0.050	0.027	0.018	0.028	0.005	4255841
Total Lithium (Li)	ug/L	4.1	4.4	3.5	1.6	3.4	0.5	4255841
Total Manganese (Mn)	ug/L	6.38	16.8	15.7	7.75	16.4	0.05	4255841
Total Molybdenum (Mo)	ug/L	0.86	2.42	0.69	0.75	0.52	0.05	4255841
Total Nickel (Ni)	ug/L	0.99	1.14	0.41	0.34	0.23	0.02	4255841
Total Selenium (Se)	ug/L	0.57	2.17	0.57	0.16	0.21	0.04	4255841
Total Silicon (Si)	ug/L	5490	5050	3510	3460	4300	100	4255841
Total Silver (Ag)	ug/L	<0.005	<0.005	<0.005	<0.005	<0.005	0.005	4255841
Total Strontium (Sr)	ug/L	215	366	240	99.2	105	0.05	4255841
Total Thallium (Tl)	ug/L	0.008	<0.002	<0.002	<0.002	<0.002	0.002	4255841
Total Tin (Sn)	ug/L	<0.01	0.02	<0.01	<0.01	<0.01	0.01	4255841
Total Titanium (Ti)	ug/L	<0.5	<0.5	<0.5	<0.5	<0.5	0.5	4255841
Total Uranium (U)	ug/L	3.71	6.29	2.80	0.699	1.14	0.002	4255841
Total Vanadium (V)	ug/L	<0.2	<0.2	<0.2	<0.2	<0.2	0.2	4255841
Total Zinc (Zn)	ug/L	7.4	1.8	1.4	0.2	0.3	0.1	4255841
Total Zirconium (Zr)	ug/L	<0.1	<0.1	<0.1	<0.1	<0.1	0.1	4255841
Total Calcium (Ca)	mg/L	56.9	82.1	72.1	21.2	24.7	0.05	4240749

RDL = Reportable Detection Limit

Maxxam Job #: B081318
Report Date: 2010/09/17

LABERGE ENVIRONMENTAL SERVICES
Client Project #: FARO BENTHICS

LOW LEVEL TOTAL METALS IN WATER (WATER)

Maxxam ID		W77423	W77424	W77425	W77426	W77427		
Sampling Date		2010/09/01 10:30	2010/08/30 14:00	2010/09/03 09:30	2010/09/02 14:45	2010/08/31 10:00		
COC Number		08322000	08322000	08322000	08322000	08322000		
	Units	**V8 VANGORDA CREEK D/S FARO**	**HORTON CREEK**	**BUTTLE CREEK**	**BLIND CREEK**	**R7 NORTH FORK ROSE CREEK**	**RDL**	**QC Batch**
Total Magnesium (Mg)	mg/L	21.1	34.9	15.0	5.43	4.84	0.05	4240749
Total Potassium (K)	mg/L	0.84	1.17	2.06	0.77	0.49	0.05	4240749
Total Sodium (Na)	mg/L	3.16	4.44	4.65	2.76	1.90	0.05	4240749
Total Sulphur (S)	mg/L	38	31	16	<10	<10	10	4240749

RDL = Reportable Detection Limit

LABERGE ENVIRONMENTAL SERVICES
Client Project #: FARO BENTHICS

Maxxam Job #: B081318
Report Date: 2010/09/17

LOW LEVEL TOTAL METALS IN WATER (WATER)

Maxxam ID		W77428	W77429	W77507	W77508	W77509		
Sampling Date		2010/08/31 12:15	2010/09/02 09:30	2010/08/31 15:30	2010/09/01 13:00	2010/09/02		
COC Number		08322000	08322000	08322001	08322001	08322001		
	Units	**USFR UPPER SOUTH FORK VANGORDA CREEK**	**VR UPPER WEST FORK VANGORDA CREEK**	**FC UPPER FARO CREEK**	**R6 ANVIL CR U/S ROSE CREEK**	**BD BLIND DUPLICATE**	**RDL**	**QC Batch**
Calculated Parameters								
Total Hardness (CaCO3)	mg/L	24.7	31.2	15.2	148	246	0.5	4238518
Total Metals by ICPMS								
Total Aluminum (Al)	ug/L	12.7	18.4	27.9	8.6	105	0.2	4255841
Total Antimony (Sb)	ug/L	0.03	0.02	<0.02	0.10	0.10	0.02	4255841
Total Arsenic (As)	ug/L	0.31	0.20	0.10	0.43	0.99	0.02	4255841
Total Barium (Ba)	ug/L	26.0	29.2	17.4	70.2	66.9	0.02	4255841
Total Beryllium (Be)	ug/L	<0.01	0.01	0.01	<0.01	<0.01	0.01	4255841
Total Bismuth (Bi)	ug/L	<0.005	<0.005	<0.005	<0.005	<0.005	0.005	4255841
Total Boron (B)	ug/L	<50	<50	<50	<50	<50	50	4255841
Total Cadmium (Cd)	ug/L	<0.005	0.007	0.009	0.010	0.068	0.005	4255841
Total Chromium (Cr)	ug/L	<0.1	<0.1	<0.1	<0.1	0.2	0.1	4255841
Total Cobalt (Co)	ug/L	0.030	0.014	0.022	0.036	0.416	0.005	4255841
Total Copper (Cu)	ug/L	0.33	0.46	0.41	0.38	1.16	0.05	4255841
Total Iron (Fe)	ug/L	112	16	29	156	331	1	4255841
Total Lead (Pb)	ug/L	0.035	0.026	0.071	0.012	0.953	0.005	4255841
Total Lithium (Li)	ug/L	0.9	<0.5	2.3	2.0	4.1	0.5	4255841
Total Manganese (Mn)	ug/L	11.4	0.78	1.02	12.7	52.9	0.05	4255841
Total Molybdenum (Mo)	ug/L	0.28	0.11	0.07	1.16	1.25	0.05	4255841
Total Nickel (Ni)	ug/L	0.17	0.17	0.23	0.29	2.23	0.02	4255841
Total Selenium (Se)	ug/L	<0.04	<0.04	<0.04	0.68	0.93	0.04	4255841
Total Silicon (Si)	ug/L	3010	4480	7000	3840	4790	100	4255841
Total Silver (Ag)	ug/L	<0.005	<0.005	<0.005	<0.005	<0.005	0.005	4255841
Total Strontium (Sr)	ug/L	51.1	54.0	30.3	131	245	0.05	4255841
Total Thallium (Tl)	ug/L	<0.002	<0.002	<0.002	<0.002	0.005	0.002	4255841
Total Tin (Sn)	ug/L	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	4255841
Total Titanium (Ti)	ug/L	<0.5	<0.5	<0.5	<0.5	4.6	0.5	4255841
Total Uranium (U)	ug/L	0.369	0.396	0.096	2.11	3.92	0.002	4255841
Total Vanadium (V)	ug/L	<0.2	<0.2	<0.2	<0.2	0.4	0.2	4255841
Total Zinc (Zn)	ug/L	0.2	0.6	1.1	0.2	4.0	0.1	4255841
Total Zirconium (Zr)	ug/L	<0.1	<0.1	<0.1	<0.1	0.1	0.1	4255841

RDL = Reportable Detection Limit

LABERGE ENVIRONMENTAL SERVICES
Maxxam Job #: B081318
Client Project #: FARO BENTHICS
Report Date: 2010/09/17

LOW LEVEL TOTAL METALS IN WATER (WATER)

Maxxam ID		W77428	W77429	W77507	W77508	W77509		
Sampling Date		2010/08/31 12:15	2010/09/02 09:30	2010/08/31 15:30	2010/09/01 13:00	2010/09/02		
COC Number		08322000	08322000	08322001	08322001	08322001		
	Units	**USFR UPPER SOUTH FORK VANGORDA CREEK**	**VR UPPER WEST FORK VANGORDA CREEK**	**FC UPPER FARO CREEK**	**R6 ANVIL CR U/S ROSE CREEK**	**BD BLIND DUPLICATE**	**RDL**	**QC Batch**
Total Calcium (Ca)	mg/L	7.81	9.52	4.61	41.5	60.9	0.05	4240749
Total Magnesium (Mg)	mg/L	1.27	1.79	0.89	10.8	22.8	0.05	4240749
Total Potassium (K)	mg/L	0.25	0.30	0.14	1.07	1.02	0.05	4240749
Total Sodium (Na)	mg/L	1.48	1.47	1.90	1.73	3.23	0.05	4240749
Total Sulphur (S)	mg/L	<10	<10	<10	<10	29	10	4240749

