2019 BENTHIC INVERTEBRATE MONITORING

EAGLE GOLD PROJECT

For

Victoria GOLD CORP

Submitted by

Laberge Environmental Services

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EXECUTIVE SUMMARY

The 2019 annual benthic invertebrate monitoring program represents the third survey completed during a construction year for the Eagle Gold Project. Nine sites were investigated within four drainages. Water quality and stream sediment programs were also undertaken during the benthic invertebrate assessment to support characterization of the existing habitat conditions. All three media were sampled concurrently.

The 2019 data indicates healthy robust benthos communities at all sites with good representation of pollution sensitive species.

As with all previous benthic invertebrate studies at the Eagle Gold Project, arsenic concentrations were high in the water column at all monitoring sites. In 2019, arsenic concentrations at four monitoring sites exceeded the recommended federal guidelines for the protection of aquatic life. The two major uptake vectors of contaminants are through the ingestion of metal enriched sediments or suspended particles and/or uptake from solution.

Although concentrations of arsenic were high, it is likely that it is not in a bioavailable form. The presence of good to excellent water quality (as measured by the Hilsenhoff Biotic Index), a relatively high density of organisms, a high species diversity (as measured by the Simpson Diversity Index), and the presence of pollution-sensitive insects, as reflected in the high numbers of Ephemeroptera, Plecoptera and Trichoptera (EPT) individuals (assuming EPT is used as an index of overall health in a stream) at all of the sites, supports this conclusion.

1.0 INTRODUCTION

Benthic invertebrate monitoring has been completed at the Eagle Gold Project site (the Project) since 1995. Various aquatic monitoring tasks are undertaken at the Project as outlined in Victoria Gold's Environmental Monitoring, Surveillance and Adaptive Management Plan- version 2020-01 (EMSAMP). The 2019 benthic invertebrate monitoring program was carried out from September 5-7, 2019, representing the third survey completed during a construction year for the Project. Construction began in August 2017; major facility construction was complete by July 2019, and was followed by several months of commissioning and the final aspects of construction. Annual benthic invertebrate monitoring was conducted in September 2017 and September 2018.

Benthic invertebrate surveys were completed at nine sites in four drainage areas within the Project footprint. Site locations are detailed in Table 1 and illustrated in Figure 1. Sites W1, W26 and W22 are located above the Project influence, while site W6 is in a different drainage basin and also not affected by the Project.

Table 1: Location of Benthic Invertebrate Sample Sites

Drainage	Site	Date Sampled	Site Description	Northing	Easting
Haggart Creek	W22	2019-09-06	Haggart Creek above Dublin Gulch	7101377	458319
	W4	2019-09-06	Haggart Creek below Dublin Gulch	7101223	458144
	W29	2019-09-06	Haggart Creek below Eagle Creek	7099583	458225
	W5	2019-09-05	Haggart Creek above Lynx Creek	7095887	457815
	W23	2019-09-05	Haggart Creek below Lynx Creek	7095682	457790
Dublin Gulch	W1	2019-09-07	Dublin Gulch above Stewart Gulch	7101545	460249
	W26	2019-09-07	Stewart Gulch	7101443	460331
Eagle Creek	W27	2019-09-06	Eagle Creek below LDSP	7100997	458235
Lynx Creek	W6	2019-09-05	Lynx Creek above Haggart Creek	7095964	458099

2.0 METHODS

2.1 WATER QUALITY

Monthly water quality samples are collected as described by the EMSAMP, with nine of these locations coinciding with benthic invertebrate survey sites. Laberge Environmental Services (Laberge) and Victoria Gold Corp. (VGC) environmental staff collected water quality samples from these nine sites during benthic invertebrate monitoring to characterize the existing aquatic conditions. Water quality samples were collected in a fast-flowing section of the stream, prior to any other sampling activity. In-situ water quality measurements were obtained using a YSI multiparameter water quality meter.

Samples were collected in bottles supplied by Analytical Laboratory Services (ALS) from their Whitehorse, Yukon depot. At each site, samples were collected in a 500 mL plastic bottle for general physical parameters. Samples to be analyzed for anions and nutrients were collected in 120 mL plastic bottles. Samples to be analyzed for metals were collected in 60 mL plastic bottles and preserved with nitric acid (HNO_3). Samples for mercury were collected in pre-charged hydrochloric acid (HCl) 40 mL vials. Total cyanide samples were collected in pre-charged sodium hydroxide (NaOH) 60 mL brown plastic bottles. Samples to be analyzed for total and dissolved organic carbon were collected in pre-charged 120 mL amber glass bottles and preserved with sulfuric acid (H_2SO_4).

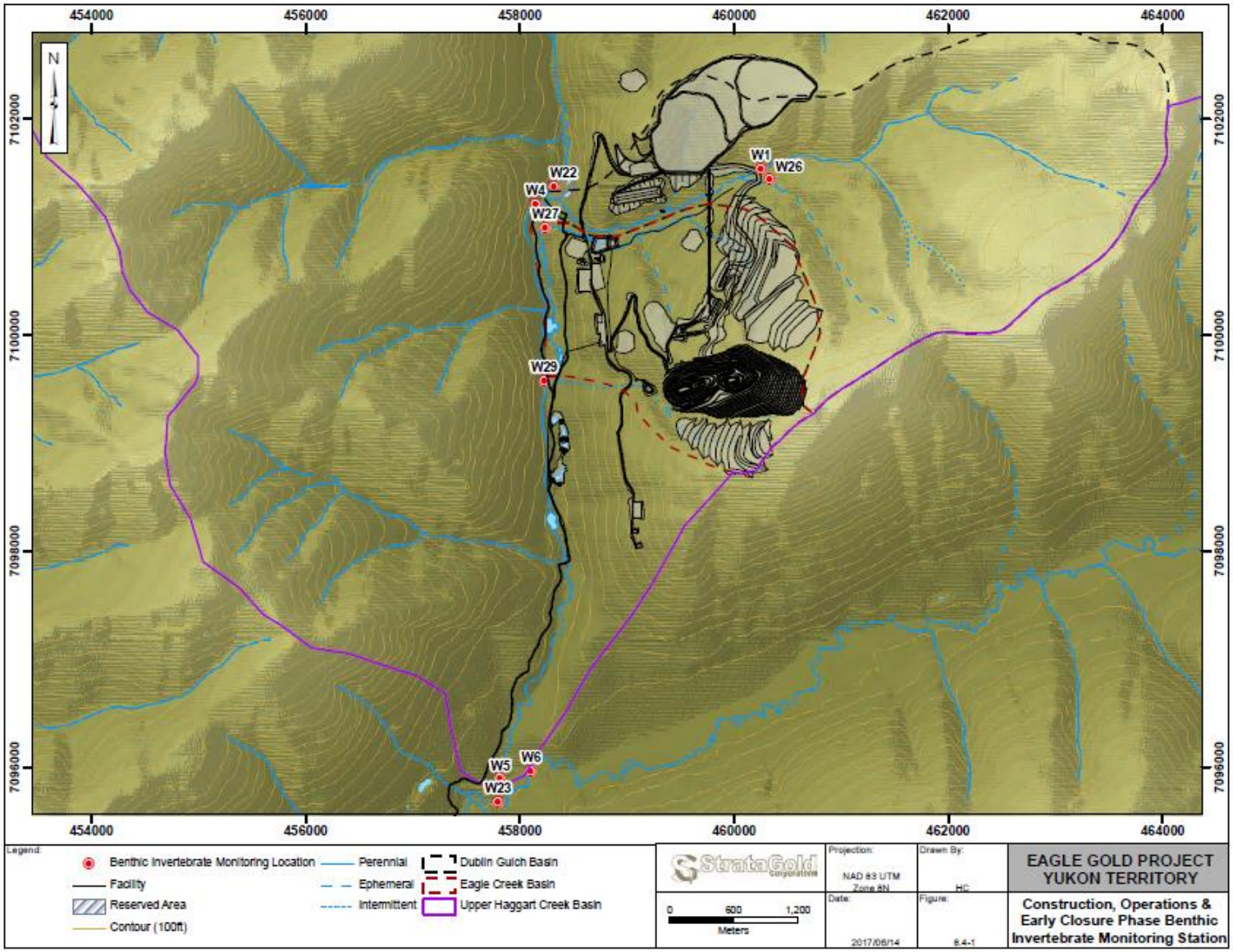


Figure 1 Locations of Benthic Invertebrate Sampling Sites for the Construction Phase

Dissolved metals, dissolved mercury and dissolved organic carbon samples were filtered in the field using disposable sterile syringes and in-line filters (filter pore size 0.45 microns) prior to preservation.

Methods used by ALS are based on the B.C. Ministry of Environment & Climate Change Strategy (BC-MOE) and American Public Health Association (APHA) standard methods and are included in the ALS analytical report (Appendix A).

2.2 BENTHIC INVERTEBRATES

Triplicate samples were collected from the nine sites using a Surber sampler (area = 0.0920 m^2) with a mesh size of 300 microns. The sampler was positioned securely at a random location on the stream bottom, parallel to the water flow. The bed material within the frame was cleaned and washed by hand with the fast-flowing current carrying the disturbed bottom fauna and detritus into the collection bag. The remaining sediment was stirred to a 10 cm depth to dislodge invertebrates. The level of effort for each sample and at each site was comparable. Riffle areas were targeted at each site as this habitat supports the greatest density and diversity of invertebrates (Epele et al, 2012). The triplicate samples were collected approximately 5 to 15 m apart within a given stream reach, as the site-specific geomorphology allowed, starting downstream and moving upstream to minimize effects from substrate disruption and avoid potential contamination.

The captured invertebrates and detritus were transferred from the collection bags to one litre nalgene bottles and preserved with 10% buffered formalin. Samples were shipped by ground transport to an entomologist for sorting, identification and enumeration.

Cordillera Consulting in Summerland, BC conducted analysis of the benthic invertebrate samples. Once the samples were received at the laboratory they were assigned a Cordillera Consulting code (CC#) and entered into a database. Samples were sorted and evaluated for total numbers. If the numbers were estimated to be greater than 600 the sample was sub-sampled to achieve a minimum number of 300 organisms. Subsampling was conducted with the use of a Marchant Box. When using the Marchant box, cells were extracted at the same time in the order indicated by a random number table. If the 300th organism was found part way into sorting a cell then the balance of that cell was sorted. If the organism count had not reached 300 by the 50th cell then the entire sample was sorted. Organisms were identified to genus or species level for all insects and if possible, to that level for non-insect specimens. For full details on the methodology used, Cordillera Consulting's method is provided in Appendix B.

2.2.1 Quality Assurance / Quality Control (QA/QC)

Quality assurance and quality control (QA/QC) procedures for the field component consisted of: ensuring all personnel were adequately trained, sampling methods per site and between sites were consistent, samples were correctly collected, labeled and preserved, equipment was properly maintained, detailed field notes were kept, chain-of-custody forms were used, and safe shipping and storage methods were followed.

Water quality QA/QC samples including two replicates, one field blank and a travel blank provided by ALS were submitted to the laboratory as part of the monitoring program. Relative percent difference (RPD) for all parameters in each replicate sample was calculated to determine the representativeness of sample collection (Appendix A, Table A-2).

As a measure of QA/QC for the laboratory component, refer to the ALS and Cordillera Consulting reports in Appendix A and B respectively.

2.2.2 Data Analysis

The data was subjected to several metrics and indices to describe the benthic populations. Abundance was determined by summing all of the individuals present in the sample. As the area of substrate sampled was known, the abundance per site was calculated as density (organisms/m^3) to allow for comparisons with previous surveys.

Taxonomic richness is a simple measure of diversity where the total number of each invertebrate species is counted per site (or stream reach). Diversity can be further refined using many different indices; the Simpson's Diversity Index (SDI) was selected as the best index for diversity and was calculated using the equation:

$$SDI = 1 - \frac{\sum n(n-1)}{N(N-1)}$$

where n = number of individuals of each species per site and N = total number of individuals of all species per site.

The SDI takes into account the number of species present, as well as the relative abundance of each species, and was used to allow comparisons to previous surveys, which also provided SDI values per site.

Biotic indices are often used to ascertain the general water quality at a particular site. The Hilsenhoff Biotic Index (HBI) is based on a formula using pre-assigned pollution tolerance scores for families. The following equation was used where n equals the number of individuals in taxa i, a is the preassigned pollution tolerance value assigned to taxa i, and N is the total number of individuals in the sample.

$$HBI = \frac{\sum n_i \times a_i}{N}$$

3.0 RESULTS

All data in the tables and figures have been grouped into drainages and arranged from upstream sites to downstream sites per drainage.

3.1 WATER QUALITY

In-situ data were collected at each site and are presented with the benthic field conditions presented in Table B-1 in Appendix B. Water temperatures were generally cool and reflected late summer/early autumn conditions, ranging from 2.4ºC to 10.1ºC. All sites were near neutral to slightly alkaline with pH ranging from 6.54 at W23 to 8.08 at W1. Conductivity is generally a measurement of the dissolved ions present and ranged from 119.2 µS/cm at W1 to 424.9 µS/cm at W27. Water was clear throughout the study area during the time of sampling.

Analytical results of water quality samples collected during the benthic invertebrate monitoring program are tabulated in Table A-1 of Appendix A, including the Canadian Council Ministers of Environment (CCME) Water Quality Guidelines for the Protection of Aquatic Life.

Total suspended solids concentrations from all sites sampled were below detection (3.0 mg/L). With the exception of arsenic, all metal concentrations were generally low throughout the study area. Concentrations of total and dissolved arsenic exceeded the CCME guideline of 0.005 mg/L

at sites W1, W26, W27, and W6. Two samples also exceeded the CCME guideline of 0.002 mg/L for dissolved copper at W5 and W26.

3.2 BENTHIC INVERTEBRATES

Five phyla were found in the study area: Arthropoda, Mollusca, Annelida, Nematoda, and Platyhelminthes (Appendix B). Of these, taxonomists do not consider Nematoda and Platyhelminthes to be benthic organisms. However, the presence of these groups has been noted where encountered in each sample. The numbers for these taxa reported in Appendix B reflect presence, not total numbers of individuals in the sample.

Of the organisms that were enumerated, a total of 30,128 invertebrates, representing 127 different taxonomic groups were identified throughout the study area. The following sections pertain to these taxa.

3.2.1 Abundance and Taxonomic Richness

General statistics on the benthic communities sampled at each site in 2019 are provided in Table 2. The total number of organisms for the triplicates from each site (with the exception of W26 where only a single sample was collected) was summed to give a total abundance value for that site. Densities were calculated based on the total area sampled per site. Community size varied throughout the study area with densities ranging from 2,685 individuals/m^2 at W26, Stewart Gulch, to 18,550 individuals/m^2 at W23, Haggart Creek below Lynx Creek.

Diversity was determined for each site by enumerating all the taxonomic groups identified from species to phylum. For biomonitoring purposes, total taxa richness is the index of choice (Reice and Wohlenberg, 1993). All communities were diverse, ranging from 36 different taxonomic groups at W27, Eagle Creek below LDSP, to 55 different taxonomic groups at W4, Haggart Creek below Dublin Gulch (26 taxonomic groups were captured at W26, Stewart Gulch from a single sample). The SDI was determined for each sample (Appendix B, Table B-2) and averaged for each site. This index takes into account the number of species present as well as the relative abundance of each species, and ranges from 0 to 1, with numbers approaching 1 representing greater diversity. This method showed that all communities were very diverse and ranged from 0.80 at W22, Haggart Creek above Dublin Gulch and W27, Eagle Creek below LDSP, to 0.89 at W5, Haggart Creek above Lynx Creek.

Table 2: General Statistics on Benthic Communities, 2019

Drainage	Site	Abundance (organisms/site)	Density (organisms/m^2)	Taxonomic Richness/site	SDI/site
Haggart Creek	W22	3156	11324	44	0.80
	W4	2779	9971	55	0.81
	W29	5156	18500	43	0.85
	W5	3810	13670	50	0.89
	W23	5170	18550	47	0.88
Dublin Gulch	W1	3251	11665	42	0.88
	W26	247	2685	26	0.85
Eagle Creek	W27	2508	8999	36	0.80
Lynx Creek	W6	4051	14535	40	0.81

3.2.2 Distribution

The composition of the benthos communities was calculated as a percentage of the major taxonomic groups present, with pie charts generated for each site (Figure 2). The grouping “Other” consists of invertebrates from Collembola, Thysanoptera and Bivalvia.

The Insect orders Ephemeroptera (mayflies), Plecoptera (stoneflies) and Diptera (true flies) formed the bulk of each community. Oligochaeta (aquatic earthworms) was also common at W1, W22 and W29 representing 16.1%, 13.9% and 12% of the population, respectively. The majority of Oligochaeta belonged to the Family Lumbriculidae, commonly found in freshwater environments (Pickavance, 1971).

Many aquatic insects require good water quality to thrive. Larvae of mayflies (Ephemeroptera), stoneflies (Plecoptera) and caddisflies (Trichoptera) require clear, clean, well-oxygenated water and have very low tolerance to pollution (Rosenberg and Resh, 1993). Analyzing the combined total number of EPT (Ephemeroptera, Plecoptera, Trichoptera) individuals at a site, gives an indication of the overall health of the stream (Hauer and Lamberti, 2006, Resh and Jackson, 1993, DFO-Streamkeepers). Table 3 summarizes the number of EPT found per site, the proportion of EPT in the benthic invertebrate community and the number of EPT taxa (richness) in each community.

