Water Quality, Stream Sediments, and Hydrology in the Atlin Placer Mining Area- A Pilot Study

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Introduction

Placer mining has a long history in British Columbia and is restricted to specified claim and lease areas (FIGURE 1). Placer mining in the Atlin, BC area dates back to 1898 and involves extracting gold and other precious metals from alluvial material using water. Open pit or underground mining practices are used to remove the overburden and extract the gold-bearing gravel. The gravel is washed with water to separate the gold from the remainder of the alluvium (clay through boulder-sized materials). The wash water and suspended waste materials are then transferred into a settling pond. Water from the settling pond is either pumped back to the operation for re-use, left in the pond and allowed to infiltrate which limits suspended solids from entering surface waters, or discharged into a receiving watercourse. Provincial regulation dictates that discharge of mine effluent into receiving waters is permitted without a permit in a number of specified watercourses in accordance with the *Placer Mining Waste Control Regulation*. As a result of this regulation, there is the potential for deleterious substances in the form of suspended sediment and metals to be introduced into freshwater ecosystems. The impact and extent of this release into the immediate and downstream freshwater ecosystems has not been studied in the Atlin area.

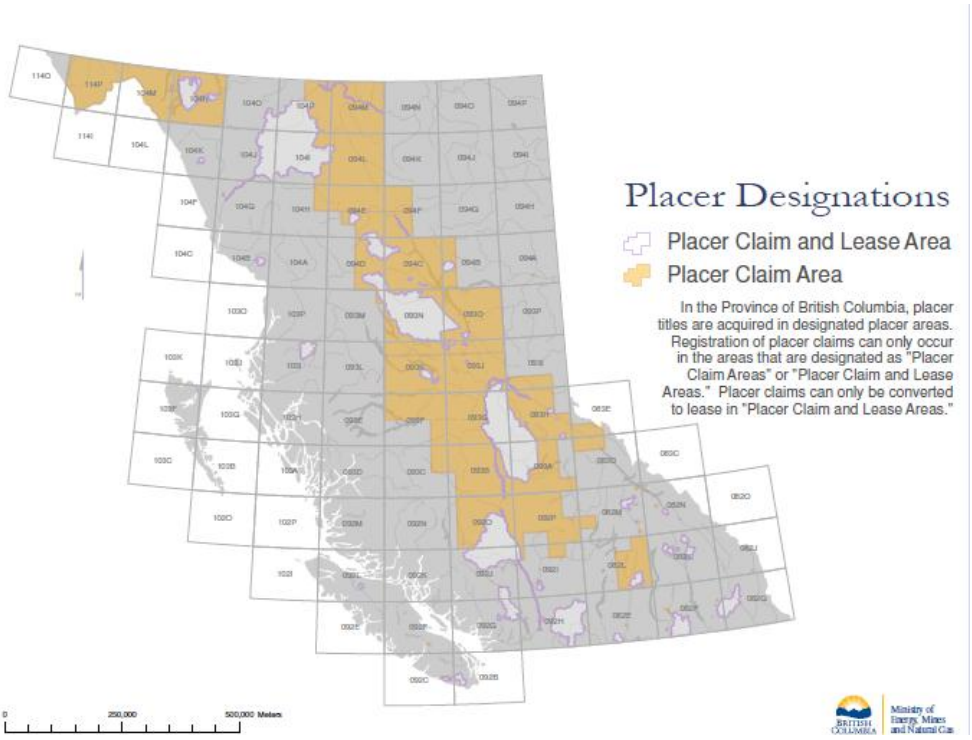

FIGURE 1 *Designated placer mining areas in British Columbia*.

Placer mining, while essentially an exercise in the logistics of earth moving and processing, is inherently dependent upon the use of water and its management. The placer mining industry relies on a number of permits under the *Water Act* including Section 8 (short term use of water) and Section 9 (changes in and about a stream), and water licences. Currently, there is limited hydrometric data available in the Atlin area to support these authorizations.

In 2011, the Atlin Taku Land Use Plan was signed; it identified the need to develop best management practices (BMPs) for placer mining. Through this process, and the Government-to-Government Forum between the BC government and the Taku River Tlingit First Nation, specific concerns and responsibilities were identified with regard to water quality. For much of the Atlin area there is lack of water quality data; this data is of high value in order to fill gaps in scientific knowledge, support BMP compliance, identify areas of concern, and support informed decision making.

The objectives of this project were to:

1. Review previous investigations in the area.
2. Review background literature to identify issues identified in other locations, sampling strategies and associated research questions.
3. Conduct a pilot project to identify whether aquatic exposure of metals is occurring in the vicinity of placer mines.
4. Collect and analyze samples to target future research regarding contaminants of interest and key sampling locations.
5. Produce research questions to address the most relevant gaps in knowledge related to placer mining BMPs.

Previous Investigations in the Study Area

Limited water quality and sediment sampling has taken place in the Atlin area. The BC Geological Survey of the Ministry of Energy Mines and Petroleum Resources (2013) conducted field investigations in 1977 in some of the same watercourses sampled in this project (TABLE 1).

The BC Geological Survey collected water and sediment samples and detected a number of metals. Through a joint initiative between the BC Ministry of Environment and the Taku River Tlingit First Nation (TRTFN), a limited water sampling program occurred in July and August of 2000 (Sharpe, 2001). This project collected water temperature, pH, conductivity, turbidity, and dissolved oxygen at several sites downstream of active placer mining operations. Fisheries & Oceans Canada (2004) funded single-event spot sampling by TRTFN of suspended sediment, settleable solids, turbidity, pH and conductivity at McKee Creek, Boulder Creek, and Ruby Creek in September 2004. This spot sampling recorded suspended sediment levels from 506 to 2877 mg/L, settleable solids of <0.1 to 8.0, and turbidity of 715 to 13248 NTU. Northern Health and the Ministry of Environment collect drinking water monitoring samples in Atlin (Ministry of Environment, 2013). Total metals in water are collected approximately every 5 years. The community of Altin withdraw drinking water from a number of locations in Atlin Lake. Raw water data from single day sampling in Atlin Lake at two sites in August 2002, one site in October 2003, and one site in July 2004 showed no values above drinking water standards.

TABLE 1 *Sediment and water information from a survey conducted by the BC Geological Survey in 1977. Observations above the Interim Sediment Quality Guidelines are identified in bold.*

Sample	Parameter	Birch Cr.	Birch Cr.	Birch Cr.	Boulder Cr.	Boulder Cr.	Lower Otter Cr.	Mid Otter Cr.	Mid Otter Cr./L. Otter Cr.	Ruby Cr.
Sediment (ppm)	Antimony	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
Sediment (ppm)	Arsenic	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
Sediment (ppm)	Barium	-1	-1	-1	-1	-1	-1	-1	-1	-1
Sediment (ppm)	Bismuth	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
Sediment (ppm)	Cadmium	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
Sediment (ppm)	Chromium	-1	-1	-1	-1	-1	-1	-1	-1	-1
Sediment (ppm)	Cobalt	32	22	19	21	11	14	11	14	25
Sediment (ppm)	Copper	**42**	**34**	**28**	**28**	**32**	**44**	**32**	**26**	**40**
Sediment (ppm)	Fluorine	-1	-1	-1	-1	-1	-1	-1	-1	-1
Sediment (ppm)	Iron	2.40	2.10	1.80	2.15	1.90	2.45	1.95	2.10	3.10
Sediment (ppm)	Lead	**9**	**3**	**2**	**4**	**31**	**1**	**1**	**1**	**14**
Sediment (ppm)	Manganese	**595**	**390**	**405**	**460**	**405**	**520**	**575**	**465**	**660**
Sediment (ppm)	Mercury	**20**	**10**	**10**	**20**	**30**	**30**	**20**	**30**	**20**
Sediment (ppm)	Molybdenum	2	1	1	1	1	1	1	2	6
Sediment (ppm)	Nickel	**255**	**150**	**184**	**215**	**102**	**98**	**82**	**110**	**186**
Sediment (ppm)	Selenium	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
Sediment (ppm)	Silver	**0.1**	**0.1**	**0.1**	**0.1**	**0.2**	**0.1**	**0.1**	**0.1**	**0.1**
Sediment (ppm)	Tin	1	1	1	1	38	1	1	1	51
Sediment (ppm)	Tungstun	2	2	2	6	135	2	2	2	120
Sediment (ppm)	Vandium	-1	-1	-1	-1	-1	-1	-1	-1	-1
Sediment (ppm)	Zinc	**44**	**42**	**38**	**60**	**205**	**82**	**88**	**70**	**128**
Water	pH	8.1	8.2	8.3	7.3	7.2	7.9	6.8	7.9	7.5
Water (ppb)	Uranium	1.8	2.1	1.6	0.1	22.8	1.6	1.7	1.6	13.0

Literature Review

Limited literature is available on the environmental impact of placer mining in British Columbia. However, research was conducted in the Yukon Territory, Alaska and elsewhere.

Water Quality

A number of studies have examined water quality in the vicinity of placer mines prior to the enactment of waste regulations, and in modern times.

Before the arrival of regulations to the placer mining industry in Alaska, placer mining operations introduced large quantities of sediments and increased levels of heavy metals such as mercury, arsenic, lead and copper (ADEC, 1986; Clark, 1970; Holmes, 1981). The Agency for Toxic Substances and Disease Registry (1987) observed widespread elevated levels of mercury and arsenic as a result of gold mining in the Nome, Alaska area. Historical placer mining operations used mercury to extract fine gold. A study by Alpers and Hunerlach (2000) in California described the estimated loss of mercury to be between 10 and 30 % per season resulting in the contamination of sediments. The USEPA (1994) noted that the amount and degree of contamination is highly variable and dependent on site characteristics, however the majority of contamination could be greatly mitigated by proper regulations and best practices.