RDL = Reportable Detection Limit

Maxxam Job #: B081318
Report Date: 2010/09/17

LABERGE ENVIRONMENTAL SERVICES
Client Project #: FARO BENTHICS

LOW LEVEL TOTAL METALS IN WATER (WATER)

Maxxam ID		W77510		
Sampling Date		2010/09/03		
COC Number		08322001		
	Units	**FB FIELD BLANK**	**RDL**	**QC Batch**
Calculated Parameters				
Total Hardness (CaCO3)	mg/L	<0.5	0.5	4238518
Total Metals by ICPMS				
Total Aluminum (Al)	ug/L	0.6	0.2	4255841
Total Antimony (Sb)	ug/L	0.50	0.02	4255841
Total Arsenic (As)	ug/L	<0.02	0.02	4255841
Total Barium (Ba)	ug/L	0.05	0.02	4255841
Total Beryllium (Be)	ug/L	<0.01	0.01	4255841
Total Bismuth (Bi)	ug/L	<0.005	0.005	4255841
Total Boron (B)	ug/L	<50	50	4255841
Total Cadmium (Cd)	ug/L	<0.005	0.005	4255841
Total Chromium (Cr)	ug/L	<0.1	0.1	4255841
Total Cobalt (Co)	ug/L	<0.005	0.005	4255841
Total Copper (Cu)	ug/L	0.08	0.05	4255841
Total Iron (Fe)	ug/L	<1	1	4255841
Total Lead (Pb)	ug/L	0.008	0.005	4255841
Total Lithium (Li)	ug/L	<0.5	0.5	4255841
Total Manganese (Mn)	ug/L	0.05	0.05	4255841
Total Molybdenum (Mo)	ug/L	<0.05	0.05	4255841
Total Nickel (Ni)	ug/L	<0.02	0.02	4255841
Total Selenium (Se)	ug/L	<0.04	0.04	4255841
Total Silicon (Si)	ug/L	<100	100	4255841
Total Silver (Ag)	ug/L	<0.005	0.005	4255841
Total Strontium (Sr)	ug/L	<0.05	0.05	4255841
Total Thallium (Tl)	ug/L	<0.002	0.002	4255841
Total Tin (Sn)	ug/L	<0.01	0.01	4255841
Total Titanium (Ti)	ug/L	<0.5	0.5	4255841
Total Uranium (U)	ug/L	<0.002	0.002	4255841
Total Vanadium (V)	ug/L	<0.2	0.2	4255841
Total Zinc (Zn)	ug/L	<0.1	0.1	4255841
Total Zirconium (Zr)	ug/L	<0.1	0.1	4255841
Total Calcium (Ca)	mg/L	<0.05	0.05	4240749
Total Magnesium (Mg)	mg/L	<0.05	0.05	4240749

RDL = Reportable Detection Limit

Maxxam Job #: B081318
Report Date: 2010/09/17

LABERGE ENVIRONMENTAL SERVICES
Client Project #: FARO BENTHICS

LOW LEVEL TOTAL METALS IN WATER (WATER)

Maxxam ID		W77510		
Sampling Date		2010/09/03		
COC Number		08322001		
	Units	**FB FIELD BLANK**	**RDL**	**QC Batch**
Total Potassium (K)	mg/L	<0.05	0.05	4240749
Total Sodium (Na)	mg/L	<0.05	0.05	4240749
Total Sulphur (S)	mg/L	<10	10	4240749

RDL = Reportable Detection Limit

LABERGE ENVIRONMENTAL SERVICES
Maxxam Job #: B081318
Client Project #: FARO BENTHICS
Report Date: 2010/09/17

Sample W77418, Elements by ICPMS Low Level (dissolved): Test repeated.
Sample W77421, Elements by ICPMS Low Level (dissolved): Test repeated.
Sample W77422, Elements by ICPMS Low Level (dissolved): Test repeated.
Sample W77426, Elements by ICPMS Low Level (dissolved): Test repeated.
Sample W77427, Elements by ICPMS Low Level (dissolved): Test repeated.
Sample W77418, Na, K, Ca, Mg, S by CRC ICPMS (diss.): Test repeated.

Results relate only to the items tested.

LABERGE ENVIRONMENTAL SERVICES
Attention: Bonnie Burns
Client Project #: FARO BENTHICS
P.O. #:
Site Reference:

Quality Assurance Report

Maxxam Job Number: VB081318

QA/QC Batch Num	Init	QC Type	Parameter	Date Analyzed yyyy/mm/dd	Value	Recovery	Units	QC Limits
4241087	CK	Matrix Spike						
		[W77421-05]	Total Phosphorus (P)	2010/09/08		96	%	80 - 120
		Spiked Blank	Total Phosphorus (P)	2010/09/08		97	%	80 - 120
		Method Blank	Total Phosphorus (P)	2010/09/08	<0.002		mg/L	
		RPD [W77421-05]	Total Phosphorus (P)	2010/09/08	NC		%	20
4241094	CK	Matrix Spike	Orthophosphate (P)	2010/09/08		100	%	80 - 120
		Spiked Blank	Orthophosphate (P)	2010/09/08		98	%	80 - 120
		Method Blank	Orthophosphate (P)	2010/09/08	<0.001		mg/L	
		RPD	Orthophosphate (P)	2010/09/08	NC		%	20
4242670	TW2	Spiked Blank	Total Suspended Solids	2010/09/09		102	%	80 - 120
		Method Blank	Total Suspended Solids	2010/09/09	<1		mg/L	
4242697	SF1	Matrix Spike	Ammonia (N)	2010/09/08		102	%	80 - 120
		Spiked Blank	Ammonia (N)	2010/09/08		101	%	80 - 120
		Method Blank	Ammonia (N)	2010/09/08	<0.005		mg/L	
		RPD [W77510-05]	Ammonia (N)	2010/09/08	NC		%	20
4244215	MKY	Spiked Blank	Conductivity	2010/09/08		102	%	80 - 120
		Method Blank	Conductivity	2010/09/08	<1		uS/cm	
		RPD	Conductivity	2010/09/09	1.0		%	20
4244216	MKY	Spiked Blank	Alkalinity (Total as CaCO3)	2010/09/08		98	%	80 - 120
		Method Blank	Alkalinity (Total as CaCO3)	2010/09/08	<0.5		mg/L	
			Alkalinity (PP as CaCO3)	2010/09/08	<0.5		mg/L	
			Bicarbonate (HCO3)	2010/09/08	<0.5		mg/L	
			Carbonate (CO3)	2010/09/08	<0.5		mg/L	
			Hydroxide (OH)	2010/09/08	<0.5		mg/L	
		RPD	Alkalinity (Total as CaCO3)	2010/09/09	0.6		%	20
			Alkalinity (PP as CaCO3)	2010/09/09	NC		%	20
			Bicarbonate (HCO3)	2010/09/09	0.6		%	20
			Carbonate (CO3)	2010/09/09	NC		%	20
			Hydroxide (OH)	2010/09/09	NC		%	20
4245026	AD5	Matrix Spike	Total Organic Carbon (C)	2010/09/09		111	%	80 - 120
		Spiked Blank	Total Organic Carbon (C)	2010/09/09		110	%	80 - 120
		Method Blank	Total Organic Carbon (C)	2010/09/09	<0.5		mg/L	
		RPD	Total Organic Carbon (C)	2010/09/09	7.5		%	20
4247638	TW2	Matrix Spike	Total Dissolved Solids	2010/09/11		106	%	80 - 120
		Spiked Blank	Total Dissolved Solids	2010/09/11		94	%	80 - 120
		Method Blank	Total Dissolved Solids	2010/09/11	<10		mg/L	
		RPD	Total Dissolved Solids	2010/09/11	2.7		%	20
4250958	IC4	Matrix Spike	Nitrate plus Nitrite (N)	2010/09/10		102	%	80 - 120
		Spiked Blank	Nitrate plus Nitrite (N)	2010/09/10		101	%	80 - 120
		Method Blank	Nitrate plus Nitrite (N)	2010/09/10	<0.02		mg/L	
		RPD [W77427-02]	Nitrate plus Nitrite (N)	2010/09/10	NC (1)		%	25
4251207	IC4	Matrix Spike	Nitrite (N)	2010/09/10		103	%	80 - 120
		Spiked Blank	Nitrite (N)	2010/09/10		101	%	80 - 120
		Method Blank	Nitrite (N)	2010/09/10	<0.005		mg/L	
		RPD [W77427-02]	Nitrite (N)	2010/09/10	NC (1)		%	20
4252526	BB3	Matrix Spike	Dissolved Chloride (Cl)	2010/09/10		NC	%	80 - 120
		Spiked Blank	Dissolved Chloride (Cl)	2010/09/10		92	%	80 - 120
		Method Blank	Dissolved Chloride (Cl)	2010/09/10	<0.5		mg/L	
		RPD [W77428-02]	Dissolved Chloride (Cl)	2010/09/10	NC		%	20
		RPD [W77429-02]	Dissolved Chloride (Cl)	2010/09/10	NC		%	20
4253935	BB3	Matrix Spike	Dissolved Sulphate (SO4)	2010/09/10		NC	%	80 - 120
		Spiked Blank	Dissolved Sulphate (SO4)	2010/09/10		98	%	80 - 120
		Method Blank	Dissolved Sulphate (SO4)	2010/09/10	0.7, RDL=0.5		mg/L	
		RPD [W77428-02]	Dissolved Sulphate (SO4)	2010/09/10	0.4		%	20
		RPD [W77429-02]	Dissolved Sulphate (SO4)	2010/09/10	7.7		%	20