Overall, all communities in the study area had good representation of pollution sensitive invertebrates. The highest abundance of EPT occurred at W23, Haggart Creek below Lynx Creek, with 4288 individuals present. The highest proportion of EPT was documented at W6, Lynx Creek above Haggart Creek forming 86% of the community. The greatest EPT taxonomic richness was found at W4, W5 and W23 with 26 different taxa identified at each site.

Table 3: EPT Abundance, Proportion and Richness, 2019

Drainage	Site	EPT Abundance	EPT %	EPT Richness
Haggart Creek	W22	2495	79	23
	W4	2331	84	26
	W29	3988	77	21
	W5	3211	84	26
	W23	4288	83	26
Dublin Gulch	W1	1586	49	18
	W26	129	52	9
Eagle Creek	W27	1049	42	8
Lynx Creek	W6	3492	86	20

The Pacific Stream Keepers Federation has indicated that streams with an EPT richness greater than 8 are of good quality (DFO). Based on this water quality assessment protocol, all sites in the Eagle Gold Project study area are of good quality.

FIGURE 2 THE COMPOSITION OF THE BENTHIC INVERTEBRATE COMMUNITIES, EAGLE GOLD PROJECT 2019

Another method to determine the health of a stream is to calculate the Hilsenhoff Biotic Index (HBI) (Hauer and Lamberti, 2006), as defined above in Section 2.2.2. Due to differences in their tolerance to pollution, the presence or absence of certain invertebrate families can provide valuable information on stream water quality. The HBI ranges from 0 to 10, where lower numbers reflect a higher abundance of sensitive groups. Therefore, sites with low HBI values are considered to have excellent water quality and would contain benthic communities with a high number of pollution sensitive families. This index was calculated for each sample (Appendix B, Table B-2) and averaged for each site. Table 4 identifies the water quality categories based on HBI and Table 5 summarizes mean data for the study area. All sites in the study area rated from good to excellent quality in 2019.

Table 4: Water Quality Categories Based on HBI

HBI	Water Quality Category
0.00 - 3.75	Excellent
3.76 - 4.25	Very Good
4.26 - 5.00	Good
5.01 - 5.75	Fair
5.76 - 6.50	Fairly Poor
6.51 - 7.25	Poor
7.26 - 10.00	Very Poor

Table 5: Water Quality Based on HBI, 2019

Drainage	Site	HBI	Water Quality Category
Haggart Creek	W22	3.82	Very good
	W4	3.86	Very good
	W29	4.21	Very good
	W5	3.41	Excellent
	W23	3.63	Excellent
Dublin Gulch	W1	3.51	Excellent
	W26	3.95	Very good
Eagle Creek	W27	4.47	Good
Lynx Creek	W6	3.33	Excellent

3.2.3 Comparisons with Past Data

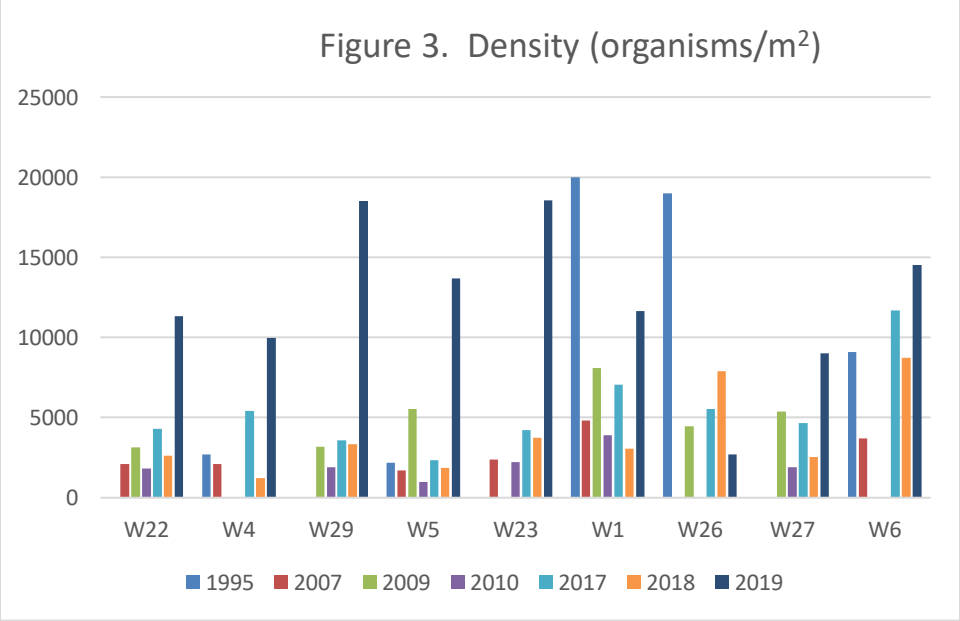
Benthic invertebrate monitoring was conducted in the Eagle Gold Project area in 1995, 2007, 2009 and 2010. These studies have been summarized in a report prepared by Stantec (2011). Benthic invertebrate monitoring as part of the EMSAMP was undertaken in 2017 and 2018. W1 and W5 are the only sites where benthic invertebrates have been collected during each period. Data collected in 2019 and all previous surveys for the sites that overlap are presented in Table 6 and Figures 3 and 4. Two parameters were chosen to detect any changes or trends over time; from Table 2: abundance as density, and diversity using the SDI.

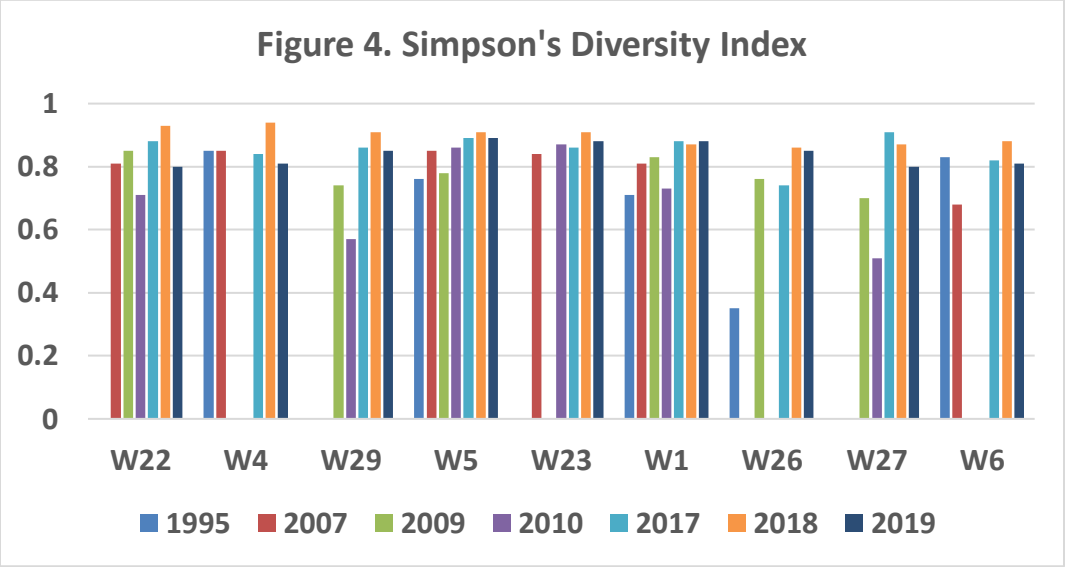
In 2019, the highest densities of benthic invertebrates on record were documented in the Haggart Creek, Eagle Creek and Lynx Creek drainages. In fact, for Haggart Creek in particular, the densities were 2-3 times those of all previous years (Figure 3). Although densities were relatively high in 2019 for Dublin Gulch (W1), the highest density documented in the Dublin Gulch watershed occurred in

1995. Generally, except for Stewart Gulch (W26) in 1995, all sites had relatively high SDI values over time, with the highest diversities for most sites occurring in 2018, and the lowest overall diversities occurring in 2010 (Figure 4).

Table 6: Density and Diversity Over the Study Period

Drainage		Haggart Creek					Dublin Gulch		Eagle Creek	Lynx Creek
Site		W22	W4	W29	W5	W23	W1	W26	W27	W6
Density (organisms/m^2)	1995		2,700		2,200		20,000	19,000		9,100
	2007	2,100	2,100		1,700	2,400	4,800			3,700
	2009	3,138		3,171	5,518		8,087	4,461	5,374	
	2010	1,832		1,888	968	2,219	3,916		1,890	
	2017	4,313	5,404	3,592	2,339	4,223	7,069	5,540	4,657	11,704
	2018	2,623	1,206	3,348	1,862	3,728	3,046	7,879	2,544	8,715
	2019	11,324	9,971	18,500	13,670	18,550	11,665	2,685	8,999	14,535
Site Average		**4,222**	**4,276**	**6,100**	**4,037**	**6,224**	**8,369**	**7,553**	**4,693**	**9,551**
Creek Average		**4,878**					**8,179**		**4,693**	**9,551**
Diversity (Simpson's Index)	1995		0.85		0.76		0.71	0.35		0.83
	2007	0.81	0.85		0.85	0.84	0.81			0.68
	2009	0.85		0.74	0.78		0.83	0.76	0.70	
	2010	0.71		0.57	0.86	0.87	0.73		0.51	
	2017	0.88	0.84	0.86	0.89	0.86	0.88	0.74	0.91	0.82
	2018	0.93	0.94	0.91	0.91	0.91	0.87	0.86	0.87	0.88
	2019	0.80	0.81	0.85	0.89	0.88	0.88	0.85	0.80	0.81
Site Average		**0.83**	**0.86**	**0.79**	**0.85**	**0.87**	**0.82**	**0.71**	**0.76**	**0.80**
Creek Average		**0.84**					**0.77**		**0.76**	**0.80**





Fluctuation in numbers between monitoring events is related to many variables. Benthic community population numbers can be affected by climate (flooding, drought, rainfall events, unusually high or low temperatures), time of year sampled, sampling methods, disturbance to riparian zones, etc.

Although neither the same number of sites nor the same frequency of sampling is available per drainage, averages have been performed to give an overall idea of potential differences between watersheds. Based on the inclusion of 2019 data, these averages indicate that the most diverse communities are found in Haggart Creek, and in particular W4 and W23 (Table 6). The greatest populations of benthic communities have been in Dublin Gulch but they are less diverse (but the overall relatively low creek diversity of 0.77 is heavily influenced by the outlier (0.35) from W26 in 1995). The greatest densities of organisms with moderately diverse communities have been documented in Lynx Creek. Overall, the limited data suggests stable benthic communities at all the sites sampled.

When comparing the most upstream site W22, Haggart Creek above Project influence, with all sample sites in Haggart Creek downstream of Project influence, the densities and diversities are very similar. This data suggests that there is little, if any, impact to Haggart Creek from construction activities at the Eagle Gold project site.

4.0 DISCUSSION

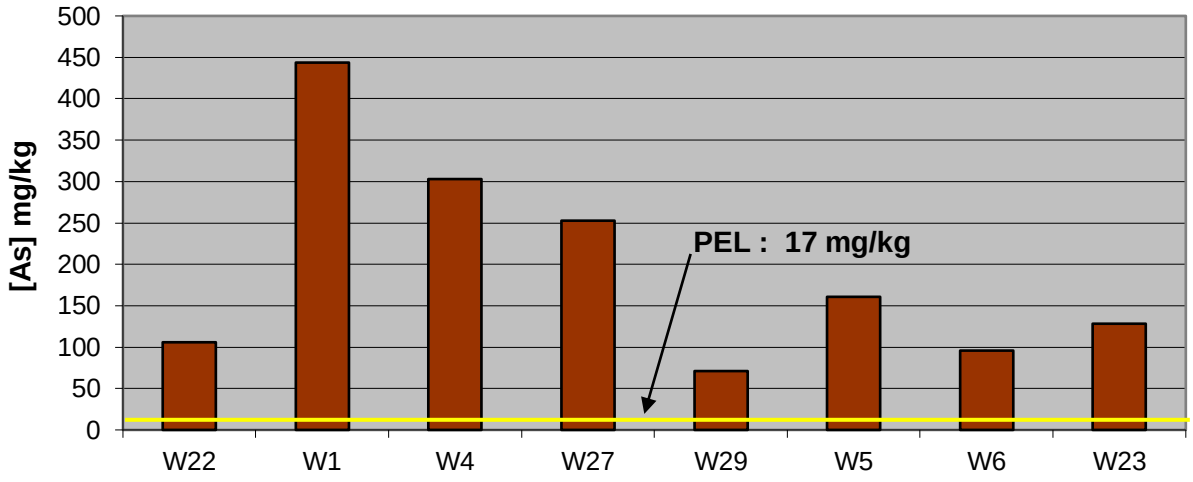
The 2019 benthic invertebrate data indicates healthy robust populations at each of the sites sampled, with good representation of EPT throughout. When examining habitat characteristics against previous surveys (Stantec, 2011, Laberge, 2018 and Laberge, 2019), while the documented 2019 conditions showed significantly increased densities, the overall metrics have not changed significantly and support healthy benthic populations at all sites.

In contrast to the benthic invertebrate data, water quality and sediment data (specifically arsenic) collected since 1995 suggest a less healthy aquatic environment. Similar to previous years, in September 2019 stream sediment samples were collected during the benthic invertebrate monitoring (Laberge, 2020). As in previous years, arsenic was prevalent in the stream sediments throughout the study area in 2019 and detected well above the guidelines for the protection of freshwater aquatic life (Table 7 and Figure 5). The sites have been arranged in the table and on the X-axes of Figure 5 to depict site locations from upstream to downstream throughout the study area.

Table 7: Arsenic Concentrations in Different Media, 2019

Site #	Arsenic in Sediment (mg/kg)	Arsenic in Water (mg/L)
W22	106	0.00085
W26	not sampled	0.02360
W1	444	0.03070
W4	303	0.00201
W27	253	0.02040
W29	71	0.00267
W5	161	0.00340
W6	96	0.00594
W23	128	0.00438

Figure 5. Arsenic Concentrations in Sediment



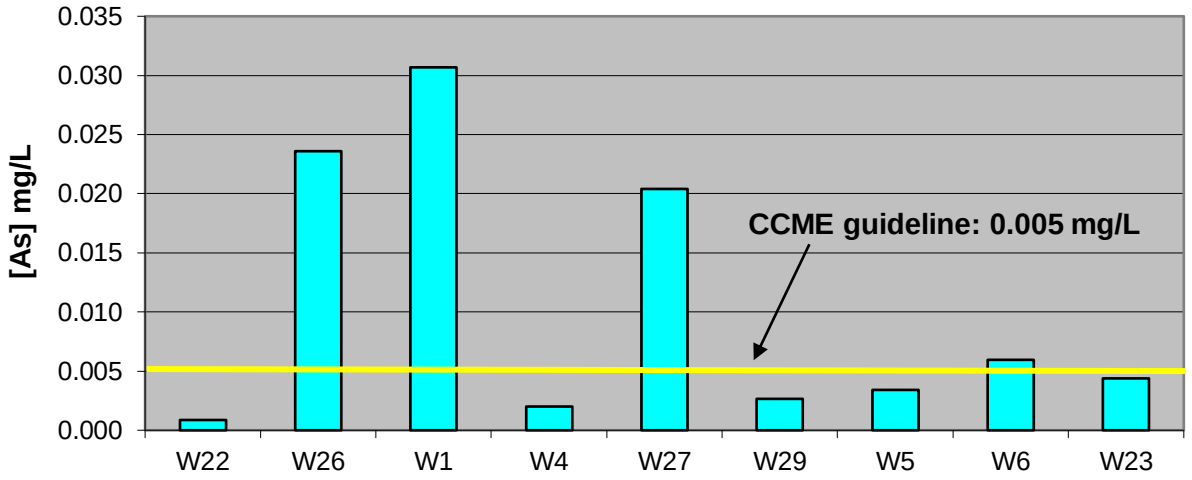
The concentrations of arsenic in the stream sediments exceeded the CCME Canadian Environmental Quality Guidelines (CEQG) Probable Effects Level (PEL) of 17 mg/kg at all sites. The highest concentrations of arsenic in the stream sediments were reported at W1, Dublin Gulch above Stewart Gulch, upstream of all Project activities.

High concentrations of arsenic were also found in the water column above the CCME guideline of 0.005 mg/L at sites W1, W26, W27, and W6. The highest arsenic water quality result was also reported at W1 (Table 7 and Figure 6, which is arranged the same as Figure 5).

The metalloid arsenic is ubiquitous in the aquatic environment as a result of natural processes (mineral rock weathering, volcanic emissions and biological activities) (Irving et al, 2007). It undergoes multiple electron transfer reactions and forms a variety of inorganic and organic compounds of different toxicity to aquatic organisms (Moore and Ramamoorthy, 1984). The toxicity of arsenic is dependent on speciation. Arsenite (AsO_3^{-3}) forms are much more toxic to biological species. Metallo-organic forms of arsenic also may be much more bioavailable than inorganic forms; however, organic-bound arsenic is excreted by most species and does not appear to be

highly toxic (Luoma, 1983). The two major uptake vectors are through the ingestion of metal enriched sediments or suspended particles, and/or uptake from solution.

Figure 6. Arsenic Concentrations in Water



The abundant presence of pollution sensitive organisms at each of the sites suggests that the arsenic concentrations found in the water column and in the stream sediments are not in a bioavailable form.