A number of studies examined placer mined streams[1] and downstream water quality. A field investigation by Mathers et al. (1981) in the Yukon found suspended sediment concentrations of < 5mg/L to 100 mg/L in un-mined[2] streams and levels of 1000 to 4000 mg/L in streams with active placer mining. This project could not detect any significant levels of heavy metals in the streams sampled. Ray (1993) and Vohden (1999) documented elevated suspended sediment in placer mined streams as compared to un-mined streams. Seakam Group et al. (Vol. 1, 1992) found that daily sediment concentrations in placer-mined streams may be quite variable especially in the immediate vicinity of the mines. They found daily suspended sediment concentrations in water from 300-1800 mg/L in May and 150-3000 mg/L in August respectively. The study recorded 40 times or greater increases in sediment loads during freshet and 100 times or greater increases in sediment loads during the active placer sluicing season in Clear and Duncan Creeks. Weber (1986) concluded that placer mining effected profound changes in turbidity. A study by Wanty et al. (1999) noted stream destabilization and increased turbidity in placer mined streams. A study examining the impacts of placer mining on benthic macroinvertebrates found that placer mining increased settleable solids, suspended sediment and the turbidity of streams (Wagener and LaPerriere, 1985). Van Nieuwenhuyse and LaPerriere (1986) noted turbidity and total residues were 100 times greater in mined compared to un-mined streams. An Alaskan study found that placer mining sediment impacted alluvial aquifers and had the potential to limit movement between surface water and ground water (Bjerklie and LaPierriere, 1985).

A study examining Yukon streams, found that downstream sites had significantly greater percent fines during sluicing days and elevated sediment metal values (Soroka and Mackenzie-Grieve, 1984). During periods of

[1] In this report placer mined streams include streams that have placer mining in the vicinity of the stream and not necessarily in the stream itself.

[2] In this report un-mined streams are stream that have no active or historical placer mining in the vicinity of the stream.

non-sluicing and greater flows, the sediment on the streambed was re-suspended and transported downstream resulting in the streambed composition appearing to recover to that of a natural stream over time. The further downstream effects of the remobilized sediment were not studied.

Other studies focused on metals in water. LaPierriere et al. (1985) intensively study mined and un-mined streams in Circle Quadrangle, Alaska, and his study noted that arsenic, lead, zinc and copper were significantly higher in mined streams than un-mined streams. In addition, total arsenic, lead, zinc, copper and dissolved arsenic and zinc were significantly greater than un-mined and historically mined streams (Bjerklie and LaPierriere, 1985). A study on Big Creek, Yukon recorded elevated total metal concentrations above drinking water and aquatic life standards (Placer Research and Development Committee, 1985). Examinations of Little Gold Creek, Yukon, found that arsenic, copper, iron, mercury, manganese, nickel, lead, and zinc at downstream sites were significantly influenced by placer mining activity. The study could not find any conclusive influence of placer mining on dissolved oxygen and temperature (Soroka and Mackenzie-Grieve, 1983). A study of the Barlow Creek area, Yukon Territory recorded significantly greater extractable heavy metals at downstream sites and found that arsenic, copper, iron, manganese, nickel, lead, and zinc levels were significantly influenced by placer mining activity (Soroka and Mackenzie-Grieve, 1984). The general conclusion was that water quality parameters were correlated with mining and, to the greatest degree, sluicing. The study recorded elevated values of extractable heavy metals, phosphorus, nitrites, suspended sediments, settleable solids, filterable residue and turbidity downstream of placer mining activity while sluicing occurred. The downstream metal values were up to 10 times greater than upstream values but still less than the drinking water and aquatic life standards.

Alternatively, a Yukon study found mercury levels were below detection limits and dissolved oxygen levels were not significantly different between sites upstream and downstream of active placer mines (Soroka and Mackenzie-Grieve, 1984). Ammonia, filterable residues, sulphates, nitrites, alkalinity, pH, and conductivity were all below drinking water and aquatic life standards. A study of the Birch Creek drainage, Alaska recorded no significant change in pH, sulfates, or conductivity upstream compared to downstream of placer mining (Mack et al., 1988). A recent study by the U.S. Geological Survey, assessing the hydrology, water quality and trace elements of a number of placer mined creeks in Alaska found no substantial water or sediment quality problems (Kennedy and Langley, 2007). This is perhaps a reflection of changes in mining practices.

Benthos and Productivity

A number of studies have illustrated negative relationships between active placer mining and benthic macroinvertebrate abundance. Taft and Shapovalov (1935) documented a greater than 6 times difference in invertebrate abundance between mined and un-mined streams. A study by Mathers et al. (1981), used upstream sites as their control and found that benthic invertebrate abundance decreased downstream of placer mining. Wagener and LaPierre (1985) linked sediment from placer mining to a reduction in density and biomass of macroinvertebrates. A Yukon study that documented depressed benthic macroinvertebrate densities, proposed the threshold for significant effects to macroinvertebrates was 25 to 100 mg/L suspended sediment concentration in water (Seakam Group Ltd. et al., Vol. 1, 1992).

Further examination of impacts to benthic macroinvertebrates recorded changes to macroinvertebrate communities in response to placer gold mining activity. Soroka and Mackenzie-Grieve (1983), found a change in community structure from *Ephemeroptera* and *Plecoptera* leading communities to *Diptera* centred communities. Further studies, found a decrease in abundance of *Orthocladiini* and *Chloroperlid* stoneflies in mined streams and noted that water mites were the group most affected by placer mining (Wagener and LaPerriere, 1985). Negative impacts to diversity have also been noted in California; with placer mined streams being 63% as rich as un-mined streams (Summer and Smith, 1939). No primary production was detected in an Alaskan study of intensively mined streams (Van Nieuwenhuyse and LaPerriere, 1986).

Fish

Studies have noted impacts to fish as a result of placer gold mining. Studies in Alaskan and South American streams found that placer mining resulted in the loss of fish presence and fish habitat and Mol and Ouboter (2004) observed a decrease in the diversity of fishes (Weber and Post, 1985). Smith (1939) noted that silt from placer mining or natural forces caused a negative impact to salmon and trout if sediment loads and channel hydraulics led to the creation of a fine-textured layer on the channel bed. Mathers et al. (1981) recorded Arctic grayling in all the placer mined Yukon streams they surveyed however, spawning and rearing was limited in streams with high suspended sediments. A Yukon study compared the survival of Chinook Salmon and Arctic Grayling in placer mined and un-mined streams (Seakam Group Ltd. et al., Vol. 1, 1992). They found that the survival of Chinook Salmon and Arctic Grayling eggs was similar regardless of exposure to placer derived or natural sediments. Earlier research indicated that post-hatch Arctic Grayling alevins are negatively impacted by high suspended sediments (≥ 340 mg/L) (Mathers et al., 1981). Further research found that streams that were not placer mined (22-23 NTU) had up to 40 times greater fish biomass than placer mined streams (440-465 NTU) (Seakam Group Ltd. et al., Vol. 1, 1992). A study in Alaska examining the effects of placer mining sediment on Arctic Grayling observed that if Grayling were unable to escape the placer mining sediment then they were negatively impacted by direct and indirect factors. Direct factors included high levels of death in sac fry, gill damage, starvation, and slowed maturation of age-0+ fingerlings and age-2 juveniles. This study also noted a greater impact to Grayling populations by indirect factors such as loss of summer habitat for feeding and reproduction (Reynolds et al., 1989). Research in the Yukon support the work by Reynolds et al. and noted fewer organisms in the stomachs of Arctic Grayling in mined sites as compared to un-mined sites (Seakam Group Ltd. et al., Vol. 1, 1992). Studies by the Seakam Group Ltd et al. (Vol. 2, 1992) noted that the threshold for when suspended sediment from placer gold mining resulted in direct and indirect effects to Grayling and juvenile Chinook salmon was 75-130 mg/L suspended sediments.

Two studies noted the impact of metals that were introduced into the freshwater environment as a result of placer mining. Buhl and Hamilton (1990) conducted a study to examine the acute toxicities of arsenic, copper, zinc and lead from placer mining on Arctic Grayling, Coho Salmon, and Rainbow Trout. Copper and zinc were found to be of highest toxicity followed by lead and arsenic to all lifestages and species tested. Arctic Grayling from Alaska were the most sensitive of the species tested and sensitivity to the metals was greatest in juveniles rather than swim-up fry or alevins. Woodward et al. (1994) found that diet-borne metals had greater

influence in decreasing growth and survival of Rainbow Trout. The livers of fish subsisting on high-metal diets showed 'degenerative changes and lacked glycogen vacuolation'. The authors speculated that the reduced growth and survival of age-0+ Rainbow Trout in the study was a result of consumption of Clark Fork River invertebrates. The Clark Fork River was impacted by mining waste and heavy metal sludge for over a century (Woodward et al., 1994).

Studies in the Birch Creek drainage of Alaska noted an increase in Arctic Grayling abundance from the 1980s to the 1990s (Townsend, 1996). Townsend attributed this increase to improved reclamation practices, reduced mining activity and changes in mining practices that improved water quality.

Study Area

The mine sites and creeks surveyed are approximately 7 km east of the town of Atlin, BC and located in the Atlin-Taku Land Use Plan Area. The study area lies within the traditional territory of the Taku River Tlingit First Nation. The eight sample sites were located on Otter Creek, Snake Creek, Ruby Creek, Boulder Creek, Birch Creek, and Spruce Creek within the Atlin River watershed of the Upper Yukon River (Appendix 1). Otter Creek, Ruby Creek, and Boulder Creek flow into Surprise Lake, which drains into Pine Creek that then feeds into Atlin Lake. Snake Creek, Birch Creek and Spruce Creek drain directly into Pine Creek. Pine Creek flows into Atlin Lake approximately 3 km southeast of the community of Atlin.

Fish species diversity is limited in the study area. Fish distribution in the Pine Creek watershed is influenced by a barrier (Pine Creek Falls) located on Pine Creek upstream of its confluence with Spruce Creek. As a result of the barrier, Slimy Sculpin (*Cottus cognatus*) and Arctic Grayling (*Thymallus arcticus*) are the only fish species confirmed in the upper Pine Creek watershed. Arctic Grayling in Surprise Lake are considered to be an adfluvial population; spending most of the year in the lake and moving into tributaries to spawn in the spring.

Boreal White and Black Spruce (BWBSdk1) and Spruce Willow Birch (SWBun) biogeoclimatic zones characterise the study area. The study area consists of mountains to 1900 m and broad valleys with a base elevation of approximately 950 m. The area has a history of placer and hardrock mining. Hunters, fishers and other outdoor recreationists frequent the area.