LABERGE ENVIRONMENTAL SERVICES
Attention: Bonnie Burns
Client Project #: FARO BENTHICS
P.O. #:
Site Reference:

Quality Assurance Report (Continued)

Maxxam Job Number: VB081318

QA/QC Batch Num	Init	QC Type	Parameter	Date Analyzed yyyy/mm/dd	Value	Recovery	Units	QC Limits
4255841	AA1	Matrix Spike						
		[W77418-03]	Total Arsenic (As)	2010/09/13		96	%	80 - 120
			Total Beryllium (Be)	2010/09/13		100	%	80 - 120
			Total Cadmium (Cd)	2010/09/13		101	%	80 - 120
			Total Chromium (Cr)	2010/09/13		99	%	80 - 120
			Total Cobalt (Co)	2010/09/13		101	%	80 - 120
			Total Copper (Cu)	2010/09/13		99	%	80 - 120
			Total Lead (Pb)	2010/09/13		98	%	80 - 120
			Total Lithium (Li)	2010/09/13		102	%	80 - 120
			Total Nickel (Ni)	2010/09/13		97	%	80 - 120
			Total Selenium (Se)	2010/09/13		104	%	80 - 120
			Total Uranium (U)	2010/09/13		117	%	80 - 120
			Total Vanadium (V)	2010/09/13		99	%	80 - 120
			Total Zinc (Zn)	2010/09/13		NC	%	80 - 120
		Spiked Blank	Total Arsenic (As)	2010/09/14		101	%	80 - 120
			Total Beryllium (Be)	2010/09/14		110	%	80 - 120
			Total Cadmium (Cd)	2010/09/14		103	%	80 - 120
			Total Chromium (Cr)	2010/09/14		100	%	80 - 120
			Total Cobalt (Co)	2010/09/14		100	%	80 - 120
			Total Copper (Cu)	2010/09/14		103	%	80 - 120
			Total Lead (Pb)	2010/09/14		107	%	80 - 120
			Total Lithium (Li)	2010/09/14		110	%	80 - 120
			Total Nickel (Ni)	2010/09/14		98	%	80 - 120
			Total Selenium (Se)	2010/09/14		102	%	80 - 120
			Total Uranium (U)	2010/09/14		112	%	80 - 120
			Total Vanadium (V)	2010/09/14		93	%	80 - 120
			Total Zinc (Zn)	2010/09/14		102	%	80 - 120
		Method Blank	Total Aluminum (Al)	2010/09/13	<0.2		ug/L	
			Total Antimony (Sb)	2010/09/13	<0.02		ug/L	
			Total Arsenic (As)	2010/09/13	<0.02		ug/L	
			Total Barium (Ba)	2010/09/13	<0.02		ug/L	
			Total Beryllium (Be)	2010/09/13	<0.01		ug/L	
			Total Bismuth (Bi)	2010/09/13	<0.005		ug/L	
			Total Boron (B)	2010/09/13	<50		ug/L	
			Total Cadmium (Cd)	2010/09/13	<0.005		ug/L	
			Total Chromium (Cr)	2010/09/13	<0.1		ug/L	
			Total Cobalt (Co)	2010/09/13	<0.005		ug/L	
			Total Copper (Cu)	2010/09/13	<0.05		ug/L	
			Total Iron (Fe)	2010/09/13	<1		ug/L	
			Total Lead (Pb)	2010/09/13	<0.005		ug/L	
			Total Lithium (Li)	2010/09/13	<0.5		ug/L	
			Total Manganese (Mn)	2010/09/13	<0.05		ug/L	
			Total Molybdenum (Mo)	2010/09/13	<0.05		ug/L	
			Total Nickel (Ni)	2010/09/13	<0.02		ug/L	
			Total Selenium (Se)	2010/09/13	<0.04		ug/L	
			Total Silicon (Si)	2010/09/13	<100		ug/L	
			Total Silver (Ag)	2010/09/13	<0.005		ug/L	
			Total Strontium (Sr)	2010/09/13	<0.05		ug/L	
			Total Thallium (Tl)	2010/09/13	<0.002		ug/L	
			Total Tin (Sn)	2010/09/13	<0.01		ug/L	
			Total Titanium (Ti)	2010/09/13	<0.5		ug/L	
			Total Uranium (U)	2010/09/13	<0.002		ug/L	
			Total Vanadium (V)	2010/09/13	<0.2		ug/L	
			Total Zinc (Zn)	2010/09/13	<0.1		ug/L	
			Total Zirconium (Zr)	2010/09/13	<0.1		ug/L	

LABERGE ENVIRONMENTAL SERVICES
Attention: Bonnie Burns
Client Project #: FARO BENTHICS
P.O. #:
Site Reference:

Quality Assurance Report (Continued)