It is concluded that the benthos populations documented in 2019 are healthy, stable and had good representation of the major groups of organisms that are typically present in lotic waters.

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APPENDIX A

Table A-1 Water Quality Analytical Data

Table A-2 RPD for Duplicate Sample

Water Quality Analytical Report L2343480, ALS

TABLE A-1 WATER QUALITY ANALYTICAL DATA WITH CCME GUIDELINES

Drainage		CCME Guidelines for the Protection of Freshwater Aquatic Life	HAGGART CREEK					DUBLIN GULCH		EAGLE CREEK	LYNX CREEK		
Sample Site			W22	W4	W29	W5	W23	W1	W26	W27	W6	DUP (W23)	DUP (W27)
Date Sampled			6-Sep-2019	6-Sep-2019	6-Sep-2019	5-Sep-2019	5-Sep-2019	7-Sep-2019	7-Sep-2019	6-Sep-2019	5-Sep-2019	5-Sep-2019	6-Sep-2019
Time Sampled			16:45	15:00	10:00	13:20	10:00	10:15	12:15	12:00	17:30	0:00	0:00
Analyte	Units		L2343480-7	L2343480-6	L2343480-4	L2343480-2	L2343480-1	L2343480-8	L2343480-9	L2343480-5	L2343480-3	L2343480-10	L2343480-11
Physical Tests													
Conductivity	uS/cm		367	353	388	420	395	137	355	433	372	399	437
Hardness (as CaCO3)	mg/L		189	191	202	228	207	63.9	196	232	194	206	238
pH	pH		8.28	8.25	8.31	8.36	8.30	7.98	8.25	8.45	8.31	8.32	8.47
Total Suspended Solids	mg/L		<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
Total Dissolved Solids	mg/L		265	264	291	313	280	90	233	300	270	291	312
Turbidity	NTU		0.17	0.17	0.22	0.33	0.18	0.20	0.27	0.24	0.16	0.20	0.26
Anions and Nutrients													
Alkalinity, Total (as CaCO3)	mg/L		111	110	115	122	118	52.4	166	169	114	123	219
Ammonia, Total (as N)	mg/L	1.54	0.0080	<0.0050	<0.0050	<0.0050	0.0088	<0.0050	<0.0050	<0.0050	0.190	<0.0050	0.0056
Bromide (Br)	mg/L		<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Chloride (Cl)	mg/L		<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	1.00	<0.50	<0.50	0.96
Fluoride (F)	mg/L		0.120	0.117	0.117	0.127	0.117	0.091	0.143	0.160	0.105	0.110	0.153
Nitrate (as N)	mg/L	13	0.0543	0.0538	0.0528	0.0383	0.0348	0.0103	0.0222	<0.0050	0.0199	0.150	<0.0050
Nitrite (as N)	mg/L	60	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Total Kjeldahl Nitrogen	mg/L		<0.050	0.067	0.058	<0.050	0.095	<0.050	0.097	0.069	0.283	0.053	0.067
Total Nitrogen	mg/L		0.054	0.121	0.111	<0.050	0.13	<0.050	0.119	0.069	0.303	0.203	0.067
Orthophosphate-Dissolved (as P)	mg/L		<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0015	0.0033	<0.0010	<0.0010	<0.0010	<0.0010
Phosphorus (P)-Total Dissolved	mg/L		<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	0.0024	0.0051	<0.0020	<0.0020	<0.0020	0.0022
Phosphorus (P)-Total	mg/L		<0.0020	<0.0020	<0.0020	0.0026	<0.0020	0.0032	0.0069	0.0023	0.0024	<0.0020	0.0022
Sulfate (SO4)	mg/L		86.4	83.5	88.2	99.2	90.4	16.7	45.8	68.3	81.9	90.0	67.8
Organic / Inorganic Carbon													
Dissolved Organic Carbon	mg/L		1.62	1.96	1.39	1.63	2.31	1.04	2.28	1.91	2.52	1.88	2.02
Total Organic Carbon	mg/L		1.26	1.18	1.07	1.28	1.83	1.19	2.37	1.81	2.14	1.69	1.91
Total Metals													
Aluminum (Al)-Total	mg/L		0.0055	0.0089	0.0044	0.0141	0.0052	0.0093	0.0114	0.0050	0.0038	0.0065	0.0059
Antimony (Sb)-Total	mg/L		0.00022	0.00031	0.00052	0.00066	0.00054	0.00106	0.00074	0.00406	0.00037	0.00054	0.00407
Arsenic (As)-Total	mg/L	0.005	0.00085	0.00201	0.00267	0.00340	0.00438	0.03070	0.02360	0.02040	0.00594	0.00439	0.02050
Barium (Ba)-Total	mg/L		0.0409	0.0406	0.0427	0.0465	0.0538	0.0510	0.0709	0.0680	0.0624	0.0548	0.0649
Beryllium (Be)-Total	mg/L		<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
Bismuth (Bi)-Total	mg/L		<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Boron (B)-Total	mg/L		<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Cadmium (Cd)-Total	mg/L	0.00009	0.0000074	<0.0000050	0.0000084	0.0000127	0.0000101	<0.0000050	0.0000051	0.0000090	0.0000085	0.0000071	0.0000083
Calcium (Ca)-Total	mg/L		42.2	42.5	45.8	51.0	52.6	17.6	41.0	46.8	59.0	55.0	50.5
Chromium (Cr)-Total	mg/L	0.001	<0.00010	<0.00010	<0.00010	0.00012	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Cobalt (Co)-Total	mg/L		<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Copper (Cu)-Total	mg/L	0.002	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	0.00068	0.00055	<0.00050	0.00073
Iron (Fe)-Total	mg/L	0.3	0.053	0.052	0.029	0.038	0.024	0.011	<0.010	0.019	0.015	0.025	0.018
Lead (Pb)-Total	mg/L	0.001	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Lithium (Li)-Total	mg/L		0.0075	0.0076	0.0076	0.0082	0.0052	0.0026	0.0048	0.0121	0.0018	0.0052	0.0119
Magnesium (Mg)-Total	mg/L		17.7	17.4	19.6	21.2	15.8	4.31	20.2	25.6	9.39	15.8	26.1
Manganese (Mn)-Total	mg/L		0.0314	0.0298	0.0519	0.0524	0.0212	0.00075	0.00024	0.00891	0.00516	0.0214	0.00912
Mercury (Hg)-Total	mg/L	0.000026	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Molybdenum (Mo)-Total	mg/L	0.073	0.000082	0.000136	0.000174	0.000184	0.000576	0.00199	0.00294	0.00111	0.000995	0.000572	0.00114
Nickel (Ni)-Total	mg/L	0.025	0.00077	0.00066	0.00075	0.00070	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Phosphorus (P)-Total	mg/L		<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Potassium (K)-Total	mg/L		1.26	1.27	1.33	1.49	1.51	0.89	1.28	2.43	1.51	1.47	2.38
Selenium (Se)-Total	mg/L		0.000130	0.000124	0.000120	0.000114	0.000222	0.000148	0.000351	0.000271	0.000376	0.000248	0.000246
Silicon (Si)-Total	mg/L		4.29	4.51	4.43	4.21	4.19	6.46	5.60	5.39	4.03	4.22	5.32
Silver (Ag)-Total	mg/L		<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)-Total	mg/L		2.18	2.20	2.39	2.53	2.53	1.91	2.06	3.83	2.52	2.53	3.99
Strontium (Sr)-Total	mg/L		0.219	0.214	0.229	0.268	0.257	0.0943	0.314	0.304	0.251	0.264	0.316
Sulfur (S)-Total	mg/L		30.5	29.9	31.3	34.3	32.1	6.19	16.7	25.2	28.8	32.8	24.0
Thallium (Tl)-Total	mg/L		<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Tin (Sn)-Total	mg/L		<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)-Total	mg/L		<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
Uranium (U)-Total	mg/L	0.015	0.00121	0.00123	0.00163	0.00187	0.00151	0.000614	0.00746	0.00673	0.00110	0.00149	0.00621
Vanadium (V)-Total	mg/L		<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Zinc (Zn)-Total	mg/L	0.030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	0.0030	<0.0030	<0.0030	<0.0030
Zirconium (Zr)-Total	mg/L		<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
Dissolved Metals													
Aluminum (Al)-Dissolved	mg/L		0.0036	0.0045	0.0040	0.0032	0.0030	0.0044	0.0116	0.0012	0.0027	0.0032	0.0019
Antimony (Sb)-Dissolved	mg/L		0.00022	0.00030	0.00049	0.00063	0.00053	0.00105	0.00074	0.00410	0.00035	0.00052	0.00400
Arsenic (As)-Dissolved	mg/L	0.005	0.00082	0.00198	0.00268	0.00317	0.00416	0.03000	0.02340	0.02030	0.00593	0.00428	0.02020
Barium (Ba)-Dissolved	mg/L		0.0441	0.0441	0.0444	0.0497	0.0576	0.0550	0.0770	0.0722	0.0652	0.0569	0.0718
Beryllium (Be)-Dissolved	mg/L		<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
Bismuth (Bi)-Dissolved	mg/L		<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Boron (B)-Dissolved	mg/L		<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Cadmium (Cd)-Dissolved	mg/L	0.00009	0.0000059	0.0000071	0.0000133	0.0000105	0.0000097	<0.0000050	0.0000097	0.0000062	0.0000066	0.0000092	0.0000073
Calcium (Ca)-Dissolved	mg/L		45.0	45.7	47.8	55.2	55.7	18.4	43.4	49.9	61.0	55.8	51.3
Chromium (Cr)-Dissolved	mg/L	0.001	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Cobalt (Co)-Dissolved	mg/L		<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Copper (Cu)-Dissolved	mg/L	0.002	0.00024	0.00027	0.00035	0.00306	0.00042	<0.00020	0.00224	0.00068	0.00049	0.00042	0.00156
Iron (Fe)-Dissolved	mg/L	0.3	0.036	0.035	0.020	0.020	0.014	<0.010	<0.010	0.010	0.015	0.015	0.011
Lead (Pb)-Dissolved	mg/L	0.001	<0.000050	<0.000050	<0.000050	0.000146	<0.000050	<0.000050	0.000113	<0.000050	<0.000050	<0.000050	<0.000050
Lithium (Li)-Dissolved	mg/L		0.0077	0.0081	0.0078	0.0083	0.0053	0.0026	0.0051	0.0122	0.0018	0.0054	0.0126
Magnesium (Mg)-Dissolved	mg/L		18.7	18.6	20.1	21.9	16.5	4.38	21.2	26.0	10.1	16.1	26.6
Manganese (Mn)-Dissolved	mg/L		0.0315	0.0301	0.0526	0.0563	0.0210	0.00052	0.00059	0.00910	0.00513	0.0209	0.00905
Mercury (Hg)-Dissolved	mg/L	0.000026	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Molybdenum (Mo)-Dissolved	mg/L	0.073	0.000058	0.000130	0.000140	0.000179	0.000529	0.00205	0.00284	0.00104	0.000969	0.000539	0.00108
Nickel (Ni)-Dissolved	mg/L	0.025	0.00064	0.00058	0.00065	0.00065	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Phosphorus (P)-Dissolved	mg/L		<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Potassium (K)-Dissolved	mg/L		1.34	1.39	1.42	1.59	1.56	0.97	1.40	2.60	1.58	1.58	2.67
Selenium (Se)-Dissolved	mg/L		0.000115	0.000106	0.000099	0.000115	0.000216	0.000125	0.000260	0.000260	0.000370	0.000204	0.000259
Silicon (Si)-Dissolved	mg/L		4.12	4.15	4.21	4.09	4.01	6.02	5.39	5.18	3.96	3.99	5.11
Silver (Ag)-Dissolved	mg/L		<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)-Dissolved	mg/L		2.27	2.32	2.47	2.66	2.59	1.96	2.17	3.96	2.62	2.60	4.02
Strontium (Sr)-Dissolved	mg/L		0.231	0.233	0.239	0.283	0.264	0.0990	0.341	0.316	0.262	0.273	0.327
Sulfur (S)-Dissolved	mg/L		28.1	26.8	29.0	31.7	29.1	5.50	15.9	22.9	26.9	30.2	22.9
Thallium (Tl)-Dissolved	mg/L		<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Tin (Sn)-Dissolved	mg/L		<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)-Dissolved	mg/L		<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
Uranium (U)-Dissolved	mg/L	0.015	0.00124	0.00123	0.00160	0.00185	0.00150	0.000602	0.00758	0.00678	0.00111	0.00150	0.00685
Vanadium (V)-Dissolved	mg/L		<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Zinc (Zn)-Dissolved	mg/L	0.030	<0.0010	0.0014	0.0017	0.0024	<0.0010	<0.0010	0.0020	0.0028	<0.0010	<0.0010	0.0033
Zirconium (Zr)-Dissolved	mg/L		<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
		Colour Key:	Within Guideline	Exceeds Guideline									