The study area has a dry boreal climate with approximately 45% of annual precipitation as snow (TABLE 2). In an average year peak flows occur in late June and are generated by snowmelt, however peak flows can also be associated with rainfall events from July to late September (FIGURE 3). Low flows occur in late winter prior to snowmelt.

TABLE 2 *Select climatic normals for Atlin, B.C.*

	Month												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Daily Av. Temp (C)	-15.4	-11.8	-5.9	1.1	6.5	10.7	13.1	12.2	7.9	2.5	-5.4	-9.8	0.5
Rainfall (mm)	1.1	1.3	0.4	2.2	16.9	27.5	32.6	32.1	35.3	31.5	9.3	2.3	192.5
Snowfall (cm)	38	24.9	16.1	6.5	0.9	0	0	0	2.2	9.1	26.4	30.7	154.8
Precipitation (mm)	39.1	26.1	16.5	8.7	17.9	27.6	32.6	32.1	37.4	40.6	35.7	33.0	347.3

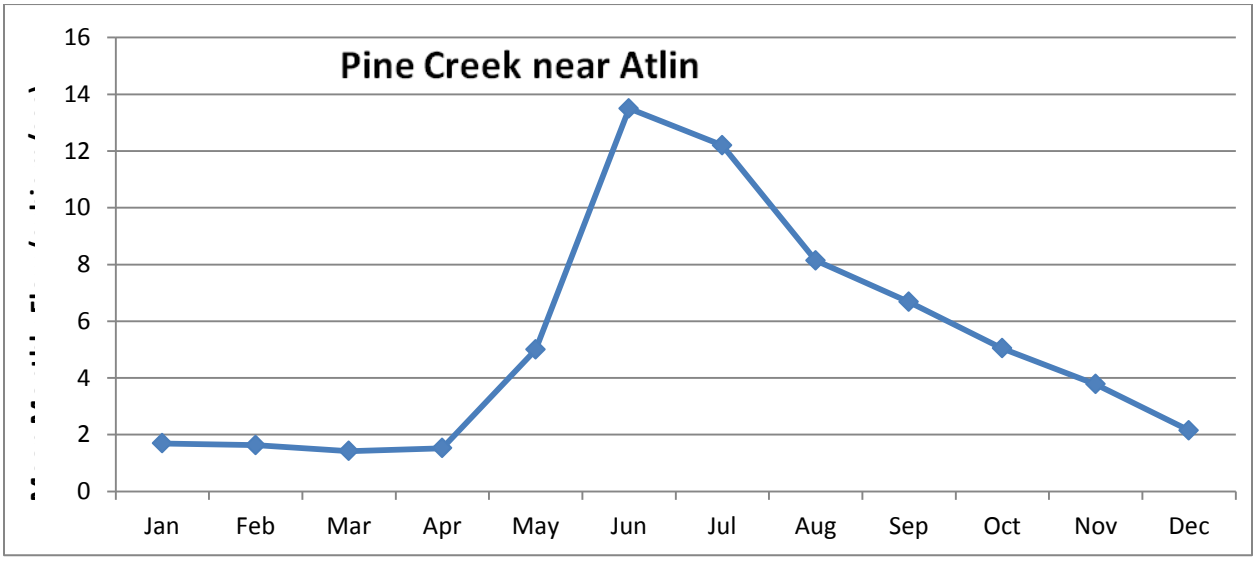

FIGURE 3 *Mean monthly streamflow for Pine Creek near Atlin (data: 1955–1970). Watershed area is 697 km^2.*

Methods

Field Methods

Sample sites were selected to represent the majority of active placer mines during the 2012 field season. All sample sites were on watercourses identified in the *Placer Mining Waste Control Regulation*. Data collected within streams were added to the BC government Environmental Monitoring System (EMS). All sample creeks have a long history of placer mining. The Snake Creek, Upper Otter Creek and Mid Otter Creek sites contain relatively intact natural habitat features in the vicinity of their mine sites. The riparian areas associated with all others were denuded of riparian vegetation (Appendix 3). The mine sites sampled varied in size from one-

person to twelve-person operations and not all mines were in operation during field sampling (TABLE 3). No significant precipitation occurred during the sampling period.

Grab samples, three replicates per location, were taken to analyze Total Suspended Solids (TSS), total metals, dissolved metals and hardness and sent to Maxxam Analytics in Burnaby, BC. Samples for TSS, metals, and hardness were collected and pH and conductivity were measured at all sites where water was present. Sediment samples were collected at upstream, outflow, and downstream locations where sediment was present in the channel bed (TABLE 4). Laboratory methods are described in Appendix 2. A YSI probe was used to collect pH and conductivity measurements and a FlowTracker was used to measure discharge. The detection limits are identified in Appendix 5.

TABLE 3 *Sampling site timing and mine size.*

Site	Mine size[1]	Washing Activity*	Sample Date	Distance between US and DS sampling locations (m)	UTMS		
Upper Otter Cr.	large	active	15-Sep-12	1830	08V	592046	6603779
Spruce Cr.	large	active	15-Oct-12	3430	08V	582132	6603725
Lower Otter Cr.	large	1 day*	17-Oct-12	3650	08V	590282	6610670
Ruby Cr.	medium	4 days*	14-Sep-12	1620	08V	594274	6614682
Boulder Cr.	small	5 days*	12-Oct-12	1200	08V	589747	6613090
Mid Otter Cr.	medium	3 weeks*	13-Oct-12	1350	08V	591651	6606525
Snake Cr.	small	> 3 weeks*	16-Oct-12	290	08V	590176	6607238
Birch Cr.	small	> 3 weeks*	14-Oct-12	410	08V	585178	6612544

[1]large - 8 or more workers; medium -3 to 7 workers; small - 1 to 2 workers.
* time since last washing activity.

TABLE 4 *Sample sites where water (W) and sediment (S) were collected. (US – upstream, DS – downstream, Outflow – of the settling pond, SP – settling pond, settling pond order goes from upstream to downstream).*

	US	DS	Outflow	SP1	SP2	SP3
Upper Otter Cr.	W, S	W, S	W, S	W	W	W
Mid Otter Cr.	W, S	W, S	-	-	W	-
Lower Otter Cr.	W, S	W, S	-	W	W	-
Snake Cr.	W	W	-	W	W	W
Ruby Cr.	W, S	W, S	W, S	-	W	W
Boulder Cr.	W, S	W, S	-	-	-	W
Birch Cr.	W, S	W, S	S	-	-	-
Spruce Cr.	W, S	W, S	-	W	-	-

Results

The results are presented in Appendix 3.

Hydrology

Discharge was greater upstream than downstream on five of the sample streams. While this result is generally within the sampling error for open channel discharge measurements (±15 – 25%) the result at Snake Creek indicates significant open channel water loss to groundwater. This may be due to the historical placer mining workings.

Water Quality

Generally, no consistent pattern was observed in pH or conductivity among sample sites. pH values ranged from 6.32 to 8.88 and conductivity from 11.3 to 162.6 uS/cm. Downstream pH values were greater than upstream values at six of the eight sites. Conductivity within and below the mine sites was greater than upstream locations at seven of the eight locations.

The majority of metal levels recorded above the Guidelines for Canadian Drinking Water Quality (GCDWQ) and the British Columbia Water Quality Guidelines for Aquatic Life (BCWQG) were total metals with the exception of dissolved manganese, dissolved aluminum, dissolved chromium, and dissolved cadmium, which were observed above the guidelines at five sites. Elevated TSS levels resulted in higher exceedance and extent of total metals above the GCDWQ and the BCWQG. Settling pond and outflow sites tended to have the greatest TSS and number of metals above the GCDWQ and the BCWQG among locations. Sites that were sampled during active gravel washing or within 1 day of washing had the greatest number and levels above the GCDWQ and BCWQG with the exception of Spruce Creek. The deviation at Spruce Creek may have been a result of the type of gravel being washed, which was different than that typically washed for gold recovery (i.e., the gravels may have had a low fine sediment content). Five sites had greater total metal *values* above the GCDWQ and BCWQG downstream than upstream. Three of these sites had a greater *number* of total metals above the GCDWQ and the BCWQG downstream than upstream.

Streambed Sediments

Downstream total metals in streambed sediments were higher at five out of eight sites. Eight metals were recorded above the Interim BC Sediment Quality Guidelines (BCISQG) for aquatic life. Measurements above the BCISQG for chromium and nickel were recorded at all sites.

Discussion and Conclusion

Although this study had limited sampling intensity and duration, it provided an opportunity to identify that elevated metal levels above the Guidelines for Canadian Drinking Water Quality and the BC Water Quality Guidelines for aquatic life are present within water and sediments downstream of placer mining operations. While this is allowed under the *Placer Mining Waste Control Regulation*, further research is needed to examine the water quality, stream sediments and aquatic community to assess the risks to aquatic life downstream. Some positive relationships between TSS and the extent and level of *total* metals were observed and very few metals were recorded above the GCDWQ and BCWQG in *dissolved* form. Based on our

preliminary research there is potential risk to aquatic life as a result of placer mining effluent, particularly suspended sediment. Further, with Atlin drinking water intakes downstream of these activities, the effects on human health and safety should be more thoroughly assessed. The settling ponds appear to be working to reduce the levels of metal and TSS into the downstream creek environments. Other jurisdictions (Alaska and Yukon Territory) have focused their effluent standards on controlling the turbidity of discharged water, which then controls the introduction of metals.

An important aspect of this project was to identify best management practices related to placer mining. A key aspect observed was the surface water connection between mining operations and streams. In cases where discharge occurred, even after passing through three settling basins, TSS and total metals reduced water quality. Several situations were observed where surface water discharge did not occur. At several operations (Mid Otter Creek; Snake Creek; and Spruce Creek) settling basins had adequate capacity to receive washed water, resulting in no surface water discharge to streams. In other situations (Lower Otter Creek) the settling basins drained subsurface into a receiving aquifer. It is possible that in these situations the aquifer is receiving dissolved metals, but as our sampling found, concentrations are generally below problematic thresholds.