Maxxam Job Number: VB081318

QA/QC Batch Num	Init	QC Type	Parameter	Date Analyzed yyyy/mm/dd	Value	Recovery	Units	QC Limits
4255841	AA1	RPD [W77418-03]	Total Aluminum (Al)	2010/09/14	1.6		%	20
			Total Antimony (Sb)	2010/09/14	NC		%	20
			Total Arsenic (As)	2010/09/14	0.01		%	20
			Total Barium (Ba)	2010/09/14	0.5		%	20
			Total Beryllium (Be)	2010/09/14	NC		%	20
			Total Bismuth (Bi)	2010/09/14	NC		%	20
			Total Boron (B)	2010/09/14	NC		%	20
			Total Cadmium (Cd)	2010/09/14	NC		%	20
			Total Chromium (Cr)	2010/09/14	NC		%	20
			Total Cobalt (Co)	2010/09/14	1.6		%	20
			Total Copper (Cu)	2010/09/14	6.8		%	20
			Total Iron (Fe)	2010/09/14	1.8		%	20
			Total Lead (Pb)	2010/09/14	0.8		%	20
			Total Lithium (Li)	2010/09/14	0.5		%	20
			Total Manganese (Mn)	2010/09/14	2.7		%	20
			Total Molybdenum (Mo)	2010/09/14	4.9		%	20
			Total Nickel (Ni)	2010/09/14	7.2		%	20
			Total Selenium (Se)	2010/09/14	0.5		%	20
			Total Silicon (Si)	2010/09/14	2.9		%	20
			Total Silver (Ag)	2010/09/14	NC		%	20
			Total Strontium (Sr)	2010/09/14	0.8		%	20
			Total Thallium (Tl)	2010/09/14	NC		%	20
			Total Tin (Sn)	2010/09/14	NC		%	20
			Total Titanium (Ti)	2010/09/14	NC		%	20
			Total Uranium (U)	2010/09/14	1.2		%	20
			Total Vanadium (V)	2010/09/14	NC		%	20
			Total Zinc (Zn)	2010/09/14	3.5		%	20
			Total Zirconium (Zr)	2010/09/14	NC		%	20
4256011	AA1	Matrix Spike [W77418-04]	Dissolved Arsenic (As)	2010/09/14		104	%	80 - 120
			Dissolved Beryllium (Be)	2010/09/14		111	%	80 - 120
			Dissolved Cadmium (Cd)	2010/09/14		103	%	80 - 120
			Dissolved Chromium (Cr)	2010/09/14		103	%	80 - 120
			Dissolved Cobalt (Co)	2010/09/14		103	%	80 - 120
			Dissolved Copper (Cu)	2010/09/14		101	%	80 - 120
			Dissolved Lead (Pb)	2010/09/14		99	%	80 - 120
			Dissolved Lithium (Li)	2010/09/14		106	%	80 - 120
			Dissolved Nickel (Ni)	2010/09/14		102	%	80 - 120
			Dissolved Selenium (Se)	2010/09/14		108	%	80 - 120
			Dissolved Uranium (U)	2010/09/14		101	%	80 - 120
			Dissolved Vanadium (V)	2010/09/14		104	%	80 - 120
			Dissolved Zinc (Zn)	2010/09/14		NC	%	80 - 120
		Spiked Blank	Dissolved Arsenic (As)	2010/09/14		104	%	80 - 120
			Dissolved Beryllium (Be)	2010/09/14		105	%	80 - 120
			Dissolved Cadmium (Cd)	2010/09/14		101	%	80 - 120
			Dissolved Chromium (Cr)	2010/09/14		100	%	80 - 120
			Dissolved Cobalt (Co)	2010/09/14		104	%	80 - 120
			Dissolved Copper (Cu)	2010/09/14		108	%	80 - 120
			Dissolved Lead (Pb)	2010/09/14		103	%	80 - 120
			Dissolved Lithium (Li)	2010/09/14		103	%	80 - 120
			Dissolved Nickel (Ni)	2010/09/14		112	%	80 - 120
			Dissolved Selenium (Se)	2010/09/14		110	%	80 - 120
			Dissolved Uranium (U)	2010/09/14		100	%	80 - 120
			Dissolved Vanadium (V)	2010/09/14		98	%	80 - 120
			Dissolved Zinc (Zn)	2010/09/14		98	%	80 - 120

LABERGE ENVIRONMENTAL SERVICES
Attention: Bonnie Burns
Client Project #: FARO BENTHICS
P.O. #:
Site Reference:

Quality Assurance Report (Continued)

Maxxam Job Number: VB081318

QA/QC Batch Num	Init	QC Type	Parameter	Date Analyzed yyyy/mm/dd	Value	Recovery	Units	QC Limits
4256011	AA1	Method Blank	Dissolved Aluminum (Al)	2010/09/14	<0.2		ug/L	
			Dissolved Antimony (Sb)	2010/09/14	<0.02		ug/L	
			Dissolved Arsenic (As)	2010/09/14	<0.02		ug/L	
			Dissolved Barium (Ba)	2010/09/14	<0.02		ug/L	
			Dissolved Beryllium (Be)	2010/09/14	<0.01		ug/L	
			Dissolved Bismuth (Bi)	2010/09/14	<0.005		ug/L	
			Dissolved Boron (B)	2010/09/14	<50		ug/L	
			Dissolved Cadmium (Cd)	2010/09/14	<0.005		ug/L	
			Dissolved Chromium (Cr)	2010/09/14	<0.1		ug/L	
			Dissolved Cobalt (Co)	2010/09/14	<0.005		ug/L	
			Dissolved Copper (Cu)	2010/09/14	<0.05		ug/L	
			Dissolved Iron (Fe)	2010/09/14	<1		ug/L	
			Dissolved Lead (Pb)	2010/09/14	<0.005		ug/L	
			Dissolved Lithium (Li)	2010/09/14	<0.5		ug/L	
			Dissolved Manganese (Mn)	2010/09/14	<0.05		ug/L	
			Dissolved Molybdenum (Mo)	2010/09/14	<0.05		ug/L	
			Dissolved Nickel (Ni)	2010/09/14	<0.02		ug/L	
			Dissolved Selenium (Se)	2010/09/14	<0.04		ug/L	
			Dissolved Silicon (Si)	2010/09/14	<100		ug/L	
			Dissolved Silver (Ag)	2010/09/14	<0.005		ug/L	
			Dissolved Strontium (Sr)	2010/09/14	<0.05		ug/L	
			Dissolved Thallium (Tl)	2010/09/14	<0.002		ug/L	
			Dissolved Tin (Sn)	2010/09/14	<0.01		ug/L	
			Dissolved Titanium (Ti)	2010/09/14	<0.5		ug/L	
			Dissolved Uranium (U)	2010/09/14	<0.002		ug/L	
			Dissolved Vanadium (V)	2010/09/14	<0.2		ug/L	
			Dissolved Zinc (Zn)	2010/09/14	<0.1		ug/L	
			Dissolved Zirconium (Zr)	2010/09/14	<0.1		ug/L	
		RPD [W77418-04]	Dissolved Aluminum (Al)	2010/09/14	0.6		%	20
			Dissolved Antimony (Sb)	2010/09/14	NC		%	20
			Dissolved Arsenic (As)	2010/09/14	8.2		%	20
			Dissolved Barium (Ba)	2010/09/14	0.9		%	20
			Dissolved Beryllium (Be)	2010/09/14	NC		%	20
			Dissolved Bismuth (Bi)	2010/09/14	NC		%	20
			Dissolved Boron (B)	2010/09/14	NC		%	20
			Dissolved Cadmium (Cd)	2010/09/14	NC		%	20
			Dissolved Chromium (Cr)	2010/09/14	NC		%	20
			Dissolved Cobalt (Co)	2010/09/14	5.7		%	20
			Dissolved Copper (Cu)	2010/09/14	5.5		%	20
			Dissolved Iron (Fe)	2010/09/14	1		%	20
			Dissolved Lead (Pb)	2010/09/14	0.8		%	20
			Dissolved Lithium (Li)	2010/09/14	1.0		%	20
			Dissolved Manganese (Mn)	2010/09/14	1.5		%	20
			Dissolved Molybdenum (Mo)	2010/09/14	6.1		%	20
			Dissolved Nickel (Ni)	2010/09/14	13.9		%	20
			Dissolved Silver (Ag)	2010/09/14	NC		%	20
			Dissolved Strontium (Sr)	2010/09/14	0.9		%	20
			Dissolved Thallium (Tl)	2010/09/14	NC		%	20
			Dissolved Tin (Sn)	2010/09/14	NC		%	20
			Dissolved Titanium (Ti)	2010/09/14	NC		%	20
			Dissolved Uranium (U)	2010/09/14	0.09		%	20
			Dissolved Vanadium (V)	2010/09/14	NC		%	20
			Dissolved Zinc (Zn)	2010/09/14	7.5		%	20
			Dissolved Zirconium (Zr)	2010/09/14	NC		%	20
4256465	BB3	Matrix Spike	Dissolved Sulphate (SO4)	2010/09/13		119	%	80 - 120

LABERGE ENVIRONMENTAL SERVICES
Attention: Bonnie Burns
Client Project #: FARO BENTHICS
P.O. #:
Site Reference:

Quality Assurance Report (Continued)