TABLE A-2 RPD VALUES FOR DUPLICATE SAMPLING, 2019

Sample Site	Lowest Detection Limit	Units	W23	DUP (W23)		W27	DUP (W27)	
Parameter			5-Sep-2019	5-Sep-2019	RPD	6-Sep-2019	6-Sep-2019	RPD
Physical Tests								
Conductivity	2.0	uS/cm	395	399	1.01%	433	437	0.92%
Hardness (as CaCO3)	0.50	mg/L	207	206	0.48%	232	238	2.55%
pH	0.10	pH	8.30	8.32	0.24%	8.45	8.47	0.24%
Total Suspended Solids	3.0	mg/L	<3.0	<3.0	nc	<3.0	<3.0	nc
Total Dissolved Solids	10	mg/L	280	291	3.85%	300	312	3.92%
Turbidity	0.10	NTU	0.18	0.20	10.53%	0.24	0.26	8.00%
Anions and Nutrients								
Alkalinity, Total (as CaCO3)	1.0	mg/L	118	123	4.15%	169	219	25.77%
Ammonia, Total (as N)	0.0050	mg/L	0.0088	<0.0050	nc	<0.0050	0.0056	nc
Bromide (Br)	0.050	mg/L	<0.050	<0.050	nc	<0.050	<0.050	nc
Chloride (Cl)	0.50	mg/L	<0.50	<0.50	nc	1.00	0.96	4.08%
Fluoride (F)	0.020	mg/L	0.117	0.110	6.17%	0.160	0.153	4.47%
Nitrate (as N)	0.0050	mg/L	0.0348	0.150	124.68%	<0.0050	<0.0050	nc
Nitrite (as N)	0.0010	mg/L	<0.0010	<0.0010	nc	<0.0010	<0.0010	nc
Total Kjeldahl Nitrogen	0.050	mg/L	0.095	0.053	56.76%	0.069	0.067	2.94%
Total Nitrogen	0.050	mg/L	0.13	0.203	43.84%	0.069	0.067	2.94%
Orthophosphate-Dissolved (as P)	0.0010	mg/L	<0.0010	<0.0010	nc	<0.0010	<0.0010	nc
Phosphorus (P)-Total Dissolved	0.0020	mg/L	<0.0020	<0.0020	nc	<0.0020	0.0022	nc
Phosphorus (P)-Total	0.0020	mg/L	<0.0020	<0.0020	nc	0.0023	0.0022	4.44%
Sulfate (SO4)	0.30	mg/L	90.4	90.0	0.44%	68.3	67.8	0.73%
Organic / Inorganic Carbon								
Dissolved Organic Carbon	0.50	mg/L	2.31	1.88	20.53%	1.91	2.02	5.60%
Total Organic Carbon	0.50	mg/L	1.83	1.69	7.95%	1.81	1.91	5.38%
Total Metals								
Aluminum (Al)-Total	0.0030	mg/L	0.0052	0.0065	22.22%	0.0050	0.0059	16.51%
Antimony (Sb)-Total	0.00010	mg/L	0.00054	0.00054	0.00%	0.00406	0.00407	0.25%
Arsenic (As)-Total	0.00010	mg/L	0.00438	0.00439	0.23%	0.0204	0.0205	0.49%
Barium (Ba)-Total	0.00010	mg/L	0.0538	0.0548	1.84%	0.0680	0.0649	4.67%
Beryllium (Be)-Total	0.000020	mg/L	<0.000020	<0.000020	nc	<0.000020	<0.000020	nc
Bismuth (Bi)-Total	0.000050	mg/L	<0.000050	<0.000050	nc	<0.000050	<0.000050	nc
Boron (B)-Total	0.010	mg/L	<0.010	<0.010	nc	<0.010	<0.010	nc
Cadmium (Cd)-Total	0.0000050	mg/L	0.0000101	0.0000071	34.88%	0.0000090	0.0000083	8.09%
Calcium (Ca)-Total	0.050	mg/L	52.6	55.0	4.46%	46.8	50.5	7.61%
Chromium (Cr)-Total	0.00010	mg/L	<0.00010	<0.00010	nc	<0.00010	<0.00010	nc
Cobalt (Co)-Total	0.00010	mg/L	<0.00010	<0.00010	nc	<0.00010	<0.00010	nc
Copper (Cu)-Total	0.00050	mg/L	<0.00050	<0.00050	nc	0.00068	0.00073	7.09%
Iron (Fe)-Total	0.010	mg/L	0.024	0.025	4.08%	0.019	0.018	5.41%
Lead (Pb)-Total	0.000050	mg/L	<0.000050	<0.000050	nc	<0.000050	<0.000050	nc
Lithium (Li)-Total	0.0010	mg/L	0.0052	0.0052	0.00%	0.0121	0.0119	1.67%
Magnesium (Mg)-Total	0.10	mg/L	15.8	15.8	0.00%	25.6	26.1	1.93%
Manganese (Mn)-Total	0.00010	mg/L	0.0212	0.0214	0.94%	0.00891	0.00912	2.33%
Mercury (Hg)-Total	0.0000050	mg/L	<0.0000050	<0.0000050	nc	<0.0000050	<0.0000050	nc
Molybdenum (Mo)-Total	0.000050	mg/L	0.000576	0.000572	0.70%	0.00111	0.00114	2.67%
Nickel (Ni)-Total	0.00050	mg/L	<0.00050	<0.00050	nc	<0.00050	<0.00050	nc
Phosphorus (P)-Total	0.050	mg/L	<0.050	<0.050	nc	<0.050	<0.050	nc
Potassium (K)-Total	0.10	mg/L	1.51	1.47	2.68%	2.43	2.38	2.08%
Selenium (Se)-Total	0.000050	mg/L	0.000222	0.000248	11.06%	0.000271	0.000246	9.67%
Silicon (Si)-Total	0.10	mg/L	4.19	4.22	0.71%	5.39	5.32	1.31%
Silver (Ag)-Total	0.000010	mg/L	<0.000010	<0.000010	nc	<0.000010	<0.000010	nc
Sodium (Na)-Total	0.050	mg/L	2.53	2.53	0.00%	3.83	3.99	4.09%
Strontium (Sr)-Total	0.00020	mg/L	0.257	0.264	2.69%	0.304	0.316	3.87%
Sulfur (S)-Total	0.50	mg/L	32.1	32.8	2.16%	25.2	24.0	4.88%
Thallium (Tl)-Total	0.000010	mg/L	<0.000010	<0.000010	nc	<0.000010	<0.000010	nc
Tin (Sn)-Total	0.00010	mg/L	<0.00010	<0.00010	nc	<0.00010	<0.00010	nc
Titanium (Ti)-Total	0.00030	mg/L	<0.00030	<0.00030	nc	<0.00030	<0.00030	nc
Uranium (U)-Total	0.000010	mg/L	0.00151	0.00149	1.33%	0.00673	0.00621	8.04%
Vanadium (V)-Total	0.00050	mg/L	<0.00050	<0.00050	nc	<0.00050	<0.00050	nc
Zinc (Zn)-Total	0.0030	mg/L	<0.0030	<0.0030	nc	0.0030	<0.0030	nc
Zirconium (Zr)-Total	0.00030	mg/L	<0.00030	<0.00030	nc	<0.00030	<0.00030	nc
Dissolved Metals								
Aluminum (Al)-Dissolved	0.0010	mg/L	0.0030	0.0032	6.45%	0.0012	0.0019	45.16%
Antimony (Sb)-Dissolved	0.00010	mg/L	0.00053	0.00052	1.90%	0.00410	0.00400	2.47%
Arsenic (As)-Dissolved	0.00010	mg/L	0.00416	0.00428	2.84%	0.0203	0.0202	0.49%
Barium (Ba)-Dissolved	0.00010	mg/L	0.0576	0.0569	1.22%	0.0722	0.0718	0.56%
Beryllium (Be)-Dissolved	0.000020	mg/L	<0.000020	<0.000020	nc	<0.000020	<0.000020	nc
Bismuth (Bi)-Dissolved	0.000050	mg/L	<0.000050	<0.000050	nc	<0.000050	<0.000050	nc
Boron (B)-Dissolved	0.010	mg/L	<0.010	<0.010	nc	<0.010	<0.010	nc
Cadmium (Cd)-Dissolved	0.0000050	mg/L	0.0000097	0.0000092	5.29%	0.0000062	0.0000073	16.30%
Calcium (Ca)-Dissolved	0.050	mg/L	55.7	55.8	0.18%	49.9	51.3	2.77%
Chromium (Cr)-Dissolved	0.00010	mg/L	<0.00010	<0.00010	nc	<0.00010	<0.00010	nc
Cobalt (Co)-Dissolved	0.00010	mg/L	<0.00010	<0.00010	nc	<0.00010	<0.00010	nc
Copper (Cu)-Dissolved	0.00020	mg/L	0.00042	0.00042	0.00%	0.00068	0.00156	78.57%
Iron (Fe)-Dissolved	0.010	mg/L	0.014	0.015	6.90%	0.010	0.011	9.52%
Lead (Pb)-Dissolved	0.000050	mg/L	<0.000050	<0.000050	nc	<0.000050	<0.000050	nc
Lithium (Li)-Dissolved	0.0010	mg/L	0.0053	0.0054	1.87%	0.0122	0.0126	3.23%
Magnesium (Mg)-Dissolved	0.10	mg/L	16.5	16.1	2.45%	26.0	26.6	2.28%
Manganese (Mn)-Dissolved	0.00010	mg/L	0.0210	0.0209	0.48%	0.00910	0.00905	0.55%
Mercury (Hg)-Dissolved	0.0000050	mg/L	<0.0000050	<0.0000050	nc	<0.0000050	<0.0000050	nc
Molybdenum (Mo)-Dissolved	0.000050	mg/L	0.000529	0.000539	1.87%	0.00104	0.00108	3.77%
Nickel (Ni)-Dissolved	0.00050	mg/L	<0.00050	<0.00050	nc	<0.00050	<0.00050	nc
Phosphorus (P)-Dissolved	0.050	mg/L	<0.050	<0.050	nc	<0.050	<0.050	nc
Potassium (K)-Dissolved	0.10	mg/L	1.56	1.58	1.27%	2.60	2.67	2.66%
Selenium (Se)-Dissolved	0.000050	mg/L	0.000216	0.000204	5.71%	0.000260	0.000259	0.39%
Silicon (Si)-Dissolved	0.050	mg/L	4.01	3.99	0.50%	5.18	5.11	1.36%
Silver (Ag)-Dissolved	0.000010	mg/L	<0.000010	<0.000010	nc	<0.000010	<0.000010	nc
Sodium (Na)-Dissolved	0.050	mg/L	2.59	2.60	0.39%	3.96	4.02	1.50%
Strontium (Sr)-Dissolved	0.00020	mg/L	0.264	0.273	3.35%	0.316	0.327	3.42%
Sulfur (S)-Dissolved	0.50	mg/L	29.1	30.2	3.71%	22.9	22.9	0.00%
Thallium (Tl)-Dissolved	0.000010	mg/L	<0.000010	<0.000010	nc	<0.000010	<0.000010	nc
Tin (Sn)-Dissolved	0.00010	mg/L	<0.00010	<0.00010	nc	<0.00010	<0.00010	nc
Titanium (Ti)-Dissolved	0.00030	mg/L	<0.00030	<0.00030	nc	<0.00030	<0.00030	nc
Uranium (U)-Dissolved	0.000010	mg/L	0.00150	0.00150	0.00%	0.00678	0.00685	1.03%
Vanadium (V)-Dissolved	0.00050	mg/L	<0.00050	<0.00050	nc	<0.00050	<0.00050	nc
Zinc (Zn)-Dissolved	0.0010	mg/L	<0.0010	<0.0010	nc	0.0028	0.0033	16.39%
Zirconium (Zr)-Dissolved	0.00030	mg/L	<0.00030	<0.00030	nc	<0.00030	<0.00030	nc

RPD greater than 20%

nc = not calculated

STRATAGOLD CORPORATION
ATTN: Hugh Coyle
Suite 1000 - 1050 W. Pender St
Vancouver BC V6E 3S7

Date Received: 08-SEP-19
Report Date: 18-SEP-19 14:02 (MT)
Version: FINAL

Client Phone: 604-682-5122

Certificate of Analysis

Lab Work Order #: L2343480

Project P.O. #: NOT SUBMITTED
Job Reference: SITE OPERATIONS (SEPTEMBER)
C of C Numbers: 19-20190907
Legal Site Desc:

Hilary Woods
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2343480-1 Water 05-SEP-19 10:00 W23	L2343480-2 Water 05-SEP-19 13:20 W5	L2343480-3 Water 05-SEP-19 17:30 W6	L2343480-4 Water 06-SEP-19 10:00 W29	L2343480-5 Water 06-SEP-19 12:00 W27
WATER						
Physical Tests	Conductivity (uS/cm)	395	420	372	388	433
	Hardness (as CaCO3) (mg/L)	207	228	194	202	232
	pH (pH)	8.30	8.36	8.31	8.31	8.45
	Total Suspended Solids (mg/L)	<3.0	<3.0	<3.0	<3.0	<3.0
	Total Dissolved Solids (mg/L)	280	313	270	291	300
	Turbidity (NTU)	0.18	0.33	0.16	0.22	0.24
Anions and Nutrients	Alkalinity, Total (as CaCO3) (mg/L)	118	122	114	115	169
	Ammonia, Total (as N) (mg/L)	0.0088	<0.0050	0.190	<0.0050	<0.0050
	Bromide (Br) (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Chloride (Cl) (mg/L)	<0.50	<0.50	<0.50	<0.50	1.00
	Fluoride (F) (mg/L)	0.117	0.127	0.105	0.117	0.160
	Nitrate (as N) (mg/L)	0.0348	0.0383	0.0199	0.0528	<0.0050
	Nitrite (as N) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Total Kjeldahl Nitrogen (mg/L)	0.095	<0.050	0.283	0.058	0.069
	Total Nitrogen (mg/L)	0.130	<0.050	0.303	0.111	0.069
	Orthophosphate-Dissolved (as P) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Phosphorus (P)-Total Dissolved (mg/L)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Phosphorus (P)-Total (mg/L)	<0.0020	0.0026	0.0024	<0.0020	0.0023
	Sulfate (SO4) (mg/L)	90.4	99.2	81.9	88.2	68.3
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	2.31	1.63	2.52	1.39	1.91
	Total Organic Carbon (mg/L)	1.83	1.28	2.14	1.07	1.81
Total Metals	Aluminum (Al)-Total (mg/L)	0.0052	0.0141	0.0038	0.0044	0.0050
	Antimony (Sb)-Total (mg/L)	0.00054	0.00066	0.00037	0.00052	0.00406
	Arsenic (As)-Total (mg/L)	0.00438	0.00340	0.00594	0.00267	0.0204
	Barium (Ba)-Total (mg/L)	0.0538	0.0465	0.0624	0.0427	0.0680
	Beryllium (Be)-Total (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Total (mg/L)	<0.010	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)-Total (mg/L)	0.0000101	0.0000127	0.0000085	0.0000084	0.0000090
	Calcium (Ca)-Total (mg/L)	52.6	51.0	59.0	45.8	46.8
	Chromium (Cr)-Total (mg/L)	<0.00010	0.00012	<0.00010	<0.00010	<0.00010
	Cobalt (Co)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)-Total (mg/L)	<0.00050	<0.00050	0.00055	<0.00050	0.00068
	Iron (Fe)-Total (mg/L)	0.024	0.038	0.015	0.029	0.019
	Lead (Pb)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Total (mg/L)	0.0052	0.0082	0.0018	0.0076	0.0121

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2343480-6	L2343480-7	L2343480-8	L2343480-9	L2343480-10
Description	Water	Water	Water	Water	Water
Sampled Date	06-SEP-19	06-SEP-19	07-SEP-19	07-SEP-19	05-SEP-19
Sampled Time	15:00	16:45	10:15	12:15	
Client ID	W4	W22	W1	W26	DUP
Grouping / **Analyte**					
WATER					
Physical Tests Conductivity (uS/cm)	353	367	137	355	399
Hardness (as CaCO3) (mg/L)	191	189	63.9	196	206
pH (pH)	8.25	8.28	7.98	8.25	8.32
Total Suspended Solids (mg/L)	<3.0	<3.0	<3.0	<3.0	<3.0
Total Dissolved Solids (mg/L)	264	265	90	233	291
Turbidity (NTU)	0.17	0.17	0.20	0.27	0.20
Anions and Nutrients Alkalinity, Total (as CaCO3) (mg/L)	110	111	52.4	166	123
Ammonia, Total (as N) (mg/L)	<0.0050	0.0080	<0.0050	<0.0050	<0.0050
Bromide (Br) (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
Chloride (Cl) (mg/L)	<0.50	<0.50	<0.50	<0.50	<0.50
Fluoride (F) (mg/L)	0.117	0.120	0.091	0.143	0.110
Nitrate (as N) (mg/L)	0.0538	0.0543	0.0103	0.0222	0.150
Nitrite (as N) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Total Kjeldahl Nitrogen (mg/L)	0.067	<0.050	<0.050	0.097	0.053
Total Nitrogen (mg/L)	0.121	0.054	<0.050	0.119	0.203
Orthophosphate-Dissolved (as P) (mg/L)	<0.0010	<0.0010	0.0015	0.0033	<0.0010
Phosphorus (P)-Total Dissolved (mg/L)	<0.0020	<0.0020	0.0024	0.0051	<0.0020
Phosphorus (P)-Total (mg/L)	<0.0020	<0.0020	0.0032	0.0069	<0.0020
Sulfate (SO4) (mg/L)	83.5	86.4	16.7	45.8	90.0
Organic / Inorganic Carbon Dissolved Organic Carbon (mg/L)	1.96	1.62	1.04	2.28	1.88
Total Organic Carbon (mg/L)	1.18 RRV	1.26	1.19	2.37	1.69
Total Metals Aluminum (Al)-Total (mg/L)	0.0089	0.0055	0.0093	0.0114	0.0065
Antimony (Sb)-Total (mg/L)	0.00031	0.00022	0.00106	0.00074	0.00054
Arsenic (As)-Total (mg/L)	0.00201	0.00085	0.0307	0.0236	0.00439
Barium (Ba)-Total (mg/L)	0.0406	0.0409	0.0510	0.0709	0.0548
Beryllium (Be)-Total (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Boron (B)-Total (mg/L)	<0.010	<0.010	<0.010	<0.010	<0.010
Cadmium (Cd)-Total (mg/L)	<0.0000050	0.0000074	<0.0000050	0.0000051	0.0000071
Calcium (Ca)-Total (mg/L)	42.5	42.2	17.6	41.0	55.0
Chromium (Cr)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Cobalt (Co)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Copper (Cu)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Iron (Fe)-Total (mg/L)	0.052	0.053	0.011	<0.010	0.025
Lead (Pb)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Lithium (Li)-Total (mg/L)	0.0076	0.0075	0.0026	0.0048	0.0052

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2343480-11	L2343480-12	L2343480-13		
Description	Water	Water	Water		
Sampled Date	06-SEP-19		07-SEP-19		
Sampled Time			10:00		
Client ID	DUP	TRAVEL BLANK	FB		
Grouping / **Analyte**					
WATER					
Physical Tests Conductivity (uS/cm)	437	<2.0	<2.0		
Hardness (as CaCO3) (mg/L)	238	<0.50 HTC	<0.50		
pH (pH)	8.47	5.52	5.47		
Total Suspended Solids (mg/L)	<3.0	<3.0	<3.0		
Total Dissolved Solids (mg/L)	312	<10	<10		
Turbidity (NTU)	0.26	<0.10	<0.10		
Anions and Nutrients Alkalinity, Total (as CaCO3) (mg/L)	219	<1.0	<1.0		
Ammonia, Total (as N) (mg/L)	0.0056	<0.0050	0.0072 RRV		
Bromide (Br) (mg/L)	<0.050	<0.050	<0.050		
Chloride (Cl) (mg/L)	0.96	<0.50	<0.50		
Fluoride (F) (mg/L)	0.153	<0.020	<0.020		
Nitrate (as N) (mg/L)	<0.0050	<0.0050	<0.0050		
Nitrite (as N) (mg/L)	<0.0010	<0.0010	<0.0010		
Total Kjeldahl Nitrogen (mg/L)	0.067	<0.050	<0.050		
Total Nitrogen (mg/L)	0.067	<0.050	<0.050		
Orthophosphate-Dissolved (as P) (mg/L)	<0.0010	<0.0010	<0.0010		
Phosphorus (P)-Total Dissolved (mg/L)	0.0022		<0.0020		
Phosphorus (P)-Total (mg/L)	0.0022	<0.0020	<0.0020		
Sulfate (SO4) (mg/L)	67.8	<0.30	<0.30		
Organic / Inorganic Carbon Dissolved Organic Carbon (mg/L)	2.02		<0.50		
Total Organic Carbon (mg/L)	1.91	<0.50	<0.50		
Total Metals Aluminum (Al)-Total (mg/L)	0.0059	<0.0030	0.0039 RRV		
Antimony (Sb)-Total (mg/L)	0.00407	<0.00010	<0.00010		
Arsenic (As)-Total (mg/L)	0.0205	<0.00010	<0.00010		
Barium (Ba)-Total (mg/L)	0.0649	<0.00010	<0.00010		
Beryllium (Be)-Total (mg/L)	<0.000020	<0.000020	<0.000020		
Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050		
Boron (B)-Total (mg/L)	<0.010	<0.010	<0.010		
Cadmium (Cd)-Total (mg/L)	0.0000083	<0.0000050	<0.0000050		
Calcium (Ca)-Total (mg/L)	50.5	<0.050	<0.050		
Chromium (Cr)-Total (mg/L)	<0.00010	<0.00010	<0.00010		
Cobalt (Co)-Total (mg/L)	<0.00010	<0.00010	<0.00010		
Copper (Cu)-Total (mg/L)	0.00073	<0.00050	0.00600 RRV		
Iron (Fe)-Total (mg/L)	0.018	<0.010	<0.010		
Lead (Pb)-Total (mg/L)	<0.000050	<0.000050	0.000216 RRV		
Lithium (Li)-Total (mg/L)	0.0119	<0.0010	<0.0010		