This observation is similar to that found in research elsewhere and is one of the foundation elements of BMPs in Alaska (Godsey, 1999). Eliminating the surface water connection between placer mining operations and streams is a key factor in reducing water quality impacts.

This study has identified that there is aquatic exposure of metals downstream of placer mines and there is an opportunity for metals to cause harm to aquatic life. However this study was limited in frequency and intensity, therefore future research should:

a) Track water quality particularly total metals, including mercury, TSS and stream sediments across the placer mining working season using the BC standardized methodology of collecting 5 samples over 30 days. As a result of the 2012 survey, dissolved metals sampling is not required.
b) Monitor locations that lie at the interface between creeks identified in the *Placer Mining Waste Control Regulation* and downstream watercourses and waterbodies not identified in the *Placer Mining Waste Control Regulation*.
c) Monitor locations upstream of Atlin drinking water intake sources in order to examine risks to drinking water.
d) Assess the benthic aquatic invertebrate community to assist in providing a greater understanding of the downstream impacts on aquatic life and to provide further information to assist in the development of an Effects Assessment[3].
e) Conduct an Effect Assessment with the results of the first and second year of sampling.

[3] An Effects Assessment is an assessment of the potential effects that the effluent has on the ecosystem.

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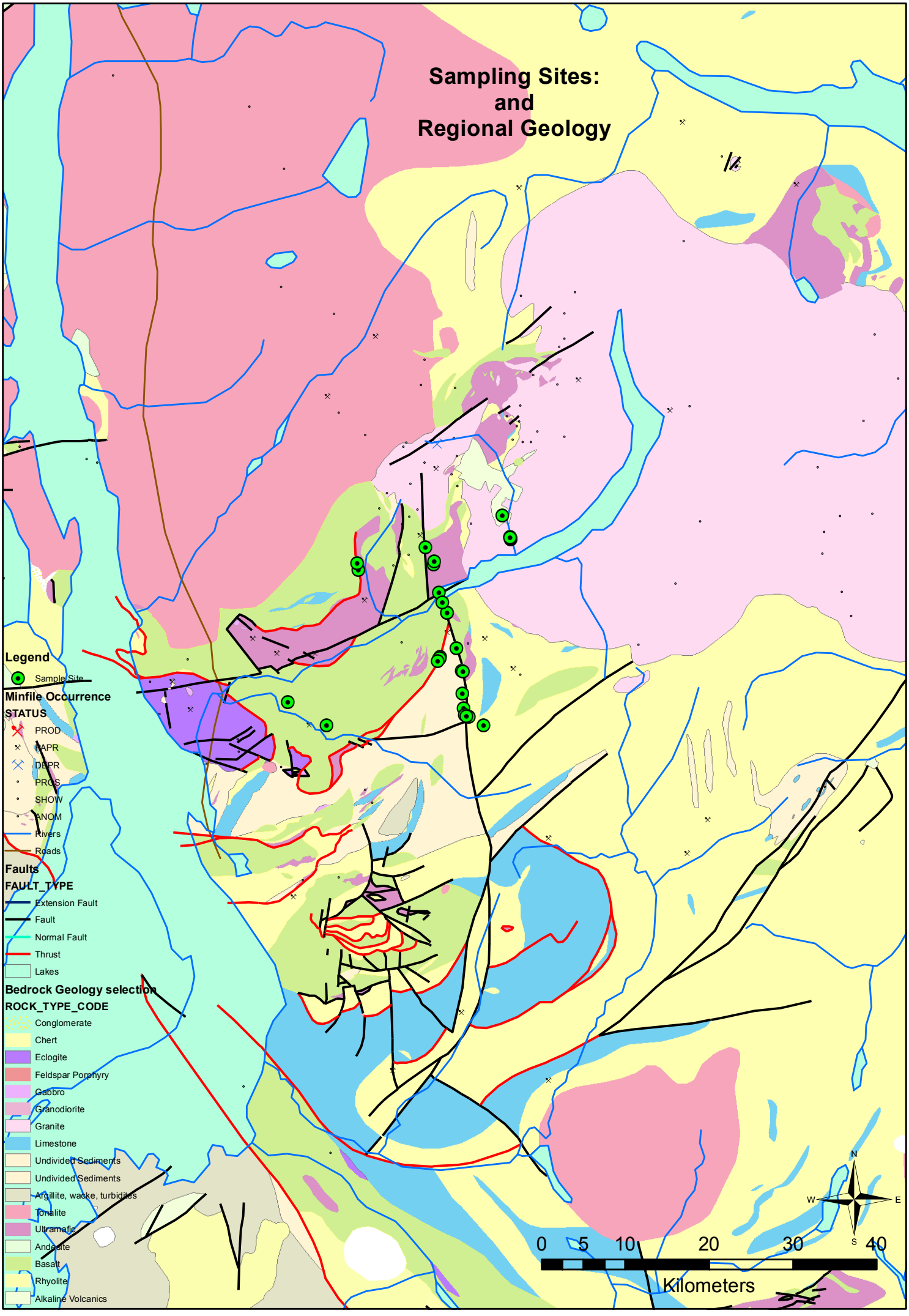
Appendix 1: Sampling Sites and Regional Geology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Conglomerate
Chert
Eclogite
Feldspar Porphyry
Gabbro
Granodiorite
Granite
Limestone
Undivided Sediments
Undivided Sediments
Argillite, wacke, turbidites
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Appendix 2: Laboratory Methodology

Determination of Metals in Environmental Samples Using CRC ICPMS

PURPOSE/PRINCIPLE OF METHOD:

This method describes the multi-elemental determination of trace elements by Collision/Reaction Cell (CRC) ICP-MS. Ions produced by radio-frequency inductively coupled plasma are measured. Analyte species originating in a liquid are pneumatically nebulized and the resulting aerosol transported by argon gas into the plasma torch. The ions produced are entrained in the plasma gas and extracted, by means of a differentially pumped vacuum interface, into a mass spectrometer. The ions flow through a Collision/Reaction Cell (CRC) where, depending on the mode of analysis, they either pass through the cell unhindered (no gas - classical ICP-MS mode) or collision/reaction chemistry takes place between the ions and an introduced gas such as hydrogen or helium. The ions are then sorted according to their mass-to-charge ratios by a quadrupole mass spectrometer. The ions transmitted through the quadrupole are quantified by a channel electron multiplier and the ion information is processed by a data handling system. Although most polyatomic interferences are removed, any additional interferences must be assessed and valid corrections applied or the data flagged to indicate problems. Interference correction must include compensation for background ions contributed by the plasma gas, reagents, and constituents of the sample matrix. Instrument drift as well as suppression or enhancement of instrument response caused by the sample matrix must be corrected for by the use of internal standards.

SCOPE:

This method is applicable for analysis of the following elements: Ag, Al, As, B, Ba, Be, Bi, Ca, Cd, Co, Cr, Cs, Cu, Fe, Hg, K, La, Li, Mg, Mn, Mo, Na, Ni, P, Pb, Rb, S, Sb, Se, Si, Sn, Sr, Te, Th, Ti, Tl, U, V, W, Zn, and Zr in aqueous solutions.

This method is applicable to water samples as well as digests of solid samples. Water samples are analyzed for dissolved metals following sample filtration or for total metals following sample preservation or digestion. Solid samples such as air filters, swabs, biota, food, soil, sludge, sediment and other solid wastes must undergo digestion specific to sample matrix prior to analysis. This method is also applicable to analysis of leachates obtained from TCLP, MLEP and SPLP and extracts of specific elements from seawater matrix.

An appropriate internal standard is required for each analyte determined by ICP-MS. Internal standards utilized in this method are ^{6}Li, ^{74}Ge, ^{103}Rh, ^{159}Tb and ^{193}Ir. Other internal standards such as ^{45}Sc or ^{115}In can be added if deemed necessary.

DETECTION LIMITS:

Report Detection Limits (RDL) for Water

Element	Regular Level in Water	Low Level in Water	Seawater	Tissue by Wet Weigh	Air Filters
	(µg/L)	(µg/L)	(µg/L)	(mg/kg)	(µg)
Ag	0.02	0.005	0.05	0.004	0.002
Al	3	0.2	10	0.2	0.03
As	0.1	0.02	0.5	0.01	0.005
B	50	50	10	0.4	0.3
Ba	1	0.02	1	0.02	0.005
Be	0.1	0.01	1	0.02	0.005
Bi	1	0.005	1	0.02	0.005
Ca	50	50	1000	2	0.3
Cd	0.01	0.005	0.05	0.002	0.001
Co	0.5	0.005	0.1	0.004	0.005
Cr	1	0.1	0.5	0.04	0.005
Cs	0.2	0.05	N/A	N/A	N/A
Cu	0.2	0.05	0.5	0.01	0.005
Fe	5	1	2	2	0.1
Hg	0.05	0.01	0.3	N/A	N/A
K	50	50	1000	2	0.5
La	0.2	0.05	N/A	0.1	N/A
Li	5	0.5	20	0.1	0.005
Mg	50	50	1000	2	0.3
Mn	1	0.05	0.5	0.02	0.005
Mo	1	0.05	1	0.01	0.003
Na	50	50	50	2	0.3
Ni	1	0.02	0.2	0.01	0.005
P	10	2	50	2	0.8
Pb	0.2	0.005	0.1	0.002	0.005
Rb	0.2	0.05	N/A	N/A	N/A
S	3000	3000	20000	60	N/A
Sb	0.5	0.02	0.5	0.001	0.005
Se	0.1	0.04	0.5	0.01	0.005

Si	100	100	100	10	2
Sn	5	0.01	1	0.02	0.005
Sr	1	0.05	10	0.02	0.005
Te	1	0.02	0.5	0.02	0.005
Th	1	0.005	0.1	0.01	0.1
Ti	5	0.5	10	0.2	0.005
Tl	0.05	0.002	0.1	0.0004	0.0005
U	0.1	0.002	0.05	0.0004	0.005
V	5	0.2	10	0.04	0.05
W	1	0.01	0.1	0.01	N/A
Zn	5	0.1	1	0.04	0.03
Zr	0.5	0.1	10	0.1	0.05

INTERFERENCES:

Interferences associated with ICP-MS analysis may be classified as physical, isobaric, or molecular in nature. Both the isobaric and molecular ion interferences have been investigated and understood prior to the introduction of this methodology.