Maxxam Job Number: VB081318

QA/QC Batch Num	Init	QC Type	Parameter	Date Analyzed yyyy/mm/dd	Value	Recovery	Units	QC Limits
4256465	BB3	Spiked Blank	Dissolved Sulphate (SO4)	2010/09/13		101	%	80 - 120
		Method Blank	Dissolved Sulphate (SO4)	2010/09/13	<0.5		mg/L	
		RPD	Dissolved Sulphate (SO4)	2010/09/13	0.8		%	20
4263052	AA1	Matrix Spike						
		[W77418-04]	Dissolved Copper (Cu)	2010/09/16		93	%	80 - 120
			Dissolved Selenium (Se)	2010/09/16		112	%	80 - 120
			Dissolved Zinc (Zn)	2010/09/16		NC	%	80 - 120
		Spiked Blank	Dissolved Copper (Cu)	2010/09/16		99	%	80 - 120
			Dissolved Selenium (Se)	2010/09/16		105	%	80 - 120
			Dissolved Zinc (Zn)	2010/09/16		100	%	80 - 120
		Method Blank	Dissolved Copper (Cu)	2010/09/16	<0.05		ug/L	
			Dissolved Molybdenum (Mo)	2010/09/16	<0.05		ug/L	
			Dissolved Selenium (Se)	2010/09/16	<0.04		ug/L	
			Dissolved Silicon (Si)	2010/09/16	<100		ug/L	
			Dissolved Thallium (Tl)	2010/09/16	<0.002		ug/L	
			Dissolved Zinc (Zn)	2010/09/16	<0.1		ug/L	
		RPD [W77418-04]	Dissolved Selenium (Se)	2010/09/16	2.3		%	20
			Dissolved Silicon (Si)	2010/09/16	2.9		%	20
4267798	BB3	Matrix Spike	Dissolved Sulphate (SO4)			TBA	%	80 - 120
		Spiked Blank	Dissolved Sulphate (SO4)	2010/09/16		105	%	80 - 120
		Method Blank	Dissolved Sulphate (SO4)	2010/09/16	<0.5		mg/L	
		RPD	Dissolved Sulphate (SO4)	2010/09/16	NC		%	20

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.
Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.
Spiked Blank: A blank matrix to which a known amount of the analyte has been added. Used to evaluate analyte recovery.
Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.
NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spiked amount was not sufficiently significant to permit a reliable recovery calculation.
NC (RPD): The RPD was not calculated. The level of analyte detected in the parent sample and its duplicate was not sufficiently significant to permit a reliable calculation.
(1) Samples arrived to laboratory past recommended hold time.

Maxxam Analytics Inc

8577 Commerce Court
Burnaby, BC V5A 4N5
www.maxxamanalytics.com

Phone: (604) 444-4808
Fax.: (604) 444-4511
Toll-Free: 1-800-440-4808

CHAIN-OF-CUSTODY RECORD AND ANALYSIS REQUEST

08322000

LAB USE ONLY
MAXXAM JOB # B081318

ANALYSIS REQUEST

LAB USE ONLY
COC #

COMPANY NAME: Laberge Environmental Services	CLIENT PROJECT NO.: Faro Benthics
COMPANY ADDRESS: P.O. Box 21072 Whitehorse, Yukon Y1A 6P7	TEL.: 867 668-6838
	E-MAIL: bonniebur[illegible]orthwestel.net
	FAX:
SAMPLER NAME (PRINT): Bonnie Burns/Deborah Fulmer	PROJECT MANAGER: Bonnie Burns
	LABORATORY CONTACT: Ashley Nivison

	FIELD SAMPLE ID	MAXXAM LAB # (LAB USE ONLY)	MATRIX: GROUNDWATER	SURFACE WATER	DRINKING WATER	SOIL	OTHER	SAMPLING: DATE DD/MM/YY	TIME	# CONTAINERS	Total Phosphorus (P)	TSS, TDS	[illegible], Alkalinity	pH, Conductivity	Dissolved Low Level Metals (filtered/preserved)	Total Low Level Metals (preserved)	Total organic carbon	Total Orthophosphate	SO4, Cl	Ammonia (N)
1	X2 North Fork Rose Creek			x				31/8/2010	17:30	5	x	x	x	x	x	x	x	x	x	x
2	R2 Rose Creek d/s tailings			x				09/02/2010	11:30	5	x	x	x	x	x	x	x	x	x	x
3	R4 Rose Creek u/s Anvil Cr			x				09/01/2010	14:30	5	x	x	x	x	x	x	x	x	x	x
4	VGMA N East Fork Vangorda Cr			x				09/01/2010	8:30	5	x	x	x	x	x	x	x	x	x	x
5	V5 West Fork Vangorda Cr			x				09/02/2010	16:50	5	x	x	x	x	x	x	x	x	x	x
6	V8 Vangorda Creek d/s Faro			x				09/01/2010	10:30	5	x	x	x	x	x	x	x	x	x	x
7	Horton Creek			x				30/8/2010	14:00	5	x	x	x	x	x	x	x	x	x	x
8	Buttle Creek			x				09/03/2010	9:30	5	x	x	x	x	x	x	x	x	x	x
9	Blind Creek			x				09/03/2010	14:45	5	x	x	x	x	x	x	x	x	x	x
10	R7 North Fork Rose Creek			x				31/8/2010	10:00	5	x	x	x	x	x	x	x	x	x	x
11	USFR Upper South Fork Vangorda Creek			x				31/8/2010	12:15	5	x	x	x	x	x	x	x	x	x	x
12	VR Upper West Fork Vangorda Creek			x				09/02/2010	9:30	5	x	x	x	x	x	x	x	x	x	x

TAT (Turnaround Time)
LESS THAN 5 DAY TAT MUST HAVE PRIOR APPROVAL
* Some exceptions apply - please contact laboratory

STANDARD	5 BUSINESS DAYS
RUSH	3 BUSINESS DAYS
RUSH	2 BUSINESS DAYS
URGENT	1 BUSINESS DAY

OTHER BUSINESS DAYS

CUSTODY RECORD

PO NUMBER OR QUOTE NUMBER:

SPECIAL DETECTION LIMITS / CONTAMINANT TYPE:

ACCOUNTING CONTACT:

SPECIAL REPORTING OR BILLING INSTRUCTIONS:

CCME
CSR
AB TIER 1
OTHER

JARS USED:

LAB USE ONLY
ARRIVAL TEMPERATURE °C: 7 6 6 7 7
DUE DATE:
LOG IN CHECK:

RELINQUISHED BY SAMPLER: Bonnie Burns	DATE: DD/MM/YY 05/09/2010	TIME:	RECEIVED BY:
RELINQUISHED BY:	DATE: DD/MM/YY	TIME: 0930	RECEIVED BY:
RELINQUISHED BY:	DATE: DD/MM/YY	TIME: 090710	RECEIVED BY LABORATORY: C. ROSEN

COCFORM - BC - 20070822

Maxxam Analytics Inc

8577 Commerce Court
Burnaby, BC V5A 4N5
www.maxxamanalytics.com

Phone: (604) 444-4808
Fax: (604) 444-4511
Toll-Free: 1-800-440-4808

CHAIN-OF-RECORD AND ANALYSIS REQUEST

08322001

LAB USE ONLY — MAXXAM JOB #: B081318

ANALYSIS REQUEST

LAB USE ONLY — COC #:

COMPANY NAME:	Laberge Environmental Services
COMPANY ADDRESS:	P.O. Box 21072 Whitehorse, Yukon Y1A 6P7
CLIENT PROJECT NO.:	Faro Benthics
TEL.:	867 668-6838
E-MAIL:	bonnieburns@northwestel.net
FAX:	
SAMPLER NAME (PRINT):	Bonnie Burns/Deborah Fulmer
PROJECT MANAGER:	Bonnie Burns
LABORATORY CONTACT:	Ashley Nivison

	FIELD SAMPLE ID	MAXXAM LAB # (LAB USE ONLY)	MATRIX: GROUNDWATER	SURFACE WATER	DRINKING WATER	SOIL	OTHER	SAMPLING: DATE DD/MM/YY	TIME	# CONTAINERS	Total Phosphorus (P)	TSS, TDS	N1/N2, Alkalinity	pH, Condutivity	Dissolved Low Level Metals (filtered/preserved)	Total Low Level Metals (preserved)	Total organic carbon	Total Orthophosphate	SO4, Cl	Ammonia (N)	[redacted]
1	FC Upper Faro Creek			x				31/8/2010	15:30	5	x	x	x	x	x	x	x	x	x	x	
2	R6 Anvil Cr u/s Rose Creek			x				09/01/2010	13:00	5	x	x	x	x	x	x	x	x	x	x	
3	BD BLIND DUPLICATE			x				09/02/2010		5	x	x	x	x	x	x	x	x	x	x	
4	FB Field Blank			x				09/03/2010		5	x	x	x	x	x	x	x	x	x	x	
5																					
6																					
7																					
8																					
9																					
10																					
11																					
12																					