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2343480-1	L2343480-2	L2343480-3	L2343480-4	L2343480-5
Description	Water	Water	Water	Water	Water
Sampled Date	05-SEP-19	05-SEP-19	05-SEP-19	06-SEP-19	06-SEP-19
Sampled Time	10:00	13:20	17:30	10:00	12:00
Client ID	W23	W5	W6	W29	W27
Grouping / **Analyte**					
WATER					
Total Metals Magnesium (Mg)-Total (mg/L)	15.8	21.2	9.39	19.6	25.6
Manganese (Mn)-Total (mg/L)	0.0212	0.0524	0.00516	0.0519	0.00891
Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Molybdenum (Mo)-Total (mg/L)	0.000576	0.000184	0.000995	0.000174	0.00111
Nickel (Ni)-Total (mg/L)	<0.00050	0.00070	<0.00050	0.00075	<0.00050
Phosphorus (P)-Total (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
Potassium (K)-Total (mg/L)	1.51	1.49	1.51	1.33	2.43
Selenium (Se)-Total (mg/L)	0.000222	0.000114	0.000376	0.000120	0.000271
Silicon (Si)-Total (mg/L)	4.19	4.21	4.03	4.43	5.39
Silver (Ag)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)-Total (mg/L)	2.53	2.53	2.52	2.39	3.83
Strontium (Sr)-Total (mg/L)	0.257	0.268	0.251	0.229	0.304
Sulfur (S)-Total (mg/L)	32.1	34.3	28.8	31.3	25.2
Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)-Total (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
Uranium (U)-Total (mg/L)	0.00151	0.00187	0.00110	0.00163	0.00673
Vanadium (V)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Zinc (Zn)-Total (mg/L)	<0.0030	<0.0030	<0.0030	<0.0030	0.0030
Zirconium (Zr)-Total (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
Dissolved Metals Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
Aluminum (Al)-Dissolved (mg/L)	0.0030	0.0032	0.0027	0.0040	0.0012
Antimony (Sb)-Dissolved (mg/L)	0.00053	0.00063	0.00035	0.00049	0.00410
Arsenic (As)-Dissolved (mg/L)	0.00416	0.00317	0.00593	0.00268	0.0203
Barium (Ba)-Dissolved (mg/L)	0.0576	0.0497	0.0652	0.0444	0.0722
Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Boron (B)-Dissolved (mg/L)	<0.010	<0.010	<0.010	<0.010	<0.010
Cadmium (Cd)-Dissolved (mg/L)	0.0000097	0.0000105	0.0000066	0.0000133	0.0000062
Calcium (Ca)-Dissolved (mg/L)	55.7	55.2	61.0	47.8	49.9
Chromium (Cr)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Copper (Cu)-Dissolved (mg/L)	0.00042	0.00306 DTC	0.00049	0.00035	0.00068
Iron (Fe)-Dissolved (mg/L)	0.014	0.020	0.015	0.020	0.010
Lead (Pb)-Dissolved (mg/L)	<0.000050	0.000146	<0.000050	<0.000050	<0.000050
Lithium (Li)-Dissolved (mg/L)	0.0053	0.0083	0.0018	0.0078	0.0122

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2343480-6	L2343480-7	L2343480-8	L2343480-9	L2343480-10
Description	Water	Water	Water	Water	Water
Sampled Date	06-SEP-19	06-SEP-19	07-SEP-19	07-SEP-19	05-SEP-19
Sampled Time	15:00	16:45	10:15	12:15	
Client ID	W4	W22	W1	W26	DUP
Grouping / **Analyte**					
WATER					
Total Metals Magnesium (Mg)-Total (mg/L)	17.4	17.7	4.31	20.2	15.8
Manganese (Mn)-Total (mg/L)	0.0298	0.0314	0.00075	0.00024	0.0214
Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Molybdenum (Mo)-Total (mg/L)	0.000136	0.000082	0.00199	0.00294	0.000572
Nickel (Ni)-Total (mg/L)	0.00066	0.00077	<0.00050	<0.00050	<0.00050
Phosphorus (P)-Total (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
Potassium (K)-Total (mg/L)	1.27	1.26	0.89	1.28	1.47
Selenium (Se)-Total (mg/L)	0.000124	0.000130	0.000148	0.000351	0.000248
Silicon (Si)-Total (mg/L)	4.51	4.29	6.46	5.60	4.22
Silver (Ag)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)-Total (mg/L)	2.20	2.18	1.91	2.06	2.53
Strontium (Sr)-Total (mg/L)	0.214	0.219	0.0943	0.314	0.264
Sulfur (S)-Total (mg/L)	29.9	30.5	6.19	16.7	32.8
Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)-Total (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
Uranium (U)-Total (mg/L)	0.00123	0.00121	0.000614	0.00746	0.00149
Vanadium (V)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Zinc (Zn)-Total (mg/L)	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
Zirconium (Zr)-Total (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
Dissolved Metals Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
Aluminum (Al)-Dissolved (mg/L)	0.0045	0.0036	0.0044	0.0116	0.0032
Antimony (Sb)-Dissolved (mg/L)	0.00030	0.00022	0.00105	0.00074	0.00052
Arsenic (As)-Dissolved (mg/L)	0.00198	0.00082	0.0300	0.0234	0.00428
Barium (Ba)-Dissolved (mg/L)	0.0441	0.0441	0.0550	0.0770	0.0569
Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Boron (B)-Dissolved (mg/L)	<0.010	<0.010	<0.010	<0.010	<0.010
Cadmium (Cd)-Dissolved (mg/L)	0.0000071	0.0000059	<0.0000050	0.0000097	0.0000092
Calcium (Ca)-Dissolved (mg/L)	45.7	45.0	18.4	43.4	55.8
Chromium (Cr)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Copper (Cu)-Dissolved (mg/L)	0.00027	0.00024	<0.00020	0.00224 DTC	0.00042
Iron (Fe)-Dissolved (mg/L)	0.035	0.036	<0.010	<0.010	0.015
Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	0.000113	<0.000050
Lithium (Li)-Dissolved (mg/L)	0.0081	0.0077	0.0026	0.0051	0.0054

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2343480-11	L2343480-12	L2343480-13		
Description	Water	Water	Water		
Sampled Date	06-SEP-19		07-SEP-19		
Sampled Time			10:00		
Client ID	DUP	TRAVEL BLANK	FB		
Grouping / **Analyte**					
WATER					
Total Metals Magnesium (Mg)-Total (mg/L)	26.1	<0.10	<0.10		
Manganese (Mn)-Total (mg/L)	0.00912	<0.00010	<0.00010		
Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050	<0.0000050		
Molybdenum (Mo)-Total (mg/L)	0.00114	<0.000050	<0.000050		
Nickel (Ni)-Total (mg/L)	<0.00050	<0.00050	<0.00050		
Phosphorus (P)-Total (mg/L)	<0.050	<0.050	<0.050		
Potassium (K)-Total (mg/L)	2.38	<0.10	<0.10		
Selenium (Se)-Total (mg/L)	0.000246	<0.000050	<0.000050		
Silicon (Si)-Total (mg/L)	5.32	<0.10	<0.10		
Silver (Ag)-Total (mg/L)	<0.000010	<0.000010	<0.000010		
Sodium (Na)-Total (mg/L)	3.99	<0.050	<0.050		
Strontium (Sr)-Total (mg/L)	0.316	<0.00020	<0.00020		
Sulfur (S)-Total (mg/L)	24.0	<0.50	<0.50		
Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010		
Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	0.00012 RRV		
Titanium (Ti)-Total (mg/L)	<0.00030	<0.00030	<0.00030		
Uranium (U)-Total (mg/L)	0.00621	<0.000010	<0.000010		
Vanadium (V)-Total (mg/L)	<0.00050	<0.00050	<0.00050		
Zinc (Zn)-Total (mg/L)	<0.0030	<0.0030	0.0039 RRV		
Zirconium (Zr)-Total (mg/L)	<0.00030	<0.00030	<0.00030		
Dissolved Metals Dissolved Mercury Filtration Location	FIELD		FIELD		
Dissolved Metals Filtration Location	FIELD		FIELD		
Aluminum (Al)-Dissolved (mg/L)	0.0019		<0.0010		
Antimony (Sb)-Dissolved (mg/L)	0.00400		<0.00010		
Arsenic (As)-Dissolved (mg/L)	0.0202		<0.00010		
Barium (Ba)-Dissolved (mg/L)	0.0718		<0.00010		
Beryllium (Be)-Dissolved (mg/L)	<0.000020		<0.000020		
Bismuth (Bi)-Dissolved (mg/L)	<0.000050		<0.000050		
Boron (B)-Dissolved (mg/L)	<0.010		<0.010		
Cadmium (Cd)-Dissolved (mg/L)	0.0000073		<0.0000050		
Calcium (Ca)-Dissolved (mg/L)	51.3		<0.050		
Chromium (Cr)-Dissolved (mg/L)	<0.00010		<0.00010		
Cobalt (Co)-Dissolved (mg/L)	<0.00010		<0.00010		
Copper (Cu)-Dissolved (mg/L)	0.00156		<0.00020		
Iron (Fe)-Dissolved (mg/L)	0.011		<0.010		
Lead (Pb)-Dissolved (mg/L)	<0.000050		<0.000050		
Lithium (Li)-Dissolved (mg/L)	0.0126		<0.0010		

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2343480-1	L2343480-2	L2343480-3	L2343480-4	L2343480-5
Description	Water	Water	Water	Water	Water
Sampled Date	05-SEP-19	05-SEP-19	05-SEP-19	06-SEP-19	06-SEP-19
Sampled Time	10:00	13:20	17:30	10:00	12:00
Client ID	W23	W5	W6	W29	W27
Grouping / **Analyte**					
WATER					
Dissolved Metals					
Magnesium (Mg)-Dissolved (mg/L)	16.5	21.9	10.1	20.1	26.0
Manganese (Mn)-Dissolved (mg/L)	0.0210	0.0563	0.00513	0.0526	0.00910
Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Molybdenum (Mo)-Dissolved (mg/L)	0.000529	0.000179	0.000969	0.000140	0.00104
Nickel (Ni)-Dissolved (mg/L)	<0.00050	0.00065	<0.00050	0.00065	<0.00050
Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
Potassium (K)-Dissolved (mg/L)	1.56	1.59	1.58	1.42	2.60
Selenium (Se)-Dissolved (mg/L)	0.000216	0.000115	0.000370	0.000099	0.000260
Silicon (Si)-Dissolved (mg/L)	4.01	4.09	3.96	4.21	5.18
Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)-Dissolved (mg/L)	2.59	2.66	2.62	2.47	3.96
Strontium (Sr)-Dissolved (mg/L)	0.264	0.283	0.262	0.239	0.316
Sulfur (S)-Dissolved (mg/L)	29.1	31.7	26.9	29.0	22.9
Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
Uranium (U)-Dissolved (mg/L)	0.00150	0.00185	0.00111	0.00160	0.00678
Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Zinc (Zn)-Dissolved (mg/L)	<0.0010	0.0024	<0.0010	0.0017	0.0028
Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2343480-6	L2343480-7	L2343480-8	L2343480-9	L2343480-10
Description	Water	Water	Water	Water	Water
Sampled Date	06-SEP-19	06-SEP-19	07-SEP-19	07-SEP-19	05-SEP-19
Sampled Time	15:00	16:45	10:15	12:15	
Client ID	W4	W22	W1	W26	DUP
Grouping / **Analyte**					
WATER					
Dissolved Metals Magnesium (Mg)-Dissolved (mg/L)	18.6	18.7	4.38	21.2 DTC	16.1
Manganese (Mn)-Dissolved (mg/L)	0.0301	0.0315	0.00052	0.00059	0.0209
Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Molybdenum (Mo)-Dissolved (mg/L)	0.000130	0.000058	0.00205	0.00284	0.000539
Nickel (Ni)-Dissolved (mg/L)	0.00058	0.00064	<0.00050	<0.00050	<0.00050
Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
Potassium (K)-Dissolved (mg/L)	1.39	1.34	0.97	1.40	1.58
Selenium (Se)-Dissolved (mg/L)	0.000106	0.000115	0.000125	0.000260	0.000204
Silicon (Si)-Dissolved (mg/L)	4.15	4.12	6.02	5.39	3.99
Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)-Dissolved (mg/L)	2.32	2.27	1.96	2.17	2.60
Strontium (Sr)-Dissolved (mg/L)	0.233	0.231	0.0990	0.341	0.273
Sulfur (S)-Dissolved (mg/L)	26.8	28.1	5.50	15.9	30.2
Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
Uranium (U)-Dissolved (mg/L)	0.00123	0.00124	0.000602	0.00758	0.00150
Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Zinc (Zn)-Dissolved (mg/L)	0.0014	<0.0010	<0.0010	0.0020	<0.0010
Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2343480-11	L2343480-12	L2343480-13		
Description	Water	Water	Water		
Sampled Date	06-SEP-19		07-SEP-19		
Sampled Time			10:00		
Client ID	DUP	TRAVEL BLANK	FB		
Grouping / **Analyte**					
WATER					
Dissolved Metals Magnesium (Mg)-Dissolved (mg/L)	26.6		<0.10		
Manganese (Mn)-Dissolved (mg/L)	0.00905		<0.00010		
Mercury (Hg)-Dissolved (mg/L)	<0.0000050		<0.0000050		
Molybdenum (Mo)-Dissolved (mg/L)	0.00108		<0.000050		
Nickel (Ni)-Dissolved (mg/L)	<0.00050		<0.00050		
Phosphorus (P)-Dissolved (mg/L)	<0.050		<0.050		
Potassium (K)-Dissolved (mg/L)	2.67		<0.10		
Selenium (Se)-Dissolved (mg/L)	0.000259		<0.000050		
Silicon (Si)-Dissolved (mg/L)	5.11		<0.050		
Silver (Ag)-Dissolved (mg/L)	<0.000010		<0.000010		
Sodium (Na)-Dissolved (mg/L)	4.02		<0.050		
Strontium (Sr)-Dissolved (mg/L)	0.327		<0.00020		
Sulfur (S)-Dissolved (mg/L)	22.9		<0.50		
Thallium (Tl)-Dissolved (mg/L)	<0.000010		<0.000010		
Tin (Sn)-Dissolved (mg/L)	<0.00010		<0.00010		
Titanium (Ti)-Dissolved (mg/L)	<0.00030		<0.00030		
Uranium (U)-Dissolved (mg/L)	0.00685		<0.000010		
Vanadium (V)-Dissolved (mg/L)	<0.00050		<0.00050		
Zinc (Zn)-Dissolved (mg/L)	0.0033		0.0054		
Zirconium (Zr)-Dissolved (mg/L)	<0.00030		<0.00030		

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

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Method Blank	Magnesium (Mg)-Total	B	L2343480-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2343480-1, -10, -11, -13, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2343480-11, -2, -9
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2343480-1, -10, -11, -13, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2343480-11, -2, -9
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2343480-1, -10, -11, -13, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2343480-11, -2, -9
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L2343480-1, -10, -11, -13, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L2343480-11, -2, -9
Matrix Spike	Molybdenum (Mo)-Dissolved	MS-B	L2343480-11, -2, -9
Matrix Spike	Potassium (K)-Dissolved	MS-B	L2343480-11, -2, -9
Matrix Spike	Silicon (Si)-Dissolved	MS-B	L2343480-11, -2, -9
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2343480-1, -10, -11, -13, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2343480-11, -2, -9
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2343480-1, -10, -11, -13, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2343480-11, -2, -9
Matrix Spike	Sulfur (S)-Dissolved	MS-B	L2343480-1, -10, -11, -13, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Sulfur (S)-Dissolved	MS-B	L2343480-11, -2, -9
Matrix Spike	Uranium (U)-Dissolved	MS-B	L2343480-11, -2, -9
Matrix Spike	Aluminum (Al)-Total	MS-B	L2343480-11, -12, -13
Matrix Spike	Barium (Ba)-Total	MS-B	L2343480-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Barium (Ba)-Total	MS-B	L2343480-11, -12, -13
Matrix Spike	Calcium (Ca)-Total	MS-B	L2343480-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Calcium (Ca)-Total	MS-B	L2343480-11, -12, -13
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2343480-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2343480-11, -12, -13
Matrix Spike	Manganese (Mn)-Total	MS-B	L2343480-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Manganese (Mn)-Total	MS-B	L2343480-11, -12, -13
Matrix Spike	Sodium (Na)-Total	MS-B	L2343480-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Sodium (Na)-Total	MS-B	L2343480-11, -12, -13
Matrix Spike	Strontium (Sr)-Total	MS-B	L2343480-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Strontium (Sr)-Total	MS-B	L2343480-11, -12, -13
Matrix Spike	Sulfur (S)-Total	MS-B	L2343480-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Sulfur (S)-Total	MS-B	L2343480-11, -12, -13
Matrix Spike	Uranium (U)-Total	MS-B	L2343480-11, -12, -13

Qualifiers for Individual Parameters Listed:

Qualifier	Description
B	Method Blank exceeds ALS DQO. Associated sample results which are < Limit of Reporting or > 5 times blank level are considered reliable.
DTC	Dissolved concentration exceeds total. Results were confirmed by re-analysis.
HTC	Hardness was calculated from Total Ca and/or Mg concentrations and may be biased high (dissolved Ca/Mg results unavailable).
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.
RRV	Reported Result Verified By Repeat Analysis

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

BE-D-L-CCMS-VA	Water	Diss. Be (low) in Water by CRC ICPMS	APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Reference Information

BE-T-L-CCMS-VA	Water	Total Be (Low) in Water by CRC ICPMS	EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

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

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

CARBONS-DOC-VA	Water	Dissolved organic carbon by combustion	APHA 5310B

This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis.