Physical Interferences

High dissolved solids or acids concentration in the sample leads to high viscosity and surface tension. This in turn induces significant changes to sample transfer and nebulization when compared with standard solutions and may lead to inaccurate results. Saturated salt solutions can form deposits on the nebulizer tip, torch and cones producing partial clogging, thus causing severe sensitivity and precision changes. Physical interferences can be minimized by reducing the concentration of dissolved solids or acids by dilution. Use of Internal Standards significantly reduces the impact of physical interferences on the final results.

Memory Interferences (effects)

Memory interferences are usually caused by large concentration differences between samples or standards which are analyzed sequentially. Sample deposition on the sampler and skimmer cones, spray chamber design, and the type of nebulizer affect the extent of the memory interferences which are observed. Certain “sticky” elements such as Mo or B have more pronounced memory effects than others. The possibility of memory interferences should be recognized within an analytical run. Memory interferences can be assessed by checking the carryover of samples with high concentration to the following samples. The rinse period between samples should be long enough to eliminate significant memory interference. This effect can also be minimized by sequencing and diluting the samples appropriately based upon the pre-screen results.

Isobaric Interference

Various elements have isotopes with masses so close they cannot be separated by quadrupole mass analyzer (e.g. ^{54}Fe and ^{54}Cr). The measurement at a specific mass is a sum of all isotopes of the same mass and therefore corrections must be applied for isobaric overlap. This is accomplished in the ICPMS software by applying interference equations.

Where possible isotopes with no isobaric overlaps are chosen.

Molecular Ion Interferences

Molecular ions are formed by combination of elemental ions present in high concentrations in the plasma (e.g., Argides, Oxides, Halides, etc.). The CeO/Ce ratio is used as an indicator of molecular ion formation. The ratio is routinely monitored and held to approximately <2%.

SAMPLE HANDLING & PRESERVATION:

For analysis of dissolved metals in water, samples should be field filtered, if possible, and preserved with 1 mL of 1:1 nitric acid : RODI water per 120 mL of sample. Highly alkaline samples may require additional preservative if the pH is not <2 pH units. Samples preserved in the field with HNO_3 are additionally preserved in the laboratory with hydrochloric acid to a final acid concentration of approximately 0.5 % HCl. Samples that are not field filtered may be filtered in the laboratory and preserved as above. Because some trace elements may be adsorbed to container walls or particles in the sample, laboratory filtered samples are less representative of field water conditions. The time between sampling and filtration should be minimized.

For analysis of total metals in water, samples should be field preserved with 1 mL of 1:1 nitric acid : RODI water per 120 mL of sample. Highly alkaline samples may require additionally preservative if the pH is not <2 pH units. Samples preserved in the field with HNO_3 are additionally preserved in the laboratory with hydrochloric acid to a final acid concentration of approximately 0.5 % HCl.

Sample Matrix	Sample Container	Holding Time	Storage Conditions	Preservation
Total Dissolved Metals in Water	Pre-cleaned (metals-free) polyethylene bottle.	Preserved samples: 6 months except 28 days for Hg	Room Temperature	Field filtered, if possible. 1 mL 1:1 HNO_3: RODI water per 120 mL sample. HCl to a final concentration of approximately 0.5% is added to field-preserved samples. Alkaline samples may require additional preservative achieve to pH <2.
Total Metals in Water	Pre-cleaned (metals-free) polyethylene bottle.	Preserved samples: 6 months except 28 days for Hg	Room Temperature	Field filtered, if possible 1 mL 1:1 HNO_3:RODI water per 120 mL sample. HCl to a final concentration of approximately 0.5% is added to field-preserved samples. Alkaline samples may require additional preservative reach to pH <2.

REFERENCE:

EPA SW846 Method 6020A "Inductively Coupled Plasma - Mass Spectrometry", Revision 1, U.S. Environmental Protection Agency, February 2007.

Digestion of Soil, Sediment and Sludge for Total Recoverable Metals

PURPOSE/PRINCIPLE OF METHOD:

The purpose of this standard operating procedure is to solubilise metals that may become environmentally available in soil or sediment samples. One gram of dried and sieved sample (<2 mm, or <63 µm if requested) is digested for 2 ± 0.25 hours at 95 ± 5°C with 5 mL 50% HCl and 5 mL 50% HNO_3. The digestate is diluted to 50 mL with deionised water, mixed, centrifuged, and the supernatant decanted and submitted for analysis for the element(s) of interest by ICP-MS or ICP-OES.

SCOPE:

This method is applicable to the digestion of soil, sediment, and sludge samples for total recoverable metals.

SAMPLE HANDLING & PRESERVATION:

Dried, ground and sieved samples are received from Maxxam's Soil Preparation lab unpreserved in plastic specimen cups. Maximum sample hold times at Maxxam Analytics have been set at 6 months for soils requiring inorganic parameters, with the exception of Mercury, which has a set hold time of 28 days.

Digestates are stored at 1 to 6°C in the Lab's refrigerators for a maximum of 180 days, with the exception of digestates for determination of Mercury which are stored at 1 to 6°C for a maximum of 28 days.

REFERENCE:

British Columbia Environmental Laboratory Manual: 2009, Section C – Metals, 1.2.1 Strong Acid Leachable Metals (SALM) in Soil – Prescriptive.

Determination of Metals in Solids

PURPOSE/PRINCIPLE OF METHOD:
This method describes the multi-elemental determination of trace elements by ICP-MS.

The method measures ions produced by a radio-frequency inductively coupled plasma. Analyte species originating in a liquid are pneumatically nebulized and the resulting aerosol transported by argon gas into the plasma torch. The metal ions produced are entrained in the plasma gas and extracted, by means of a differentially pumped vacuum interface, into a mass spectrometer. The metal ions produced in the plasma are sorted according to their mass-to-charge ratios by a quadrupole mass spectrometer having a minimum resolution capability of 1 AMU peak width at 5% peak height. The ions transmitted through the quadrupole are quantified by a channel electron multiplier and the ion information processed by a data handling system. Interferences must be assessed and valid corrections applied or the data flagged to indicate problems. Interference correction must include compensation for background ions contributed by the plasma gas, reagents, and constituents of the sample matrix. Instrument drift as well as suppressions or enhancements of instrument response caused by the sample matrix must be corrected for by the use of internal standards.

SCOPE:
This method is applicable to solid samples composed of soil, sediment, vegetation, animal tissue, paint chips, air filter, and other solid type matrices as approved by the Department Manager or Supervisor. The subsampling and digestion procedures are provided in separate standard operating procedures. This method is applicable for the analyses of the following elements: Ag, Al, As, B, Ba, Be, Bi, Ca, Cd, Co, Cr, Cu, Fe, K, Li, Mg, Mn, Mo, Na, Ni, P, Pb, Sb, Se, Sn, Sr, Te, Ti, Tl, U, V, Zn, Zr, and Hg in solid samples.

DETECTION LIMITS:

Element	Reporting Limit for Soil (ug/g)	Reporting Limit for Air Filter (ug)
Ag	0.05	
Al	100	
As	0.2	1
Ba	0.1	
Be	0.1	
Bi	0.1	
Ca	100	

Cd	0.05	0.05
Co	0.3	
Cr	1	1
Cu	0.5	0.5
Fe	100	
K	100	
Li	5	
Mg	100	
Mn	0.2	
Mo	0.1	
Na	100	
Ni	0.8	
P	10	
Pb	0.1	0.1
Sb	0.1	
Se	0.5	
Sn	0.1	
Sr	0.1	
Te	0.1	
Ti	1	
Tl	0.05	
U	0.05	
V	2	
Zn	1	1
Zr	0.5	
Hg	0.05	

INTERFERENCES:

1. Physical Interferences: Changes in viscosity or surface tension cause significant inaccuracies, especially in samples containing high dissolved solids or high acid concentrations. Saturated salt solutions can form deposits on the nebulizer tip producing partial clogging, thus causing severe sensitivity and precision changes. This can be minimized by reducing the salt concentration by dilution.
2. Memory Interferences: Memory interferences are usually caused from large concentration differences between samples or standards which are analyzed sequentially. Sample deposition on the sampler and skimmer cones, spray chamber design, and the type of nebulizer affect the extent of the memory interferences which are observed. The possibility of memory interferences should be recognized

within an analytical run. Memory interferences can be assessed by the carryover of samples with high concentration to the following samples. The rinse period between samples should be long enough to eliminate significant memory interference.

SAMPLE HANDLING & PRESERVATION:

1. Collection containers: Soil, vegetation, animal tissue, and paint chip samples can be received in a variety of containers including glass and plastic bags. Preference is glass containers with Teflon lined lids for soils and plastic bags for vegetation. Once samples have been prepared according they are stored in plastic specimen cups. Air samples are normally received as filters which can be a rectangular HiVol filter (with exposure area of 0.043 m^2) or single filter disc.
2. Preservation: Soils are stored at 4°C until dried and ground followed by ambient storage. Sample hold time is 6 months for all metals. All materials are air dried at 60°C and ground, and sieved through 10 mesh prior to digestion. Air samples on filters are stored at room temperature.

QC REQUIREMENTS:

Mass Calibration and Resolution Check: These parameters are check prior to analysis.

Internal Standard Intensity: The intensities of all internal standards are monitored in every analysis.

Initial Calibration Verification: This verification is performed immediately after calibration. A secondary source of standard is used and the values must lie within ±10% of the true concentration.

Continuing Calibration Verification: This is performed continuously throughout the run after every 10^{th} client sample. A secondary source of standard is used and the values must lie within ±15% of the true concentration.

Method Blank: One processed method blank is prepared for every 20 samples. Acceptance criteria is $\leq$2X RDL.

Blank Spikes (method spikes) and Sample Spikes (matrix spikes): To be performed at a ratio of 1 in 20 samples for both water samples and soil samples. Also to be used for Control Charting purposes. Control limits of 75-125% are acceptable but may be dependent upon the regulatory agency's method being used.