TAT (Turnaround Time)

LESS THAN 5 DAY TAT MUST HAVE PRIOR APPROVAL

* Some exceptions apply - please contact laboratory

STANDARD	5 BUSINESS DAYS	
RUSH	3 BUSINESS DAYS	
RUSH	2 BUSINESS DAYS	
URGENT	1 BUSINESS DAY	

OTHER BUSINESS DAYS _____

CUSTODY RECORD

PO NUMBER OR QUOTE NUMBER:

SPECIAL DETECTION LIMITS / CONTAMINANT TYPE: Low Level metals

ACCOUNTING CONTACT:

SPECIAL REPORTING OR BILLING INSTRUCTIONS:

CCME / CSR / AB TIER 1 / OTHER

JARS USED:

LAB USE ONLY — ARRIVAL TEMPERATURE °C: 7 6 6 / 6 7 7

LAB USE ONLY — DUE DATE:

LAB USE ONLY — LOG IN CHECK:

	DATE: DD/MM/YY	TIME:	RECEIVED BY:
RELINQUISHED BY SAMPLER: Bonnie Burns			
RELINQUISHED BY:	DATE: DD/MM/YY	TIME: 0930	RECEIVED BY:
RELINQUISHED BY:	DATE: DD/MM/YY	TIME: 09 0710	RECEIVED BY LABORATORY: C ROSEN

COCFORM - BC - 20070822

APPENDIX B

PHOTOGRAPHS, 2010, AND CABIN HABITAT FORM

Photo #1: X2 looking upstream, August 31, 2010.

Photo #2: X2 looking downstream, August 31, 2010.

Photo #3: R2 looking downstream, September 2, 2010.

Photo #4: Staff gauge at X14, September 2, 2010.

Photo #5: R4 looking upstream, September 1, 2010.

Photo #6: R4 looking downstream to the confluence with Anvil Creek, September 1/10.

Photo #7: VGMAIN looking upstream, Sept 1, 2010.

Photo #8: VGMAIN looking downstream, Sept 1, 2010.

Photo #9: V5 looking upstream, Sept 2, 2010.

Photo #10: V5 looking downstream, Sept 2, 2010.

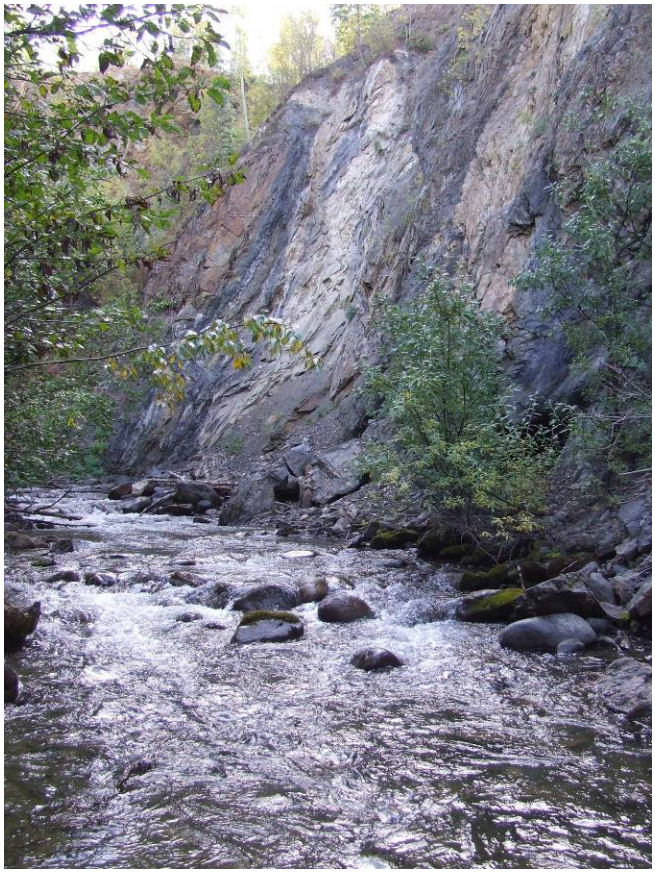


Photo #11: V8 looking upstream, Sept 1, 2010.

Photo #12: V8 looking downstream, Sept 1, 2010.

Photo #13: R6 looking upstream, September 1, 2010.

Photo #14: R6 looking downstream to the confluence with Rose Creek, September 1/10

Photo #15: R7 looking upstream, August 31, 2010.

Photo #16: R7 looking downstream, August 31, 2010.

Photo #17: FC, upper Faro Creek looking upstream, August 31, 2010.

Photo #18: FC, upper Faro Creek looking downstream, August 31, 2010.

Photo #19: VR, upper West Fork Vangorda Creek looking upstream from the haul road, Sept 2/10.

Photo #20 VR, upper West Fork Vangorda Creek looking downstream to the culvert, Sept 2, 2010.

Photo # 21: USFR, upper South Fork Vangorda Creek looking upstream, Aug 31, 2010.

Photo #22: USFR, upper South Fork Vangorda Creek looking downstream, Aug 31, 2010.

Photo #23: BLC, Blind Creek looking upstream to the bridge, September 2, 2010.

Photo #24: BLC, Blind Creek looking downstream, September 2, 2010.

Photo #25: BUC, Buttle Creek looking downstream from the highway, Sept 3, 2010.

Photo #26: BUC, Buttle Creek looking upstream from the sample site, Sept 3, 2010.

Photo # 27: HOC, Horton Creek looking upstream, August 30, 2010.

Photo # 28: HOC, Horton Creek looking downstream, August 30, 2010.

Field Crew_____Site Code:_____

Sampling Date (D/M/Y) _____

OHS: Site Inspection Sheet Completed ☐

Primary Site Data

CABIN Study Name: _____

Local Basin name:_____Ecoregion_____

River/Stream Name:_____Stream Order (map scale 1:50,000):_____

Select one: Test Site ☐ Potential Reference Site ☐ Confirmed ☐ How?

Geographical description/notes:

Surrounding Land Use: (check those present) information source: _____

☐ Forest ☐ Field/Pasture ☐ Agriculture ☐ Residential/Urban
☐ Logging ☐ Mining ☐ Commercial/Industrial ☐ Other _____

Dominant surrounding Land Use: (check one) information source: _____

☐ Forest ☐ Field/Pasture ☐ Agriculture ☐ Residential/Urban
☐ Logging ☐ Mining ☐ Commercial/Industrial ☐ Other _____

Location Data

Latitude:_____N Longitude: - _____W (deg/min/sec *or* decimal deg)

Elevation:_____(fasl *or* masl) GPS Datum: GRS80 (NAD83/WGS84) ☐ Other _____ ☐

Site Location Map Drawing

Field Crew_____Site Code:_____

Sampling Date (D/M/Y) _____

Photos

field sheet ☐ upstream ☐ downstream ☐ across site ☐ aerial view ☐

substrate (exposed bar) ☐ substrate (aquatic) ☐ miscellaneous _____ ☐

Reach Data *(represent 6x bankfull width)*

1. Habitat types present in reach *(check those present):*

☐ riffle ☐ rapids ☐ straight run ☐ pool/back eddy

2. Canopy Coverage *(hint: stand in middle of stream and look up - check one)*

☐ 0% ☐ 1-25% ☐ 26-50% ☐ 51-75% ☐ 76-100%

3. Macrophyte Coverage *(i.e. not algae; check one):*

☐ 0% ☐ 1-25% ☐ 26-50% ☐ 51-75% ☐ 76-100%

4. Streamside Vegetation (*check those present):*

☐ ferns/grasses ☐ shrubs ☐ deciduous trees ☐ coniferous trees

5. Dominant Streamside Vegetation *(check one)*:

☐ ferns/grasses ☐ shrubs ☐ deciduous trees ☐ coniferous trees

6. Periphyton Coverage on Substrate *(benthic algae; check one*)

☐ **1** - Rocks not slippery, no obvious colour (thin layer < 0.5 mm thick)