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

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

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

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

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

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

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

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

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

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

HARDNESS-CALC-VA	Water	Hardness	APHA 2340B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HG-D-CVAA-VA	Water	Diss. Mercury in Water by CVAAS or CVAFS	APHA 3030B/EPA 1631E (mod)

Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

HG-T-CVAA-VA	Water	Total Mercury in Water by CVAAS or CVAFS	EPA 1631E (mod)

Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

MET-D-CCMS-VA	Water	Dissolved Metals in Water by CRC ICPMS	APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA	Water	Total Metals in Water by CRC ICPMS	EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-F-VA	Water	Ammonia in Water by Fluorescence	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-WR	Water	Nitrite in Water by IC (Low Level)	EPA 300.1 (mod)

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

NO3-L-IC-N-WR	Water	Nitrate in Water by IC (Low Level)	EPA 300.1 (mod)

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

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

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

Reference Information

Arsenic (5+), at elevated levels, is a positive interference on colourimetric phosphate analysis.

P-TD-PRES-COL-VA Water Total Dissolved P in Water by Colour APHA 4500-P Phosphorous

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

Arsenic (5+), at elevated levels, is a positive interference on colourimetric phosphate analysis.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

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

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

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

Arsenic (5+), at elevated levels, is a positive interference on colourimetric phosphate analysis.

SO4-IC-WR Water Sulfate in Water by IC EPA 300.1 (mod)

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

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

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

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

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

TN-CALC-VA Water Total Nitrogen (Calculation) BC MOE LABORATORY MANUAL (2005)

Total Nitrogen is a calculated parameter. Total Nitrogen = Total Kjeldahl Nitrogen + [Nitrate and Nitrite (as N)]

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

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

TURBIDITY-VA Water Turbidity by Meter APHA 2130 Turbidity

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

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

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

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

Chain of Custody Numbers:

19-20190907

Reference Information

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Chain of Custody (COC) / Analytical Request Form

ALS Environmental
www.alsglobal.com

Canada Toll Free: 1 800 668 9878

L2343480-COFC

COC Number: 19 - 20190907

Report To	Contact and company name below will appear on the final report
Company:	StrataGold Corporation
Contact:	Hugh Coyle
Phone:	604-696-6600
	Company address below will appear on the final report
Street:	100-1050 West Pender Street
City/Province:	Vancouver, V6E 3S7
Postal Code:	
Invoice To	Same as Report To ☐ YES ☐ NO
	Copy of Invoice with Report ☐ YES ☐ NO
Company:	
Contact:	

Report Format / Distribution	
Select Report Format:	☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)
Quality Control (QC) Report with Report	☐ YES ☐ NO
☐ Compare Results to Criteria on Report - provide details below if box checked	
Select Distribution:	☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax	kbabin@vitgoldcorp.com; pemerson@vitgoldcorp.c
Email 2	hcoyle@vitgoldcorp.com; jknox@vitgoldcorp.com
Email 3	swilbur@vitgoldcorp.com

Invoice Distribution	
Select Invoice Distribution:	☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax	
Email 2	

Project Information	
ALS Account # / Quote #:	
Job #:	Site Operations (September)
PO / AFE:	
LSD:	
ALS Lab Work Order # (lab use only):	

Oil and Gas Required Fields (client use)	
AFE/Cost Center:	PO#
Major/Minor Code:	Routing Code:
Requisitioner:	
Location:	
ALS Contact: Joanne Lee	**Sampler:**

Select Service Level Below - Contact your AM to confirm all E&P TATs (surcharges may apply)

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

PRIORITY (Business Days)		EMERGENCY	
	4 day [P4-20%] ☐		1 Business day [E - 100%] ☐
	3 day [P3-25%] ☐		Same Day, Weekend or Statutory holiday [E2 -200% (Laboratory opening fees may apply)] ☐
	2 day [P2-50%] ☐		

Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm

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

Analysis Request

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

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type		pH, EC, Turbidity, Total Alk.	TDS, TSS, Anion Scan	Total Cyanide, WAD Cyanide	T-PO4 TD-PO4, Ortho-PO4	TKN, HN3, TN-CALC-VA	DOC	TOC	MET-D-NDR-VA	MET-T-NDR-VA	HG-DIS-LOW-CVAFS-VA	HG-TOT-LOW-CVAFS-VA				Number of Containers	SUSPECTED HAZARD (see Special Instructions)
						P		P	F/P	P	F/P	P	F/P	P							
	W23	5-Sep-19	10:00	Water		R	R	R	R	R	R	R	R	R	R	R				8	
	W5	5-Sep-19	13:20	Water		R	R	R	R	R	R	R	R	R	R	R				8	
	W6	5-Sep-19	17:30	Water		R	R	R	R	R	R	R	R	R	R	R				8	
	W29	6-Sep-19	10:00	Water		R	R	R	R	R	R	R	R	R	R	R				8	
	W27	6-Sep-19	12:00	Water		R	R	R	R	R	R	R	R	R	R	R				8	
	W4 *	6-Sep-19	15:00	Water		R	R	R	R	R	R	R	R	R	R	R				8	
	W22	6-Sep-19	16:45	Water		R	R	R	R	R	R	R	R	R	R	R				8	
	W1	7-Sep-19	10:15	Water		R	R	R	R	R	R	R	R	R	R	R				8	
	W26	7-Sep-19	12:15	Water		R	R	R	R	R	R	R	R	R	R	R				8	
	DUP	5-Sep-19		Water		R	R	R	R	R	R	R	R	R	R	R				8	
	DUP	6-Sep-19		Water		R	R	R	R	R	R	R	R	R	R	R				8	
	Travel Blank			Water		R	R		R	R		R		R		R				4	

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

Are samples taken from a Regulated DW System?
☐ YES ☑ NO

Are samples for human consumption/ use?
☐ YES ☑ NO

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

* W4 dissolved Hg bottle leaked, resampled September 7 @ 13:40

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ SIF Observations Yes ☐ No ☐

Ice Packs ☐ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐

Cooling Initiated ☐

INITIAL COOLER TEMPERATURES °C				FINAL COOLER TEMPERATURES °C			
3.9	7.3	6.9					

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: Phil Emerson	Date: 9/7/2019	Time: 16:00	Received by:	Date: Sept 8, 2019	Time: 4:20PM	Received by:	Date:	Time:

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

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

Chain of Custody (COC) / Analytical Request Form

ALS Environmental
www.alsglobal.com

Canada Toll Free: 1 800 668 9878

L2343480-COFC

COC Number: 19 -

Report To	Contact and company name below will appear on the final report
Company:	StrataGold Corporation
Contact:	Hugh Coyle
Phone:	604-696-6600
	Company address below will appear on the final report
Street:	100-1050 West Pender Street
City/Province:	Vancouver, V6E 3S7
Postal Code:	
Invoice To	Same as Report To ☐ YES ☐ NO
	Copy of Invoice with Report ☐ YES ☐ NO
Company:	
Contact:	

Report Format / Distribution

Select Report Format: ☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)
Quality Control (QC) Report with Report ☐ YES ☐ NO
☐ Compare Results to Criteria on Report - provide details below if box checked
Select Distribution: ☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax: kbabin@vitgoldcorp.com; pemerson@vitgoldcorp.c
Email 2: hcoyle@vitgoldcorp.com; jknox@vitgoldcorp.com
Email 3: swilbur@vitgoldcorp.com

Invoice Distribution

Select Invoice Distribution: ☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax:
Email 2:

Select Service Level Below - Contact your AM to confirm all E&P TATs (surcharges may apply)

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

PRIORITY (Business Days): 4 day [P4-20%] ☐ | 3 day [P3-25%] ☐ | 2 day [P2-50%] ☐

EMERGENCY: 1 Business day [E - 100%] ☐ | Same Day, Weekend or Statutory holiday [E2 -200% (Laboratory opening fees may apply)] ☐

Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm

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

Project Information

ALS Account # / Quote #:
Job #: Site Operations (MONTH)
PO / AFE:
LSD:

Oil and Gas Required Fields (client use)

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

ALS Lab Work Order # (lab use only):

ALS Contact: Joanne Lee | Sampler:

Analysis Request

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

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	pH, EC, Turbidity, Total Alk.	TDS, TSS, Anion Scan	Total Cyanide, WAD Cyanide	T-PO4,TD-PO4, Ortho-PO4	TKN, HN3, TN-CALC-VA	DOC	TOC	MET-D-NDR-VA	MET-T-NDR-VA	HG-DIS-LOW-CVAFS-VA	HG-TOT-LOW-CVAFS-VA	Number of Containers	SUSPECTED HAZARD (see Special Instructions)
					P		P		P	F/P	P	F/P	P	F/P	P		
	FB	7-Sep-19	10:00	Water	R	R	R	R	R	R	R	R	R	R	R		8

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

Are samples taken from a Regulated DW System?
☐ YES ☑ NO
Are samples for human consumption/ use?
☐ YES ☑ NO

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

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ | SIF Observations Yes ☐ No ☐
Ice Packs ☐ Ice Cubes ☐ | Custody seal intact Yes ☐ No ☐
Cooling Initiated ☐

INITIAL COOLER TEMPERATURES °C				FINAL COOLER TEMPERATURES °C			

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by:	Date:	Time:	Received by:	Date:	Time:	Received by:	Date:	Time:

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

JUNE 2018 FRONT

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

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

APPENDIX B

Table B-1 Field Observations, September 2019

Table B-2 Additional Metrics per Benthic Sample

Benthic Invertebrate Data, Cordillera Consulting

Cordillera Consulting Methods and QC Report

TABLE B-1 FIELD CONDITIONS AT THE TIME OF SAMPLING, 2019									
Drainage	**Haggart Creek**					**Dublin Gulch**		**Eagle Creek**	**Lynx Creek**
Site	**W22**	**W4**	**W29**	**W5**	**W23**	**W1**	**W26**	**W27**	**W6**
Date Sampled	2019-09-06	2019-09-06	2019-09-06	2019-09-05	2019-09-05	2019-09-07	2019-09-07	2019-09-06	2019-09-05
Time	16:45	15:00	10:00	13:20	10:00	10:15	12:15	12:00	17:30
Temp ^{o}C	8.5	7.8	2.4	10.1	4.8	2.6	3.1	6.1	6.5
Conductivity (µS/cm)	366.9	360.7	392.2	422.8	402.3	119.2	355.2	424.9	375.7
pH	7.76	7.99	6.87	7.94	6.54	8.08	7.86	7.80	7.91
Bankfull Width (m)	4.65	7.20	8.65	9.00	12.50	3.00	0.90	0.90	11.40
Wetted Width (m)	4.35	3.30	4.70	5.00	8.20	1.30	0.47	0.40	6.40
Average Water Depth (m)	0.16	0.19	0.19	0.17	0.18	0.12	0.03	0.07	0.11
Average Velocity (m/s)	0.31	0.27	0.35	0.39	0.28	nm	nm	nm	0.26
Discharge (m^3/s)	0.233	0.230	0.279	0.275	0.476	0.025	<0.001	0.005	0.258
Substrate	gravel, some cobble and sand	cobble, gravel, some sand	cobble, gravel, some sand	gravel, cobble, some sand	gravel, cobble	gravel, sand,cobble, some boulders	gravel, some cobble and soil	gravel and sand, some cobble	gravel, some cobble and sand
Embeddedness	<25%	<25%	<25%	25-50%	50-75%	<25%	<25%	<25%	<25%
Canopy Cover	<5%	<5%	<5%	<5%	<5%	10-25%	25-75%	10%	<5%
Riparian Vegetation	grasses, sedges, willows, aspen, spruce	alder, willows, spruce, aspen, sedges, grasses, forbs	alder, willows, grasses, sedges, horsetail, birch	grasses, alder, willows, forbs, aspen	grasses, alder, willows, sedges, rushes, forbs, aspen, spruce	alder, willows, grasses, sedges, forbs, mosses, aspen, spruce, birch	willow, alder, forbs, mosses, horsetail, aspen, spruce	willows, grasses, sedges, mosses, alder, forbs	willows, grasses, sedges, forbs, spruce

nm = not measured, discharge calculated by salt dilution

Sample:	W1-A	W1-B	W1-C	W4-A	W4-B	W4-C
Sample Collection Date:	07-Sep-19	07-Sep-19	07-Sep-19	06-Sep-19	06-Sep-19	06-Sep-19
CC#:	CC200772	CC200773	CC200774	CC200760	CC200761	CC200762
Dominance Measures						
1st Dominant Taxon	Zapada	Capniidae	Pagastia	Baetis	Baetis	Baetidae
1st Dominant Abundance	158	171	469	365	293	374
2nd Dominant Taxon	Lumbriculidae	Lumbriculidae	Zapada	Zapada	Zapada	Zapada
2nd Dominant Abundance	152	93	272	128	197	202
3rd Dominant Taxon	Diamesa	Heptageniidae	Lumbriculidae	Heptageniidae	Lumbriculidae	Baetis
3rd Dominant Abundance	78	64	213	69	45	125
% 1 Dominant Taxon	24.38%	20.48%	26.53%	40.74%	34.67%	36.03%
% 2 Dominant Taxa	23.46%	11.14%	15.38%	14.29%	23.31%	19.46%
% 3 Dominant Taxa	12.04%	7.66%	12.05%	7.70%	5.33%	12.04%
Functional Group Composition						
% Predators	4.01%	11.98%	5.37%	11.38%	7.93%	5.49%
% Shredder-Herbivores	33.64%	36.53%	30.43%	18.30%	31.95%	24.66%
% Collector-Gatherers	50.62%	38.08%	55.15%	59.60%	52.43%	58.29%
% Scrapers	7.41%	10.54%	4.24%	8.93%	6.27%	10.69%
% Macrophyte-Herbivore						
% Collector-Filterer		0.60%			0.36%	
% Omnivore	3.70%	1.92%	4.81%	1.45%	0.71%	0.87%
% Parasite						
% Piercer-Herbivore						
% Gatherer						
% Unclassified	0.62%	0.36%		0.33%	0.36%	0.00%
Diversity/Evenness Measures						
Shannon-Weiner H' (log 10)	1.05	1.25	1.08	1.04	1.02	0.94
Shannon-Weiner H' (log 2)	3.47	4.14	3.59	3.46	3.39	3.12
Shannon-Weiner H' (log e)	2.41	2.87	2.49	2.40	2.35	2.16
Simpson's Index (D)	0.14	0.08	0.13	0.20	0.19	0.19
Simpson's Index of Diversity (1 - D)	0.86	0.92	0.87	0.80	0.81	0.81
Simpson's Reciprocal Index (1/D)	7.07	12.03	7.88	5.02	5.39	5.18
Biotic Indices						
Hilsenhoff Biotic Index	4.24	3.27	3.02	4.05	3.86	3.67

Sample:	W5-A	W5-B	W5-C	W6-A	W6-B	W6-C
Sample Collection Date:	05-Sep-19	05-Sep-19	05-Sep-19	05-Sep-19	05-Sep-19	05-Sep-19
CC#:	CC200766	CC200767	CC200768	CC200779	CC200780	CC200781
Dominance Measures						
1st Dominant Taxon	Heptageniidae	Heptageniidae	Baetidae	Heptageniidae	Heptageniidae	Baetis
1st Dominant Abundance	272	348	186	795	331	230
2nd Dominant Taxon	Zapada	Baetis	Heptageniidae	Baetis	Capniidae	Heptageniidae
2nd Dominant Abundance	220	260	163	272	227	218
3rd Dominant Taxon	Baetidae	Baetidae	Zapada	Capniidae	Baetis	Capniidae
3rd Dominant Abundance	176	160	125	229	53	179
% 1 Dominant Taxon	21.45%	24.17%	16.88%	36.10%	39.59%	22.70%
% 2 Dominant Taxa	17.35%	18.06%	14.79%	12.35%	27.15%	21.52%
% 3 Dominant Taxa	13.88%	11.11%	11.34%	10.40%	6.34%	17.67%
Functional Group Composition						
% Predators	6.31%	7.78%	3.90%	4.54%	16.63%	7.50%
% Shredder-Herbivores	34.38%	26.11%	32.58%	22.52%	28.47%	25.17%
% Collector-Gatherers	33.44%	37.78%	42.65%	35.65%	14.23%	41.46%
% Scrapers	22.71%	26.39%	16.52%	36.56%	40.31%	22.11%
% Macrophyte-Herbivore						
% Collector-Filterer		0.83%	0.91%		0.36%	0.59%
% Omnivore	2.21%	0.56%	3.45%	0.73%		3.16%
% Parasite						
% Piercer-Herbivore						
% Gatherer						
% Unclassified	0.95%	0.56%	0.00%			
Diversity/Evenness Measures						
Shannon-Weiner H' (log 10)	1.14	1.12	1.16	1.00	0.85	1.00
Shannon-Weiner H' (log 2)	3.80	3.71	3.84	3.33	2.83	3.32
Shannon-Weiner H' (log e)	2.64	2.57	2.66	2.31	1.96	2.30
Simpson's Index (D)	0.11	0.12	0.10	0.17	0.24	0.15
Simpson's Index of Diversity (1 - D)	0.89	0.88	0.90	0.83	0.76	0.85
Simpson's Reciprocal Index (1/D)	8.72	8.05	10.31	5.79	4.16	6.87
Biotic Indices						
Hilsenhoff Biotic Index	3.19	3.56	3.48	3.45	2.94	3.59