Matrix (Sample) Duplicates (SD): One matrix duplicate is analysed for every 20 samples. The control limit for duplicates is 35% RPD (relative percent difference) if both values are >5X the RDL for Ag, Al, Ba, Hg, K, Mo, Na, Pb, Sn, Sr, and Ti, 30% RPD for remaining elements.

REFERENCE:

EPA Method 200.8 "Determination of Trace Elements in Waters and Wastes by Inductively Coupled Plasma - Mass Spectrometry", Revision 5.4, U.S. Environmental Protection Agency, May 1994.

Total Suspended Solids in Waters and Wastewaters

PURPOSE/PRINCIPLE OF METHOD:

A well-mixed sample is filtered through a weighed standard glass-fibre filter and the residue retained on the filter is dried to a constant weight at 104 ± 1°C. The increase in weight of the filter represents the total suspended solids.

If required, the filter is placed in a 550 ± 10°C muffle furnace for 1 hour to determine fixed suspended solids (non-filterable residue). The loss on ignition indicates the total organic matter volatile at 550°C. The residue is defined as fixed suspended solids (non-filterable residue).

SCOPE:

This method is applicable to determination of total suspended, fixed and volatiles solids in potable, surface, ground and saline waters as well as domestic and industrial wastewaters.

DETECTION LIMITS:

Sub Sample TSS	4 mg/L
Whole Bottle TSS	1 mg/L
TSS Fixed	1 mg/L

INTERFERENCES:

1. Large floating particles or submerged agglomerates of non-homogeneous materials should be excluded from the sample if it is determined that their inclusion is not representative.

2. Excessive residue on the filter may form a water-trapping crust. Limit the sample size to that yielding no more than 200 mg residue.

3. For Sea Water samples and samples high in salt solids, copious rinsing with RODI water is required to ensure removal of the salt material. Also, prolonged drying, proper desiccation and prompt weighing are required with minimum amount of exposure in transfer from desiccator to balance.

4. Visible floating oil and grease should be dispersed by vigorous shaking or blending before withdrawing a sample portion for analysis. Drying to constant weight may be difficult.

5. Samples with heavy rapid-settling particulates must be shaken vigorously and sub-sampled quickly to maintain homogeneity.

6. Negative errors in the volatile solids may be produced by loss of volatile matter during drying. Determination of low concentrations of volatile solids in the presence of high fixed solids concentrations may be subject to considerable error.

SAMPLE HANDLING & PRESERVATION:

Sample Containers

Samples are received in 250 to 1000 mL plastic containers. The higher the suspended load, the smaller the subsample volume used.

Sample Preservation

No preservative is added to the samples. Samples are transported in coolers with gel packs to maintain temperature at <10°C.

Holding Times

Hold Time	Storage Temperature
7 Days	1-6°C

REFERENCES:

Standard Methods for the Examination of Water and Wastewater, 22nd Edition, 2011, Method 2540 D, Total Suspended Solids Dried at 103-105°C; E, Fixed and Volatile Solids Ignited at 550°C.

Appendix 3: Field Site Photographs

FIGURE 4 *Upper Otter sample location SP1 looking downstream, across the pond, and up the pond during gravel washing (left to right).*

FIGURE 5 *Upper Otter sample location SP2 looking downstream, and up the pond during gravel washing (left to right).*

FIGURE 6 *Upper Otter sample location SP3 looking downstream, into the pond, and up the pond during gravel washing (left to right).*

FIGURE 7 *Outflow Upper Otter Creek sample location looking downstream, across the outflow, and upstream during gravel washing and surface water discharge (left to right).*

FIGURE 8 *Upstream (US) Upper Otter Creek sample location looking downstream, across the stream, and upstream (left to right).*

FIGURE 9 *Downstream (DS) Upper Otter Creek sample location looking downstream, across the stream, and upstream during gravel washing and surface water discharge (left to right).*

FIGURE 10 *Mid OtterCreek sample location SP2 looking at the pond three weeks after active mining.*

FIGURE 11 *Upstream (US) Mid OtterCreek sample location looking downstream, across the stream, and upstream (left to right).*

FIGURE 12 *Downstream (DS) Mid OtterCreek sample location looking downstream, across the stream, and upstream three weeks after active mining (left to right).*

FIGURE 13 *Lower Otter Creek sample location SP2 looking downstream, across the pond, and upstream of the pond one day after gravel washing (left to right).*

FIGURE 14 *Lower Otter Creek sample location SP1 looking downstream, across the pond, and up the pond one day after gravel washing (left to right).*

FIGURE 15 *Upstream (US) Lower Otter Creek sample location looking downstream, across the stream, and upstream (left to right). A placer mine upstream of this location was washing pay gravel.*

FIGURE 16 *Downstream (DS) Lower Otter Creek sample location looking downstream, across the stream, and upstream one day after gravel washing (left to right).*

FIGURE 17 *Snake Creek sample location SP3 looking downstream, and at one of the sample holes in the ice. The pictures were taken at least three weeks after mining activity.*

FIGURE 18 *Snake Creek sample location SP2 looking at the pond, at one of the sample holes in the ice, and at the other two sample holes. The pictures were taken at least three weeks after mining activity.*

FIGURE 19 *Snake Creek sample location SP1 looking at the pond, at one of the sample holes in the ice, and at all three sample holes. The pictures were taken at least three weeks after mining activity.*

FIGURE 20 *Upstream (US) Snake Creek sample location looking downstream, across the stream, and upstream (left to right). The pictures were taken at least three weeks after mining activity.*

FIGURE 21 *Downstream (DS) Snake Creek sample location looking downstream, across the stream, and upstream (left to right). The pictures were taken at least three weeks after mining activity.*

FIGURE 22 *Ruby Creek sample location SP3 looking downstream, across the pond, and up the pond (left to right). The pictures were taken four days after gravel washing activity.*

FIGURE 23 *Ruby Creek sample location SP2 looking downstream, across the pond, and up the pond (left to right). The pictures were taken four days after gravel washing activity.*

FIGURE 24 *Outflow into Ruby Creek sample location looking downstream, across the outflow (left to right). The pictures were taken four days after gravel washing activity.*

FIGURE 25 *Upstream (US) Ruby Creek sample location looking downstream, across the stream, and upstream (left to right).*

FIGURE 26 *Downstream (DS) Ruby Creek sample location looking downstream, across the stream, and upstream (left to right). The pictures were taken four days after gravel washing activity while surface water discharge into the creek occurred.*

FIGURE 27 *Boulder Creek sample location SP3 looking at each side and across the pond. The pictures were taken five days after gravel washing activity.*

FIGURE 28 *Upstream (US) Boulder Creek sample location looking downstream, across the stream, and upstream (left to right).*

FIGURE 29 *Downstream (DS) Boulder Creek sample location looking downstream, across the stream, and upstream (left to right). The pictures were taken five days after gravel washing activity and no surface water discharge was observed.*

FIGURE 30 *Outflow into Birch Creek sample location looking across the stream taken five days after gravel washing activity.*

FIGURE 31 **Upstream (US) Birch Creek sample location looking downstream, across the stream, and upstream (left to right) taken five days after gravel washing activity.**

FIGURE 32 *Downstream (DS) Birch Creek sample location looking downstream, across the stream, and upstream (left to right).*

FIGURE 33 *Spruce Creek sample location SP1 looking up the pond, across the pond and to the edge of the pond. Pictures taken while gravel was being washed on the mine site.*

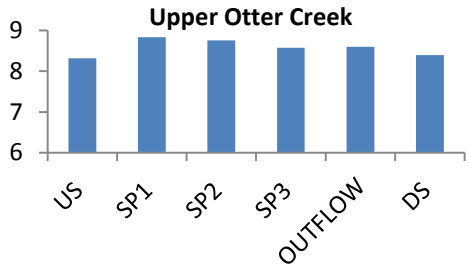
FIGURE 34 *Upstream (US) Spruce Creek sample location looking downstream, across the stream, and upstream(left to right).*

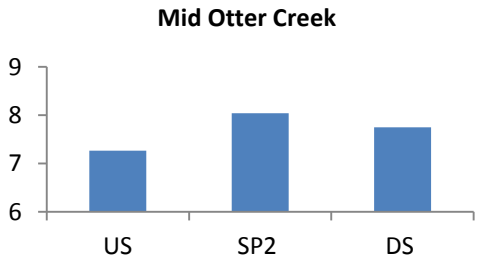
FIGURE 35 *Downstream (DS) Spruce Creek sample location looking downstream (note the culvert), a view upstream from the same location, and a view upstream from the culvert. The Pictures were taken while gravel washing took place and no surface discharge was observed.*

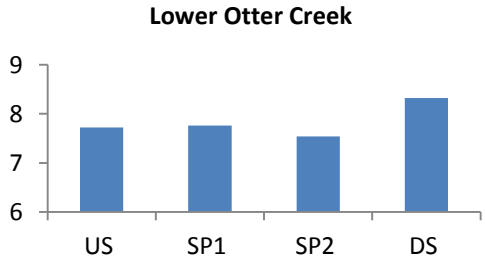
Appendix 4: Results

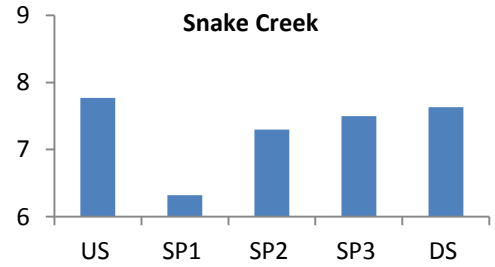
TABLE 5 *Upstream and downstream discharge values in m^3/sec collected at low flow in September and October, 2012.*

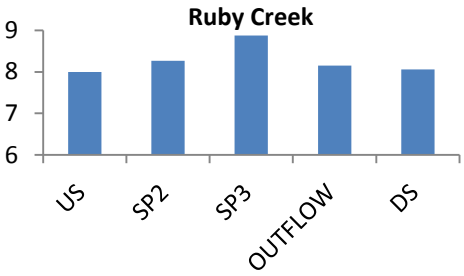
	Upper Otter Cr.	Mid Otter Cr.	Lower Otter Cr.	Snake Cr.	Spruce Cr.	Birch Cr.	Boulder Cr.	Ruby Cr.
US	0.1342	0.0969	0.0850	0.0194	0.5766	0.1028	0.0585	1.1215
DS	0.1301	0.0846	0.1121	0.0149	0.1775	0.1098	0.1172	1.0971