☐ **2** - Rocks slightly slippery, yellow-brown to light green colour (0.5-1 mm thick)

☐ **3** - Rocks have a noticeable slippery feel (footing is slippery), with patches of thicker green to brown algae (1-5 mm thick)

☐ **4** - Rocks are very slippery (algae can be removed with thumbnail), numerous large clumps of green to dark brown algae (5 mm -20 mm thick)

☐ **5** - Rocks mostly obscured by algal mat, extensive green, brown to black algal mass may have long strands (> 20 mm thick)

Benthic Invertebrate Samples

Habitat sampled (*check one*): ☐ riffle ☐ rapids ☐ straight run ☐ pool/back eddy

400 µm mesh Kick net	
Person Sampling	
Sampling Time (i.e. 3 min)	
No. of Sample Jars	
Typical Depth (in kick area)	

Preservative used: _____

Sampled sieved on site using "Bucket Swirling Method":

YES ☐ NO ☐

If YES, debris collected for QAQC ☐

Field Crew_____Site Code:_____

Sampling Date (D/M/Y) _____

SUBSTRATE DATA

Surrounding/Interstitial Material

Circle substrate size category for surrounding material

SUBSTRATE SIZE CLASS	CATEGORY
organic cover	0
<0.1 cm	1
0.1-0.2 cm	2
0.2-1.6 cm	3
1.6-3.2 cm	4
3.2-6.4 cm	5
6.4-12.8 cm	6
12.8-25.6 cm	7
>25.6 cm	8
bedrock	9

100 Pebble Count & Embeddedness of the armour layer on the stream bed

Measure the intermediate axis & the depth the substrate is buried in the surrounding material
If the site is bedrock or sand, indicate that the pebble count could not be done
E: 1=completely embedded, 2=3/4 embedded, 3=1/2 embedded, 4=1/4 embedded, 5=unembedded

	Diameter (cm)	E		Diameter (cm)	E		Diameter (cm)	E		Diameter (cm)	E
1			26			51			76		
2			27			52			77		
3			28			53			78		
4			29			54			79		
5			30			55			80		
6			31			56			81		
7			32			57			82		
8			33			58			83		
9			34			59			84		
10			35			60			85		
11			36			61			86		
12			37			62			87		
13			38			63			88		
14			39			64			89		
15			40			65			90		
16			41			66			91		
17			42			67			92		
18			43			68			93		
19			44			69			94		
20			45			70			95		
21			46			71			96		
22			47			72			97		
23			48			73			98		
24			49			74			99		
25			50			75			100		

Note: *Dominant size category & subdominant size category based on substrate size class table will be determined in CABIN. Wolman D_{50} (median diameter), Wolman Dg (geometric mean diameter) and the % composition of the substrate classes are also automatically calculated with the 100 pebble measurements entered into CABIN. Median embeddenss score will also be calculated based on data entered into CABIN*

Field Crew_____Site Code:_____

Sampling Date (D/M/Y) _____

Water Chemistry **Time**: _____(24hr clock) **Time zone**: _____

Air Temp (ºC) _____Water Temp _____(ºC) pH _____

Specific Conductance (µs/cm) _____DO (mg/L) _____Turbidity (NTU) _____

Check if samples collected:

☐TSS

☐Nitrogen (i.e. total, nitrate, nitrite, dissolved, ammonia) ☐Phosphorus (total, ortho, dissolved)

☐Major Ions (i.e. alkalinity, hardness, Cl, SO4) ☐Other_____

Channel Data

Slope (*indicate how slope was measured)*

☐ 1. **Calculated from map** *(small scale map recommend i.e. 1:20,000)*:_____

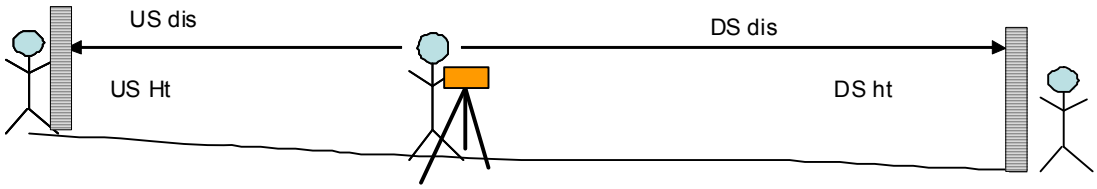
contour interval (vertical distance) _____(m), distance between contour intervals (m)_____

slope = vertical distance/horizontal distance =_____

☐ 2. **Measured in field** (*circle device and fill out table according to device used: a or b*)

a. survey equipment **b. hand level & measuring tape**

Measurements	Upstream (US)	Downstream (DS)	Calculation
[a]Top Hairline (T)			
[a]Mid Hairline (ht) OR [b]Height of rod			
[a]Bottom Hairline (B)			
[b]Distance (dis) OR [a]T-B x 100	[a]US_{dis}=T-B	[a]DS_{dis}=T-B	$US_{dis}+DS_{dis}$=
Change in height (Δht)			$DS_{ht}-US_{ht}$=
Slope (Δht/total dis)			



Field Crew_____Site Code:_____

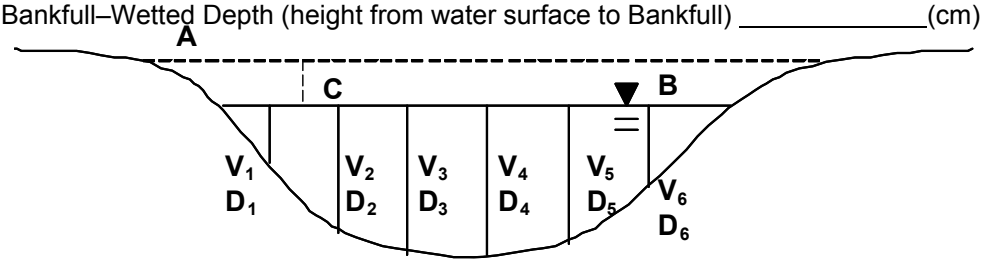
Sampling Date (D/M/Y) _____

Widths and Depth

Location at site _____*(note where in sample site i.e. d/s of kick area)*

A. Bankfull Width _____(m) B. Wetted Stream Width: _____(m)

C. Bankfull–Wetted Depth (height from water surface to Bankfull) _____(cm)



For wetted widths > 5m, measure a minimum of 5-6 equidistant locations;
For wetted widths < 5m, measure 3-4 equidistant locations

Velocity and Depth (*Check appropriate measuring device and fill out appropriate chart below*):

☐ **1. Velocity Head Rod (or ruler)**: *Equation* - velocity (m/s) = √ [2(ΔD/100) * 9.81]

☐ **2. Rotary meters: Gurley/Price/mini-Price/Propeller** *(refer to specific meter conversion chart for calculation)*

☐ **3. Direct velocity measurements**: ☐Marsh-McBirney ☐Sontek or ☐Other_____

	1	2	3	4	5	6	AVG
Distance from Shore (m)							
Depth (**D**) (cm)							
1. Velocity Head Rod (ruler)							
Flowing water Depth ($\mathbf{D_1}$) (cm)							
Depth of Stagnation ($\mathbf{D_2}$) (cm)							
Change in depth ($\mathbf{\Delta D=D_2-D_1}$) (cm)							
2. Rotary meters							
Revolutions							
Time (min 40 sec)							
3. Direct Measurement							
Velocity (**V**) (m/s) Direct measurement or Calculated measurement							

Field Crew_____Site Code:_____

Sampling Date (D/M/Y) _____

Site Inspection

Site Inspected by: _____

☐ Itinerary left with contact person (incl. contact numbers)

Contact Person: _____ Time checked in: _____

Form of communication: ☐ radio ☐ cell ☐ satellite ☐ hotel/pay phone ☐ SPOT

Phone number: (___) _____

☐ Wading Task Hazard Analysis read by all field staff

☐ Wading Safe Work Procedures read by all field staff

Vehicle Safety

☐ Safety equipment (first aid, fire extinguisher, blanket, emergency kit in vehicle)

☐ Equipment and chemicals safely secured for transport

☐ Vehicle parked in safe location; pylons, hazard light, reflective vests if necessary