Sample:	W22-A	W22-B	W22-C	W23-A	W23-B	W23-C
Sample Collection Date:	06-Sep-19	06-Sep-19	06-Sep-19	05-Sep-19	05-Sep-19	05-Sep-19
CC#:	CC200757	CC200758	CC200759	CC200769	CC200770	CC200771
Dominance Measures						
1st Dominant Taxon	Baetis	Baetis	Baetis	Baetidae	Baetidae	Heptageniidae
1st Dominant Abundance	454	296	392	291	288	560
2nd Dominant Taxon	Zapada	Nemouridae	Heptageniidae	Heptageniidae	Heptageniidae	Baetis
2nd Dominant Abundance	106	68	284	221	240	480
3rd Dominant Taxon	Heptageniidae	Heptageniidae	Lumbriculus	Baetis	Zapada	Zapada
3rd Dominant Abundance	80	52	196	150	116	336
% 1 Dominant Taxon	40.39%	47.44%	27.84%	23.06%	23.45%	20.90%
% 2 Dominant Taxa	9.43%	10.90%	20.17%	17.51%	19.54%	17.91%
% 3 Dominant Taxa	7.12%	8.33%	13.92%	11.89%	9.45%	12.54%
Functional Group Composition						
% Predators	11.30%	13.46%	5.40%	8.32%	5.86%	4.18%
% Shredder-Herbivores	20.55%	18.91%	8.81%	21.63%	23.45%	25.07%
% Collector-Gatherers	58.27%	56.41%	60.23%	50.32%	46.91%	44.48%
% Scrapers	8.54%	10.58%	22.73%	18.54%	22.15%	21.79%
% Macrophyte-Herbivore						
% Collector-Filterer	0.27%		0.57%	0.48%	0.33%	0.90%
% Omnivore	0.53%	0.64%	2.27%	0.71%	0.98%	3.28%
% Parasite						
% Piercer-Herbivore						
% Gatherer						
% Unclassified	0.53%	0.00%	0.00%		0.33%	0.30%
Diversity/Evenness Measures						
Shannon-Weiner H' (log 10)	1.03	0.90	1.00	1.14	1.13	1.17
Shannon-Weiner H' (log 2)	3.42	3.00	3.32	3.79	3.74	3.88
Shannon-Weiner H' (log e)	2.37	2.08	2.30	2.63	2.59	2.69
Simpson's Index (D)	0.19	0.25	0.15	0.12	0.12	0.11
Simpson's Index of Diversity (1 - D)	0.81	0.75	0.85	0.88	0.88	0.89
Simpson's Reciprocal Index (1/D)	5.21	3.96	6.48	8.68	8.26	9.12
Biotic Indices						
Hilsenhoff Biotic Index	3.89	3.89	3.68	3.56	3.62	3.71

Sample:	W26-A	W27-A	W27-B	W27-C
Sample Collection Date:	07-Sep-19	06-Sep-19	06-Sep-19	06-Sep-19
CC#:	CC200775	CC200776	CC200777	CC200778
Dominance Measures				
1st Dominant Taxon	Capniidae	Nemouridae	Nemouridae	Nemouridae
1st Dominant Abundance	70	358	108	436
2nd Dominant Taxon	Eukiefferiella	Orthocladius complex	Orthocladius complex	Orthocladius complex
2nd Dominant Abundance	56	108	105	204
3rd Dominant Taxon	Zapada	Metriocnemus	Diamesa	Eukiefferiella
3rd Dominant Abundance	24	74	56	112
% 1 Dominant Taxon	28.34%	48.38%	25.71%	32.34%
% 2 Dominant Taxa	22.67%	14.59%	25.00%	15.13%
% 3 Dominant Taxa	9.72%	10.00%	13.33%	8.31%
Functional Group Composition				
% Predators	3.24%	2.16%	2.14%	3.26%
% Shredder-Herbivores	40.08%	48.65%	26.67%	34.12%
% Collector-Gatherers	29.55%	41.62%	56.67%	40.95%
% Scrapers	3.64%	0.27%	0.24%	4.75%
% Macrophyte-Herbivore				
% Collector-Filterer	0.81%	2.16%	0.48%	7.42%
% Omnivore	22.67%	4.59%	13.10%	8.90%
% Parasite				
% Piercer-Herbivore				
% Gatherer				
% Unclassified		0.54%	0.71%	0.59%
Diversity/Evenness Measures				
Shannon-Weiner H' (log 10)	1.02	0.80	0.93	1.03
Shannon-Weiner H' (log 2)	3.40	2.65	3.10	3.41
Shannon-Weiner H' (log e)	2.36	1.84	2.15	2.36
Simpson's Index (D)	0.15	0.28	0.17	0.15
Simpson's Index of Diversity (1 - D)	0.85	0.72	0.83	0.85
Simpson's Reciprocal Index (1/D)	6.61	3.61	5.99	6.50
Biotic Indices				
Hilsenhoff Biotic Index	3.95	3.98	4.85	4.60

Sample:	W29-A	W29-B	W29-C
Sample Collection Date:	06-Sep-19	06-Sep-19	06-Sep-19
CC#:	CC200763	CC200764	CC200765
Dominance Measures			
1st Dominant Taxon	Baetidae	Heptageniidae	Baetidae
1st Dominant Abundance	340	485	644
2nd Dominant Taxon	Heptageniidae	Baetidae	Heptageniidae
2nd Dominant Abundance	220	331	364
3rd Dominant Taxon	Lumbriculidae	Baetis	Zapada
3rd Dominant Abundance	196	272	256
% 1 Dominant Taxon	26.23%	26.36%	31.88%
% 2 Dominant Taxa	16.98%	17.99%	18.02%
% 3 Dominant Taxa	15.12%	14.78%	12.67%
Functional Group Composition			
% Predators	5.86%	5.54%	5.74%
% Shredder-Herbivores	15.74%	13.32%	22.77%
% Collector-Gatherers	58.33%	53.91%	52.28%
% Scrapers	16.98%	26.63%	18.22%
% Macrophyte-Herbivore			
% Collector-Filterer	1.54%		
% Omnivore	1.54%	0.60%	0.59%
% Parasite			
% Piercer-Herbivore			
% Gatherer			
% Unclassified	0.00%	0.00%	0.40%
Diversity/Evenness Measures			
Shannon-Weiner H' (log 10)	1.04	1.01	0.99
Shannon-Weiner H' (log 2)	3.45	3.36	3.30
Shannon-Weiner H' (log e)	2.39	2.33	2.29
Simpson's Index (D)	0.14	0.14	0.17
Simpson's Index of Diversity (1 - D)	0.86	0.86	0.83
Simpson's Reciprocal Index (1/D)	7.12	6.95	6.06
Biotic Indices			
Hilsenhoff Biotic Index	4.51	4.10	4.02

Site:	W1	W1	W1	W4	W4	W4	W5	W5	W5	W6	W6	W6	W22	W22	W22	W23	W23	W23	W26	W27	W27	W27	W29	W29	W29
Sample:	W1-A	W1-B	W1-C	W4-A	W4-B	W4-C	W5-A	W5-B	W5-C	W6-A	W6-B	W6-C	W22-A	W22-B	W22-C	W23-A	W23-B	W23-C	W26-A	W27-A	W27-B	W27-C	W29-A	W29-B	W29-C
Sample Collection Date:	07-Sep-19	07-Sep-19	07-Sep-19	06-Sep-19	06-Sep-19	06-Sep-19	05-Sep-19	05-Sep-19	05-Sep-19	05-Sep-19	05-Sep-19	05-Sep-19	06-Sep-19	06-Sep-19	06-Sep-19	05-Sep-19	05-Sep-19	05-Sep-19	07-Sep-19	06-Sep-19	06-Sep-19	06-Sep-19	06-Sep-19	06-Sep-19	06-Sep-19
CC#:	CC200772	CC200773	CC200774	CC200760	CC200761	CC200762	CC200766	CC200767	CC200768	CC200779	CC200780	CC200781	CC200757	CC200758	CC200759	CC200769	CC200770	CC200771	CC200775	CC200776	CC200777	CC200778	CC200763	CC200764	CC200765
SubSample %:	50	37.5	18.75	37.5	37.5	31.25	25	25	31.25	18.75	37.5	31.25	31.25	50	25	31.25	25	12.5	100	50	75	25	25	18.75	25
Phylum: Arthropoda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Order: Collembola	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	1	0	0	0	0	0	0
| Family: Isotomidae	8	0	5	0	0	0	4	4	0	0	0	22	0	0	0	0	0	0	0	0	7	8	0	0	0
Subphylum: Hexapoda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Class: Insecta	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Order: Ephemeroptera	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Ameletidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ameletus	10	13	5	5	3	0	0	0	0	0	0	0	3	0	0	0	0	0	14	0	0	0	0	5	0
| Family: Baetidae	22	29	37	32	37	374	176	160	186	139	5	51	51	32	84	291	288	264	2	2	0	12	340	331	644
Baetis	26	45	16	365	293	125	44	260	118	272	53	230	454	296	392	150	100	480	2	0	5	20	116	272	140
Baetis rhodani group	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	3	20	8	0	0	0	0	16	27	4
| Family: Ephemerellidae	2	5	0	11	19	10	52	8	10	75	16	19	10	4	12	19	8	80	0	0	0	4	0	5	0
Drunella doddsii	0	0	0	16	3	0	4	24	19	16	3	6	13	10	0	19	12	32	0	0	0	0	0	0	4
| Family: Heptageniidae	46	64	64	69	40	86	272	348	163	795	331	218	80	52	284	221	240	560	9	2	1	64	220	485	364
Cinygmula	0	3	0	3	0	0	4	0	0	5	3	0	3	2	0	3	0	16	0	0	0	0	0	0	0
Epeorus	2	21	11	0	0	0	0	8	3	5	0	3	3	0	8	0	0	0	0	0	0	0	0	0	0
Rhithrogena	0	0	0	3	0	0	0	12	16	0	0	3	0	0	8	0	4	0	0	0	0	0	0	0	0
| Order: Plecoptera	0	0	0	0	0	0	8	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Capniidae	30	171	128	19	19	19	136	56	112	229	227	179	19	6	24	38	36	144	70	0	0	0	28	48	52
| Family: Chloroperlidae	6	48	32	0	16	0	0	16	10	32	53	26	13	6	28	35	12	0	1	2	0	8	4	11	16
Haploperla	0	8	16	5	3	0	0	4	3	37	27	29	6	0	8	16	0	0	0	0	0	0	0	5	0
Suwallia	0	8	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sweltsa	0	0	0	0	0	0	0	4	0	0	0	3	0	0	0	0	4	8	0	0	0	0	0	0	8
| Family: Leuctridae	0	0	5	3	3	0	8	32	10	0	0	0	0	0	0	6	36	32	0	0	0	0	8	11	12
Paraleuctra	0	0	0	3	0	0	4	4	0	0	0	0	3	0	0	0	0	16	0	0	0	0	0	0	0
Perlomyia	0	0	0	0	0	0	0	0	10	0	0	0	0	0	0	3	0	8	0	0	0	0	0	0	0
| Family: Nemouridae	12	8	0	0	24	0	36	8	29	16	5	6	77	68	0	45	16	32	5	358	108	436	0	5	88
Ostrocerca	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	20	0	0	0
Zapada	158	51	272	128	197	202	220	156	125	171	3	35	106	14	76	67	116	336	24	0	0	0	124	155	256
Zapada oregonensis group	18	24	53	5	11	13	0	0	0	0	0	0	10	0	4	3	12	16	0	0	0	0	8	5	4
Zapada cinctipes	0	0	0	0	0	3	12	8	0	5	0	0	0	0	0	3	0	8	0	0	0	0	0	0	0
Zapada columbiana	0	19	75	0	5	6	4	0	6	0	0	0	10	12	8	6	4	8	0	0	0	0	8	16	12
| Family: Perlodidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Megarcys	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Taeniopterygidae	0	0	0	3	8	13	16	100	64	64	3	35	6	18	12	102	68	72	0	0	0	0	16	0	36
Taenionema	0	0	0	13	0	3	16	0	16	16	0	10	0	0	24	0	0	40	0	0	0	0	16	11	0
| Order: Trichoptera	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Glossosomatidae	0	0	0	0	5	3	8	8	0	0	3	0	10	4	4	0	12	0	0	0	0	0	0	5	4
Glossosoma	0	0	0	5	5	22	4	4	0	0	0	0	0	8	16	10	16	8	0	0	0	0	0	0	0
| Family: Limnephilidae	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0
| Family: Rhyacophilidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhyacophila	4	3	11	19	5	32	20	24	3	5	16	6	22	30	24	16	24	24	0	2	1	0	24	0	8
Rhyacophila vofixa group	0	0	0	3	5	3	16	0	0	0	0	0	10	4	4	0	4	8	0	0	0	0	0	11	0
| Order: Diptera	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	4	0	0	0
| Family: Ceratopogonidae	0	0	0	0	0	3	4	0	0	0	0	0	0	4	0	0	0	0	0	4	0	0	0	0	0
Bezzia/ Palpomyia	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ceratopogon	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	4	0	0	0
| Family: Chironomidae	4	3	0	3	0	0	4	0	0	0	0	0	0	0	0	0	4	8	0	4	3	4	0	0	8
| Subfamily: Chironominae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Sample:	W1-A	W1-B	W1-C	W4-A	W4-B	W4-C	W5-A	W5-B	W5-C	W6-A	W6-B	W6-C	W22-A	W22-B	W22-C	W23-A	W23-B	W23-C	W26-A	W27-A	W27-B	W27-C	W29-A	W29-B	W29-C
Sample Collection Date:	07-Sep-19	07-Sep-19	07-Sep-19	06-Sep-19	06-Sep-19	06-Sep-19	05-Sep-19	05-Sep-19	05-Sep-19	05-Sep-19	05-Sep-19	05-Sep-19	06-Sep-19	06-Sep-19	06-Sep-19	05-Sep-19	05-Sep-19	05-Sep-19	07-Sep-19	06-Sep-19	06-Sep-19	06-Sep-19	06-Sep-19	06-Sep-19	06-Sep-19
CC#:	CC200772	CC200773	CC200774	CC200760	CC200761	CC200762	CC200766	CC200767	CC200768	CC200779	CC200780	CC200781	CC200757	CC200758	CC200759	CC200769	CC200770	CC200771	CC200775	CC200776	CC200777	CC200778	CC200763	CC200764	CC200765
SubSample %:	50	37.5	18.75	37.5	37.5	31.25	25	25	31.25	18.75	37.5	31.25	31.25	50	25	31.25	25	12.5	100	50	75	25	25	18.75	25
| Tribe: Chironomini	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Phaenopsectra	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Tribe: Tanytarsini	0	0	0	0	0	35	56	24	86	11	0	0	0	0	0	10	8	32	0	0	5	16	32	0	28
Micropsectra	0	0	0	24	19	0	16	20	0	0	0	0	0	2	4	0	0	48	0	8	0	8	20	48	12
Paratanytarsus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	16	0	92	0	0	0
| Subfamily: Diamesinae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Tribe: Diamesini	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Diamesa	78	45	117	0	0	3	0	0	0	0	0	3	0	0	8	16	20	40	0	72	56	76	0	0	0
Pagastia	26	56	469	3	0	0	8	0	0	32	0	0	0	4	0	19	4	8	3	0	0	0	4	5	4
Pseudodiamesa	2	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	9	10	5	8	0	0	0
| Subfamily: Orthocladiinae	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brillia	0	32	5	3	0	0	0	8	0	11	0	0	0	0	0	0	0	0	0	2	0	4	8	5	0
Eukiefferiella	12	11	80	0	3	6	8	4	22	0	0	0	6	4	8	6	12	48	56	28	45	112	4	0	12
Hydrobaenus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	18	1	16	0	0	0
Krenosmittia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0
Metriocnemus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	16	74	37	84	0	0	0
Orthocladius	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0
Orthocladius complex	0	11	32	11	8	10	24	0	19	11	5	0	0	2	0	70	96	72	2	108	105	204	0	0	12
Parakiefferiella	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rheocricotopus	4	5	0	0	3	0	0	0	0	0	0	0	0	0	0	3	0	0	0	4	3	0	0	0	0
Thienemanniella	0	0	0	0	5	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tvetenia	0	16	11	5	8	10	40	36	26	59	11	6	6	0	20	6	12	64	1	4	4	4	24	27	48
| Subfamily: Podonominae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Tribe: Podonomini	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Parochlus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0
| Family: Empididae	2	3	0	5	0	0	0	0	0	0	0	0	0	2	4	16	0	0	2	4	1	8	0	5	8
Clinocerinae Unknown Genus	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0
Neoplasta	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0
Oreogeton	0	0	0	35	27	6	4	8	6	5	5	0	48	28	8	3	0	0	0	0	0	0	24	43	48
| Family: Muscidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Limnophora	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0
| Family: Psychodidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pericoma/Telmatoscopus	6	5	11	8	0	3	0	8	3	0	5	3	0	2	0	32	0	64	4	0	5	8	8	5	4
| Family: Simuliidae	0	5	0	0	3	0	0	12	0	0	3	6	3	0	8	6	4	24	0	0	1	8	20	0	0
Simulium	0	0	0	0	0	0	0	0	10	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0
| Family: Tipulidae	0	0	0	0	3	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0
Dicranota	0	3	0	0	0	0	0	0	0	5	5	0	0	0	0	3	0	0	0	0	0	0	4	0	0
Limnophila	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tipula	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0
| Order: Thysanoptera	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Subphylum: Chelicerata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Class: Arachnida	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Order: Trombidiformes	2	5	5	3	0	0	0	0	3	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	8
| Family: Aturidae	4	0	5	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Aturus	0	19	0	13	3	0	8	0	0	11	8	6	3	0	0	0	0	8	0	0	0	0	4	0	4
| Family: Feltriidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Feltria	0	3	21	0	5	0	4	0	0	0	19	3	0	0	0	0	0	0	2	0	0	0	0	0	0
| Family: Hygrobatidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Atractides	2	0	0	8	0	0	8	28	6	0	0	3	0	0	0	10	0	0	0	0	0	0	0	11	0
| Family: Lebertiidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lebertia	0	0	0	3	0	0	8	4	3	0	0	0	0	4	0	0	12	8	0	0	0	0	0	0	4