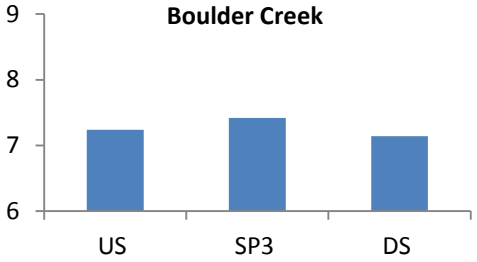


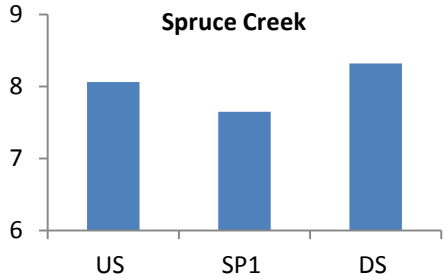












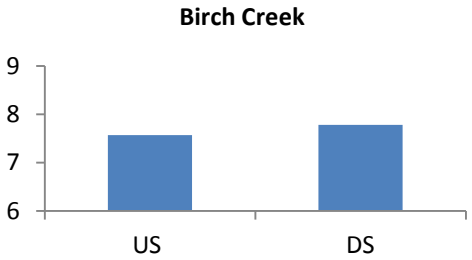


FIGURE 36 *Single measurements of pH from Upper Otter Creek, Mid Otter Creek, Lower Otter Creek, Snake Creek, Ruby Creek, Boulder Creek, Birch Creek, and Spruce Creek collected in September and October of 2012.*

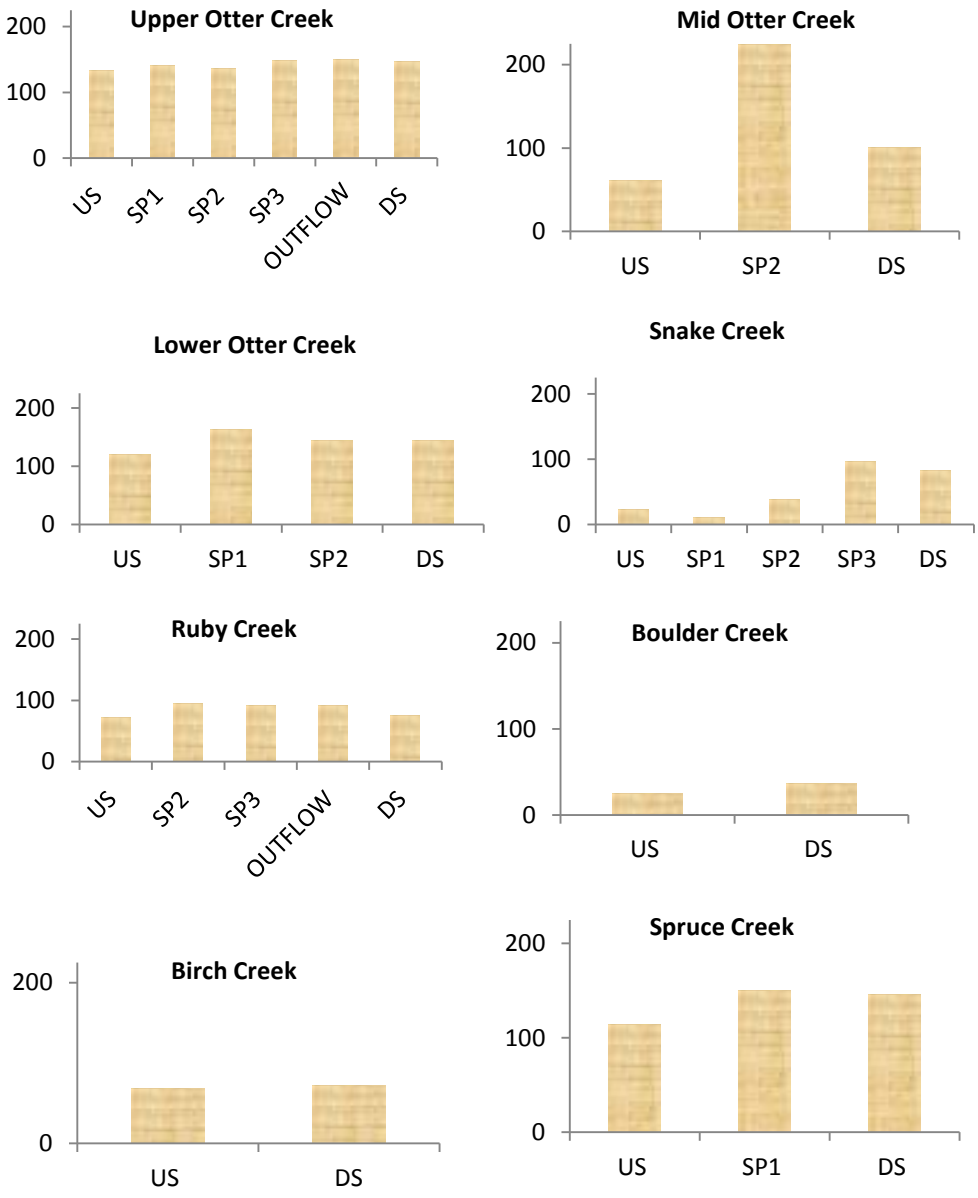


FIGURE 37 *Single conductivity measurement in µS/cm from Upper Otter Creek, Mid Otter Creek, Lower Otter Creek, Snake Creek, Ruby Creek, Boulder Creek, Birch Creek, and Spruce Creek collected in September and October of 2012.*

TABLE 6 *Upper Otter Creek total and dissolved metal values that exceeded the Guidelines for Canadian Drinking Water Quality. The samples were collected during active washing of gravel and surface water discharge into the creek.*

Sample Location	Total Suspended Solids (mg/L)			Metal	Parameter type	Mean	SD	Times Exceedance DW
SP1 Upper Otter Creek	25900	22100	19500	Total	Aluminum	118.667	10.263	1185.67
SP1 Upper Otter Creek				Total	Arsenic	0.016	0.002	0.62
SP1 Upper Otter Creek				Total	Barium	5.603	0.474	4.60
SP1 Upper Otter Creek				Total	Cadmium	0.012	0.001	1.36
SP1 Upper Otter Creek				Total	Chromium	0.362	0.033	6.24
SP1 Upper Otter Creek				Total	Copper	1.940	0.121	0.94
SP1 Upper Otter Creek				Total	Iron	141.333	11.676	470.11
SP1 Upper Otter Creek				Total	Lead	0.113	0.010	10.30
SP1 Upper Otter Creek				Total	Manganese	14.767	1.201	294.33
SP1 Upper Otter Creek				Total	Uranium	0.020	0.001	0.01
SP1 Upper Otter Creek				Dissolved	Manganese	0.106	0.001	1.13
SP2 Upper Otter Creek	12700	11900	11900	Total	Aluminum	87.433	0.462	873.33
SP2 Upper Otter Creek				Total	Arsenic	0.012	0.001	0.22
SP2 Upper Otter Creek				Total	Barium	4.293	0.096	3.29
SP2 Upper Otter Creek				Total	Cadmium	0.010	0.000	1.01
SP2 Upper Otter Creek				Total	Chromium	0.335	0.005	5.71
SP2 Upper Otter Creek				Total	Copper	1.447	0.061	0.45
SP2 Upper Otter Creek				Total	Iron	113.667	2.517	377.89
SP2 Upper Otter Creek				Total	Lead	0.099	0.002	8.91
SP2 Upper Otter Creek				Total	Manganese	10.247	0.356	203.93
SP2 Upper Otter Creek				Dissolved	Manganese	0.101	0.002	1.02
SP3 Upper Otter Creek	87.0	81.6	81.3	Total	Aluminum	2.633	0.072	25.33
SP3 Upper Otter Creek				Total	Iron	3.730	0.113	11.43
SP3 Upper Otter Creek				Total	Manganese	0.299	0.004	4.98
SP3 Upper Otter Creek				Dissolved	Manganese	0.099	0.002	0.97
Outflow Upper Otter Creek	80.0	61.3	72.8	Total	Aluminum	2.890	0.131	27.90

Outflow Upper Otter Creek				Total	Iron	4.223	0.032	13.08
Outflow Upper Otter Creek				Total	Lead	0.012	0.015	0.17
Outflow Upper Otter Creek				Total	Manganese	1.271	1.653	24.43
Outflow Upper Otter Creek				Dissolved	Manganese	0.076	0.002	0.53
DS Upper Otter	36.0	31.0	30.0	Total	Aluminum	1.073	0.055	9.73
DS Upper Otter				Total	Iron	1.627	0.057	4.42
DS Upper Otter				Total	Manganese	0.120	0.002	1.41
DS Upper Otter				Dissolved	Manganese	0.053	0.009	0.05

TABLE 7 *Upper Otter Creek total and dissolved metal values that exceeded the Guidelines for British Columbia Water Quality Guidelines for Aquatic Life. The samples were collected during active washing of gravels and the mine was discharging into the creek.*