Notes:

Shore & Wading Safety

☐ Instream hazards identified (i.e. log jams, deep pools, slippery rocks)

☐ PFD worn

☐ Appropriate footwear, waders, wading belt

☐ Belay used

Notes:

APPENDIX C

BENTHIC INVERTEBRATE DATA, 2010

APPENDIX C **BENTHIC INVERTEBRATE DATA, FARO MINE COMPLEX, 2010**

Site:	X2	R2	R4	VGMAIN	V5	V8	R6	R7	FC	VR	USFR	BLC	BUC	HOC	Totals	%
Phylum: Arthropoda																
Subphylum: Hexapoda																
| Class: Insecta																
| Order: Ephemeroptera							13								13	0.01
| Family: Ameletidae																
Ameletus sp.				25		6			1050	37	45	18			1181	1.31
| Family: Baetidae																
Acentrella sp.	40						25								65	0.07
Baetis bicaudatus					13					42	64				119	0.13
Baetis sp.	1260	300	430	1238	217	118	1313	140	300	11	973	23	340	90	6753	7.51
| Family: Ephemerellidae	340		67	38		2	175	320	350	126	236	5	60	8	1727	1.92
Drunella doddsi			11		4	3	13			37	18			8	94	0.10
Drunella grandis			4				25						10		39	0.04
Ephemerella sp.	20					3	25				45			16	109	0.12
| Family: Heptageniidae			356	163	78	67	88	80	100	274	82	23	200	106	1617	1.80
Cinygmula sp.										11	9			2	22	0.02
Epeorus sp.					4		25		50	47	55				181	0.20
Rhithrogena sp.			33	38								27			98	0.11
| Order: Plecoptera				13											13	0.01
| Family: Capniidae	80	40	22	375	52	58	50	180	50	637	9	100	10	57	1720	1.91
| Family: Chloroperlidae										47					47	0.05
Alloperla sp.				38	13	3				11				10	75	0.08
Suwallia sp.		20	11	38	74	5	25	120						39	332	0.37
Sweltsa sp.			22			5	25		150	195	36	5			438	0.49
| Family: Leuctridae			11	88		16	63					5	10		193	0.21
| Family: Nemouridae																
Podmosta sp.					4			20							24	0.03
Zapada cinctipes	40			13	4	2	13		250		18				340	0.38
Zapada columbiana					26	1			50	42	64				183	0.20
Zapada oregonensis group	60	20	11	75	74	11		20		11	27		20		329	0.37
Zapada sp.	400	40	30	888	122	74	75	300	2100	111	418		610	61	5229	5.82
| Family: Perlodidae	20	40	4				13		50	11		14		4	156	0.17
Isoperla sp.											9				9	0.01
Megarcys sp.			19	13	4					11					47	0.05
Skwala sp.			7	38											45	0.05
| Family: Taeniopterygidae				113	109	5	25			5	18	5	70	78	428	0.48
| Order: Trichoptera	40			75	13	1				5					134	0.15
| Family: Apataniidae																
Apatania sp.					9	7									16	0.02
| Family: Brachycentridae			7	13											20	0.02
| Family: Glossosomatidae																
Glossosoma sp.	20		7										10		37	0.04
| Family: Hydropsychidae	20		4	50							27		10		111	0.12
Parapsyche sp.	20		7	25		1					27				80	0.09
| Family: Limnephilidae																
Ecclisomyia sp.						10			50	5					65	0.07
| Family: Rhyacophilidae																
Rhyacophila sp.	20		48	100	83	7					18	9	30	12	327	0.36
| Order: Diptera			4		4	1									9	0.01
| Family: Blephariceridae																
Agathon sp.														2	2	0.002
| Family: Ceratopogonidae																
Atrichopogon sp.													10		10	0.01
Bezzia sp.												5			5	0.01
Mallochohelea		100													100	0.11
Probezzia sp.		100	11									9	10		130	0.14
| Family: Chironomidae																
| Subfamily: Chironominae																
| Tribe: Tanytarsini																
Micropsectra sp.	15000	9500		50		12	500	4200	5700		373		240		35575	39.57
| Tribe: Chironomini																
Saetheria sp.												168			168	0.19
Stempellinella sp.			19		9						45	86	370		529	0.59
Zavrelia sp.													450		450	0.50
| Subfamily: Diamesinae																
| Tribe: Diamesini																
Diamesa sp.					148	84									232	0.26
Pagastia sp.	400	400	37	13				280	350	21	36		20		1557	1.73
Potthastia longimana group													90		90	0.10
Pseudodiamesa sp.										11					11	0.01
| Subfamily: Orthocladiinae				163						47		105			315	0.35
Brillia sp.				50							9				59	0.07
Cardiocladius sp.									3200						3200	3.56
Cricotopus sp.			7							16					23	0.03
Eukiefferiella sp.				175			38							18	231	0.26
Euryhapsis sp.												14			14	0.02

APPENDIX C **BENTHIC INVERTEBRATE DATA, FARO MINE COMPLEX, 2010**

Site:	X2	R2	R4	VGMAIN	V5	V8	R6	R7	FC	VR	USFR	BLC	BUC	HOC	Totals	%
Heleniella sp.					4							50			54	0.06
Hydrobaenus sp.												159			159	0.18
Orthocladius sp.	300	180			26	88	1300	1780			64		140	53	3931	4.37
Rheosmittia sp.												282			282	0.31
Tvetenia sp.	14000									21	73		130		14224	15.82
| Subfamily: Tanypodinae		300													300	0.33
| Tribe: Pentaneurini																
Thienemannimyia group												132	170		302	0.34
| Family: Empididae	20						25		50						95	0.11
Chelifera/ Metachela	120	100		13		13		80		5	9	77		4	421	0.47
Oreogeton sp.				13	4					5				10	32	0.04
| Family: Psychodidae					9	1									10	0.01
Pericoma sp.	40	20	63		4	3	25	40				50	70	51	366	0.41
| Family: Simuliidae			7							5					12	0.01
Prosimulium sp.				63	191					11					265	0.29
Simulium sp.	20												110		130	0.14
| Family: Tipulidae					4										4	0.004
Dicranota sp.	20	40		100	9	2	25		200			32	20	6	454	0.51
Hesperoconopa sp.						5						14			19	0.02
Limnophila sp.								20							20	0.02
| Class: Entognatha																
| Order: Collembola																
| Family: Poduridae					22										22	0.02
Subphylum: Crustacea																
| Class: Ostracoda	280	400										9	60		749	0.83
| Class: Copepoda																
| Order: Cyclopoida												0	0		0	
Subphylum: Chelicerata																
| Class: Arachnida																
| Order: Trombidiformes																
| Family: Aturidae																
Aturus sp.	80					1	25	20	200		9		10		345	0.38
| Family: Feltriidae																
Feltria sp.	40								150				10		200	0.22
| Family: Hygrobatidae																
Hygrobates sp.									100			14	20	2	136	0.15
| Family: Lebertiidae																
Lebertia sp.	200	160	7		4		25	20	300	5	9	9	40		779	0.87
| Family: Sperchontidae																
Sperchon sp.	80		4	13		16	38		200		18				369	0.41
Sperchonopsis sp.														2	2	0.002
Suborder: Prostigmata	80	100	4				25		150			5		2	366	0.41
| Order: Oribatei																
| Family: Hydrozetidae									50						50	0.06
Phylum: Mollusca																
| Class: Gastropoda		20													20	0.02
Phylum: Annelida																
Subphylum: Clitellata																
| Class: Oligochaeta																
| Order: Tubificida																
| Family: Enchytraeidae																
Enchytraeus	120	20	7			1				16	55				219	0.24
| Family: Naididae					61	2				195		5			263	0.29
Phylum: Nemata	60	60	0			2	13		0	0	36	0		0	171	0.19
Phylum: Platyhelminthes																
| Class: Turbellaria																
| Order: Tricladida																
| Family: Planariidae																
Polycelis coronata						3									3	0.003
Totals:	**33240**	**11960**	**1281**	**4110**	**1402**	**639**	**4030**	**7620**	**15200**	**2034**	**2934**	**1459**	**3350**	**641**	**89900**	