Sample:	W1-A	W1-B	W1-C	W4-A	W4-B	W4-C	W5-A	W5-B	W5-C	W6-A	W6-B	W6-C	W22-A	W22-B	W22-C	W23-A	W23-B	W23-C	W26-A	W27-A	W27-B	W27-C	W29-A	W29-B	W29-C
Sample Collection Date:	07-Sep-19	07-Sep-19	07-Sep-19	06-Sep-19	06-Sep-19	06-Sep-19	05-Sep-19	05-Sep-19	05-Sep-19	05-Sep-19	05-Sep-19	05-Sep-19	06-Sep-19	06-Sep-19	06-Sep-19	05-Sep-19	05-Sep-19	05-Sep-19	07-Sep-19	06-Sep-19	06-Sep-19	06-Sep-19	06-Sep-19	06-Sep-19	06-Sep-19	06-Sep-19
CC#:	CC200772	CC200773	CC200774	CC200760	CC200761	CC200762	CC200766	CC200767	CC200768	CC200779	CC200780	CC200781	CC200757	CC200758	CC200759	CC200769	CC200770	CC200771	CC200775	CC200776	CC200777	CC200778	CC200763	CC200764	CC200765
SubSample %:	50	37.5	18.75	37.5	37.5	31.25	25	25	31.25	18.75	37.5	31.25	31.25	50	25	31.25	25	12.5	100	50	75	25	25	18.75	25
| Family: Mideopsidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mideopsis	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Sperchontidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sperchon	4	0	0	5	3	10	8	24	6	0	0	0	13	6	0	6	8	56	0	0	3	0	12	16	12
Suborder: Prostigmata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Stygothrombidiida	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stygothrombium	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0	0	0	0	0	0	0
| Order: Sarcoptiformes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Order: Oribatida	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	3	0	0	0	0
| Family: Hydrozetidae	2	0	0	0	0	0	0	0	0	0	3	0	3	0	0	0	0	0	2	0	1	24	4	0	0
Phylum: Mollusca	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Class: Bivalvia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Order: Veneroida	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Pisidiidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Phylum: Annelida	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Subphylum: Clitellata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Class: Oligochaeta	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Order: Haplotaxida	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Haplotaxidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Haplotaxis	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Order: Lumbriculida	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Lumbriculidae	152	93	213	27	45	32	4	0	3	112	21	99	64	0	132	0	0	0	10	10	15	92	196	160	156
Lumbriculus	0	0	64	21	0	0	0	0	0	53	0	0	48	0	196	0	0	0	0	0	0	0	0	107	0
Rhynchelmis	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	4	0	2	0	0	0	0	0	0
| Order: Tubificida	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Naididae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nais	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0
Totals:	**648**	**835**	**1768**	**896**	**845**	**1038**	**1268**	**1440**	**1102**	**2202**	**836**	**1013**	**1124**	**624**	**1408**	**1262**	**1228**	**2680**	**247**	**740**	**420**	**1348**	**1296**	**1840**	**2020**

Total Organisms:	**648**	**835**	**1768**	**896**	**845**	**1038**	**1268**	**1440**	**1102**	**2202**	**836**	**1013**	**1124**	**624**	**1408**	**1262**	**1228**	**2680**	**247**	**740**	**420**	**1348**	**1296**	**1840**	**2020**
Total per site:	**3251**			**2779**			**3810**			**4051**			**3156**			**5170**			**247**	**2508**			**5156**		
Taxonomic Richness per sampl	**28**	**32**	**27**	**38**	**35**	**27**	**36**	**36**	**32**	**28**	**25**	**26**	**34**	**26**	**27**	**34**	**33**	**35**	**26**	**24**	**24**	**27**	**28**	**28**	**31**
Taxonomic Richness per site:	**42**			**55**			**50**			**40**			**44**			**47**			**26**	**36**			**43**		
Taxa present but not included:																									
Phylum: Arthropoda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Subphylum: Crustacea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Class: Ostracoda	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0
| Class: Maxillipoda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Class: Copepoda	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	1	0	0	4	0	0	0
Phylum: Nemata	2	3	0	3	3	0	4	4	0	0	3	3	0	0	0	3	0	8	1	2	1	4	4	0	4
Phylum: Platyhelminthes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Class: Turbellaria	0	0	5	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0
Totals:	2	3	5	3	3	3	4	4	0	5	3	3	0	2	0	6	0	8	2	2	1	8	4	5	4

Methods and QC Report 2019

Project ID: Dublin Gulch 2019

Client: Laberge Environmental

Prepared by:
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Sample Reception

On September 13, 2019, Cordillera Consulting received 25 benthic samples from Laberge Environmental. When samples arrived to Cordillera Consulting, exterior packaging was initially inspected for damage or wet spots that would have indicated damage to the interior containers.

Samples were logged into a proprietary software database (INSTAR1) where the clients assigned sample name was recorded along with a Cordillera Consulting (CC) number for cross-reference. Each sample was checked to ensure that all sites and replicates recorded on field sheets or packing lists were delivered intact and with adequate preservative. Any missing, mislabelled or extra samples were reported to the client immediately to confirm the total numbers and correct names on the sample jars. The client representative was notified of the arrival of the shipment and provided a sample inventory once intake was completed.
See table below for sample inventory:

Table 1: Summary of sample information including Cordillera Consulting (CC) number

Site	Sample	CC#	Date	Size	# of Jars
W22	W22-A	CC200757	9/6/2019	300µM	1
W22	W22-B	CC200758	9/6/2019	300µM	1
W22	W22-C	CC200759	9/6/2019	300µM	1
W4	W4-A	CC200760	9/6/2019	300µM	1
W4	W4-B	CC200761	9/6/2019	300µM	1
W4	W4-C	CC200762	9/6/2019	300µM	1
W29	W29-A	CC200763	9/6/2019	300µM	1
W29	W29-B	CC200764	9/6/2019	300µM	1
W29	W29-C	CC200765	9/6/2019	300µM	1
W5	W5-A	CC200766	9/5/2019	300µM	1
W5	W5-B	CC200767	9/5/2019	300µM	1
W5	W5-C	CC200768	9/5/2019	300µM	1
W23	W23-A	CC200769	9/5/2019	300µM	1
W23	W23-B	CC200770	9/5/2019	300µM	1
W23	W23-C	CC200771	9/5/2019	300µM	1
W1	W1-A	CC200772	9/7/2019	300µM	1
W1	W1-B	CC200773	9/7/2019	300µM	1
W1	W1-C	CC200774	9/7/2019	300µM	1
W26	W26-A	CC200775	9/7/2019	300µM	1
W27	W27-A	CC200776	9/6/2019	300µM	1
W27	W27-B	CC200777	9/6/2019	300µM	1
W27	W27-C	CC200778	9/6/2019	300µM	1
W6	W6-A	CC200779	9/5/2019	300µM	1
W6	W6-B	CC200780	9/5/2019	300µM	1
W6	W6-C	CC200781	9/5/2019	300µM	1

Sample Sorting

- Using a gridded Petri dish, fine forceps and a low power stereo-microscope (Olympus, Nikon, Leica) the sorting technicians removed the invertebrates and sorted them into family/orders.
- The sorting technician kept a running tally of total numbers excluding organisms from Porifera, Nemata, Platyhelminthes, Ostracoda, Copepoda, Cladocera and terrestrial drop-ins such as aphids. These organisms were marked for their presence (given a value of 1) only and left in the sample. They were not included towards the 300-organism subsample count.
- Where specimens are broken or damaged, only heads were counted.
- Subsampling was conducted with the use of a Marchant Box.
- When using the Marchant box, cells were extracted at the same time in the order indicated by a random number table. If the 300th organism was found part way into sorting a cell then the balance of that cell was sorted. If the organism count had not reached 300 by the 50th cell then the entire sample was sorted.
- The total number of cells sorted and the number of organisms removed were recorded manually on a bench sheet and then recorded into INSTAR1
- Organisms were stored in vials containing 80% ethanol and an interior label indicating the site names, date of sampling, site code numbers and portion subsampled. This information was also recorded on the laboratory bench sheet and on INSTAR1.
- The sorted portion of the debris was preserved and labeled separately from the unsorted portion and was tested for sorting efficiency (Sorting Quality Control – Sorting Efficiency). The unsorted portion was also labeled and preserved in separate jars.

Percent sub-sampled and total countable invertebrates pulled from the samples were summarized in the table below.

Table 2: Percent sub-sample and invertebrate count for each sample

Site	Sample	Date	CC#	300 micron fraction	
				% Sampled	# Invertebrates
W22	W22-A	06-Sep-19	CC200757	31.25%	352
W22	W22-B	06-Sep-19	CC200758	50%	312
W22	W22-C	06-Sep-19	CC200759	25%	352
W4	W4-A	06-Sep-19	CC200760	37.5%	335
W4	W4-B	06-Sep-19	CC200761	37.5%	316
W4	W4-C	06-Sep-19	CC200762	31.25%	325
W29	W29-A	06-Sep-19	CC200763	25%	324

W29	W29-B	06-Sep-19	CC200764	18.75%	345
W29	W29-C	06-Sep-19	CC200765	25%	505
W5	W5-A	05-Sep-19	CC200766	25%	317
W5	W5-B	05-Sep-19	CC200767	25%	360
W5	W5-C	05-Sep-19	CC200768	31.25%	345
W23	W23-A	05-Sep-19	CC200769	31.25%	396
W23	W23-B	05-Sep-19	CC200770	25%	307
W23	W23-C	05-Sep-19	CC200771	12.5%	335
W1	W1-A	07-Sep-19	CC200772	50%	324
W1	W1-B	07-Sep-19	CC200773	37.5%	313
W1	W1-C	07-Sep-19	CC200774	18.75%	332
W26	W26-A	07-Sep-19	CC200775	100%	247
W27	W27-A	06-Sep-19	CC200776	50%	370
W27	W27-B	06-Sep-19	CC200777	75%	317
W27	W27-C	06-Sep-19	CC200778	25%	337
W6	W6-A	05-Sep-19	CC200779	18.75%	413
W6	W6-B	05-Sep-19	CC200780	37.5%	313
W6	W6-C	05-Sep-19	CC200781	31.25%	318

Sorting Quality Control - Sorting Efficiency

As a part of Cordillera's laboratory policy, all projects undergo sorting efficiency checks.

- As sorting progresses, 10% of samples were randomly chosen by senior members of the sorting team for resorting.
- All sorters working on a project had at least 1 sample resorted by another sorter.
- An efficiency of 90 % was expected (95% for CABIN samples).
- If 90/95% efficiency was not met, samples from that sorter were resorted.
- To calculated sorting efficiency the following formula was used:

$$\frac{\#OrganismsMissed}{TotalOrganismsFound} * 100 = \%OM$$

Table 3 Summary of sorting efficiency

				Total from Sample	**Percent Efficiency**

Site - QC, Sample - QC1, CC# - CC200761, Percent sampled = 37.5%, Sieve size = 300					
Plecoptera		1			
Trichoptera		2			
Total:		**3**		**316**	**99%**
Site - QC, Sample - QC2, CC# - CC200771, Percent sampled = 12.5%, Sieve size = 300					
Plecoptera		1			
Total:		**1**		**335**	**100%**
Site - QC, Sample - QC3, CC# - CC200774, Percent sampled = 18.75%, Sieve size = 300					
Chironomidae		1			
Plecoptera		4			
Total:		**5**		**332**	**98%**

Sorting Quality Control - Sub-Sampling QC

Certain Provincial and Mining projects require additional sorting checks in the form of sub-sampling QC, (Environmental Effects Monitoring (EEM) protocol). This ensured that any fraction of the total sample that was examined was actually an accurate representation of the number of total organisms. Organisms from the additional sub-samples were not identified; rather total organism count only was compared.

Sub-Sampling efficiency was measured on 10% of the number of sub-sampled samples in the project. Ex. In a project where 50 of 100 total samples were processed through subsampling using a Marchant box, then 10% of 50; or 5 samples were used for sub sampling efficiency.

Sub-Sampling efficiency was performed by fractioning the entire sample into sub-sample percentages. On each sub-sampled portion, a total organism count was recorded and compared to the rest of the sub-samples. In order to pass, all fractions were required to be within 20% of total organism count.

Example: If 300 organisms are found in 10% of the sample, the sorter will continue to sample in 10% fractions until the entire sample is separated. They will then count the total number of organisms in each of the 10 fractions of 10% and compare the organism count.

When divergence is >20% the sorting manager examines for the source of the problem and takes steps to correct it. With the Marchant box, the problem typically rested with how the box is flipped back to the upright position. For this reason, subsampling was performed by experienced employees only. Another common source of error would be the type of debris in the sample. Samples with algae or heavy with periphyton have a higher incident of failure due to clumping than clear samples.

Table 4 Summary of Sub Sample efficiency

Station ID		Organisms in Subsample																			Sorter		Actual Total	Precision Error		Accuracy Error	
CC#	Sample Name	1	2	3	4	5	6	7	8	9											By	Time		Min (%)	Max (%)	Min (%)	Max (%)
200758	W22-B	317	353																		MP	40	670	10.20	10.20	5.37	5.37
200763	W29-A	327	338	346	339																AR	130	1350	0.29	5.49	0.15	3.11
200772	W1-A	333	345																		MP	40	678	3.48	3.48	1.77	1.77

Taxonomic Effort

The next procedure was the identification to genus-species level where possible of all the organisms in the sample.

- Identifications were made at the genus/species level for all insect organisms found including Chironomidae (Based on CABIN protocol).
- Non-insect organisms (except those not included in CABIN count) were identified to genus/species where possible and to a minimum of family level with intact and mature specimens.
- The Standard Taxonomic Effort lists compiled by the CABIN manual[1], SAFIT[2] , and PNAMP[3] were used as a guide line for what level of identification to achieve where the condition and maturity of the organism enabled.
- Organisms from the same families/order were kept in separate vials with 80% ethanol and an interior label of printed laser paper.
- Chironomidae was identified to genus/species level where possible and was aided by slide mounts. CMC-10 was used to clear and mount the slide.
- Oligochaetes was identified to family/genus level with the aid of slide mounts. CMC-10 was used to clear and mount the slide.
- Other Annelida (leeches, polychaetes) were identified to the family/genus/species level with undamaged, mature specimens.
- Mollusca was identified to family and genus/species where possible
- Decapoda, Amphipoda and Isopoda were identified at family/genus/species level where possible.
- Bryozoans and Nemata remained at the phylum level
- Hydrachnidae and Cnidaria were identified at the family/genus level where possible.
- When requested, reference collections were made containing at least one individual from each taxa listed. Organisms represented will have been identified to the lowest practical level.
- Reference collection specimens were stored in 55 mm glass vials with screw-cap lids with polyseal inserts (museum quality). They were labeled with taxa name, site code, date identified and taxonomist name. The same information was applied to labels on the slide mounts.

Taxonomists

The taxonomists for this project were certified by the Society of Freshwater Science (SFS) Taxonomic Certification Program at level 2 which is the required certification for CABIN projects:

Scott Finlayson: Group 1 General Arthropods (East/West); Group 2 EPT (East/West); Group 3 Chironomidae (East/West); Group 4 Oligochaeta

Adam Bliss: Group 1 General Arthropods (East/West); Group 2 EPT (East/West); Group 3 Chironomidae
Rita Avery: Group 1 General Arthropods (East/West); Group 2 EPT (East/West)

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[2] Southwest Association of Freshwater Invertebrate Taxonomists. (2015). www.safit.org

[3] Pacific Northwest Aquatic Monitoring Partnership (Accessed 2015). www.pnamp.org

Taxonomic Keys

Below is a reference list of taxonomic keys utilized by taxonomists at Cordillera Consulting. Cordillera taxonomists routinely seek out new literature to ensure the most accurate identification keys are being utilized. This is not reflective of the exhaustive list of resources that we use for identification. A more complete list of taxonomic resources can be found at Southwest Association of Freshwater Invertebrate Taxonomists. (2015).
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