Sample Location	Total Suspended Solids (mg/L)			Metal	Parameter type	Mean	SD	Times Exceedance
SP1 Upper Otter Creek	25900	22100	19500	Total	Aluminum	118.667	10.263	1185.67
SP1 Upper Otter Creek				Total	Arsenic	0.016	0.002	0.62
SP1 Upper Otter Creek				Total	Barium	5.603	0.474	4.60
SP1 Upper Otter Creek				Total	Cadmium	0.012	0.001	1.36
SP1 Upper Otter Creek				Total	Chromium	0.362	0.033	6.24
SP1 Upper Otter Creek				Total	Copper	1.940	0.121	0.94
SP1 Upper Otter Creek				Total	Iron	141.333	11.676	470.11
SP1 Upper Otter Creek				Total	Lead	0.113	0.010	10.30
SP1 Upper Otter Creek				Total	Manganese	14.767	1.201	294.33
SP1 Upper Otter Creek				Total	Uranium	0.020	0.001	0.01
SP1 Upper Otter Creek				Dissolved	Manganese	0.106	0.001	1.13
SP2 Upper Otter Creek	12700	11900	11900	Total	Aluminum	87.433	0.462	873.33
SP2 Upper Otter Creek				Total	Arsenic	0.012	0.001	0.22
SP2 Upper Otter Creek				Total	Barium	4.293	0.096	3.29
SP2 Upper Otter Creek				Total	Cadmium	0.010	0.000	1.01
SP2 Upper Otter Creek				Total	Chromium	0.335	0.005	5.71
SP2 Upper Otter Creek				Total	Copper	1.447	0.061	0.45
SP2 Upper Otter Creek				Total	Iron	113.667	2.517	377.89
SP2 Upper Otter Creek				Total	Lead	0.099	0.002	8.91
SP2 Upper Otter Creek				Total	Manganese	10.247	0.356	203.93
SP2 Upper Otter Creek				Dissolved	Manganese	0.101	0.002	1.02
SP3 Upper Otter Creek	87.0	81.6	81.3	Total	Aluminum	2.633	0.072	25.33
SP3 Upper Otter Creek				Total	Iron	3.730	0.113	11.43
SP3 Upper Otter Creek				Total	Manganese	0.299	0.004	4.98
SP3 Upper Otter Creek				Dissolved	Manganese	0.099	0.002	0.97
Outflow Upper Otter Creek	80.0	61.3	72.8	Total	Aluminum	2.890	0.131	27.90

Outflow Upper Otter Creek				Total	Iron	4.223	0.032	13.08
Outflow Upper Otter Creek				Total	Lead	0.012	0.015	0.17
Outflow Upper Otter Creek				Total	Manganese	1.271	1.653	24.43
Outflow Upper Otter Creek				Dissolved	Manganese	0.076	0.002	0.53
DS Upper Otter Creek	36.0	31.0	30.0	Total	Aluminum	1.073	0.055	9.73
DS Upper Otter Creek				Total	Iron	1.627	0.057	4.42
DS Upper Otter Creek				Total	Manganese	0.120	0.002	1.41
DS Upper Otter Creek				Dissolved	Manganese	0.053	0.009	0.05

TABLE 8 *Mid Otter Creek total and dissolved metal values that exceeded the Guidelines for Canadian Drinking Water Quality. The samples were collected during inactive placer mining, the Outflow was dry, and the operator upstream (1.4 km) was actively washing pay gravel.*

Sample Location	Total Suspended Solids (mg/L)			Metal	Parameter type	Mean	SD	Times Exceedance DW
SP2 Mid Otter Creek	1760	-	1020	Total	Aluminum	2.000	1.236	19.00
SP2 Mid Otter Creek				Total	Iron	4.410	2.866	13.70
SP2 Mid Otter Creek				Total	Manganese	0.148	0.081	1.96
US Mid Otter Creek	<4.0	<4.0	4.5	Total	Aluminum	0.155	0.151	0.55
US Mid Otter Creek				Total	Iron	0.458	0.390	0.53
US Mid Otter Creek				Total	Manganese	0.071	0.028	0.41

TABLE 9 *Mid Otter Creek total and dissolved metal values that exceeded the Guidelines for British Columbia Water Quality Guidelines for Aquatic Life. The samples were collected during inactive placer mining, the Outflow was dry, and the operator upstream (1.4 km) was actively washing pay gravel.*

Sample Location	Total Suspended Solids (mg/L)			Metal	Parameter	Mean	SD	Times Exceedance
SP2 Mid Otter Creek	1760	-	1020	Total	Aluminum	2.000	1.236	19.00
SP2 Mid Otter Creek				Total	Iron	4.410	2.866	13.70
SP2 Mid Otter Creek				Total	Manganese	0.148	0.081	1.96
US Mid Otter Creek	7.3	5.3	<4.0	Total	Aluminum	0.155	0.151	0.55
US Mid Otter Creek				Total	Iron	0.458	0.390	0.53
US Mid Otter Creek				Total	Manganese	0.071	0.028	0.41

TABLE 10 *Lower Otter Creek total and dissolved metal values that exceeded the Guidelines for Canadian Drinking Water Quality. The samples were collected 24 hours from gravel washing, the Outflow was under ground and therefore sampling was not possible, and an upstream operator (3.6 km) was actively mining.*

Sample Location	Total Suspended Solids (mg/L)			Metal	Parameter type	Mean	SD	Times Exceedance DW
SP1 Lower Otter	211000	91500	110000	Total	Aluminum	62.500	58.464	624.00
SP1 Lower Otter				Total	Arsenic	0.031	0.027	2.06
SP1 Lower Otter				Total	Barium	6.260	1.231	5.26
SP1 Lower Otter				Total	Cadmium	0.026	0.004	4.29
SP1 Lower Otter				Total	Chromium	0.244	0.278	3.87
SP1 Lower Otter				Total	Copper	1.148	0.903	0.15
SP1 Lower Otter				Total	Iron	168.333	36.611	560.11
SP1 Lower Otter				Total	Lead	0.057	0.071	4.70
SP1 Lower Otter				Total	Manganese	63.633	25.943	1271.67
SP1 Lower Otter				Dissolved	Manganese	0.400	0.069	6.99
SP2 Lower Otter	-	47.7	40.0	Total	Aluminum	0.751	0.320	6.51
SP2 Lower Otter				Total	Iron	1.690	0.676	4.63
SP2 Lower Otter				Total	Manganese	0.085	0.032	0.70
US Lower Otter	7.8	9.2	8.2	Total	Aluminum	0.247	0.008	1.47
US Lower Otter				Total	Iron	0.897	0.050	1.99
US Lower Otter				Total	Manganese	0.112	0.011	1.23
US Lower Otter				Dissolved	Manganese	0.099	0.006	0.97
DS Lower Otter	21.0	43.0	24.3	Total	Aluminum	0.393	0.064	2.93
DS Lower Otter				Total	Iron	0.834	0.105	1.78

TABLE 11 *Lower Otter Creek total and dissolved metal values that exceeded the Guidelines for British Columbia Water Quality Guidelines for Aquatic Life. The samples were collected 24 hours from gravel washing, the Outflow was under ground and therefore sampling was not possible, and an upstream operator (3.6 km) was actively mining.*

Sample Location	Total Suspended Solids (mg/L)			Metal	Parameter type	Mean	SD	Times Exceedance AL
SP1 Lower Otter	211000	91500	110000	Total	Aluminum	62.500	58.464	624.00
SP1 Lower Otter				Total	Arsenic	0.031	0.027	5.13
SP1 Lower Otter				Total	Barium	6.260	1.231	0.25
SP1 Lower Otter				Total	Beryllium	0.007	0.004	0.46
SP1 Lower Otter				Total	Chromium	0.244	0.278	242.60
SP1 Lower Otter				Total	Cobalt	1.363	0.221	11.39
SP1 Lower Otter				Total	Copper	1.148	0.903	4.39
SP1 Lower Otter				Total	Iron	168.333	36.611	167.33
SP1 Lower Otter				Total	Manganese	63.633	25.943	1.50
SP1 Lower Otter				Total	Nickel	8.103	0.720	72.67
SP1 Lower Otter				Total	Vanadium	0.222	0.331	35.96
SP2 Lower Otter	-	47.7	40.0	Total	Aluminum	0.751	0.320	6.51
SP2 Lower Otter				Total	Chromium	0.006	0.002	4.81
SP2 Lower Otter				Total	Iron	1.690	0.676	0.69
US Lower Otter	7.8	9.2	8.2	Total	Aluminum	0.247	0.008	1.47
US Lower Otter				Total	Chromium	0.002	0.00009	0.95
DS Lower Otter	21.0	43.0	24.3	Total	Aluminum	0.393	0.064	2.93
DS Lower Otter				Total	Chromium	0.003	0.0004	2.05

TABLE 12 *Snake Creek total and dissolved metal values that exceeded the Guidelines for Canadian Drinking Water Quality. Samples were collected during a period of inactive mining and no surface water discharge was present.*

Sample Location	Total Suspended Solids (mg/L)			Metal	Parameter type	Mean	SD	Times Exceedance DW
SP1 Snake Creek	10.3	<4.0	-	Total	Aluminum	1.626	1.441	15.26
SP1 Snake Creek				Total	Iron	2.293	2.071	6.64
SP1 Snake Creek				Total	Manganese	0.152	0.137	2.03
SP1 Spruce Creek				Total	Aluminum	0.242	0.241	1.42
SP1 Spruce Creek				Total	Iron	0.412	0.423	0.37
SP1 Spruce Creek				Dissolved	Aluminum	0.152	0.255	0.52
SP2 Snake Creek	<4.0	-	8.5	Total	Aluminum	0.852	1.228	7.52
SP2 Snake Creek				Total	Iron	1.213	1.756	3.04
SP2 Snake Creek				Total	Manganese	0.069	0.103	0.39
SP3 Snake Creek	-	13.0	10.3	Total	Aluminum	0.360	0.306	2.60
SP3 Snake Creek				Total	Iron	0.635	0.654	1.12
SP3 Snake Creek				Total	Manganese	0.053	0.073	0.07
DS Snake Creek				Total	Aluminum	1.210	1.740	11.10
DS Snake Creek				Total	Iron	3.281	5.166	9.94
DS Snake Creek	23.5	-	4.3	Total	Manganese	0.598	1.007	10.96

TABLE 13 *Snake Creek total and dissolved metal values that exceeded the Guidelines for British Columbia Water quality Guidelines for Aquatic Life. Samples were collected during a period of inactive mining and no surface water discharge was observed.*

Sample Location	Total Suspended Solids (mg/L)			Metal	Parameter type	Mean	SD	Times Exceedance
SP1 Snake Creek	10.3	<4.0	-	Total	Aluminum	1.626	1.441	15.26
SP1 Snake Creek				Total	Chromium	0.012	0.010	11.04
SP1 Snake Creek				Total	Copper	0.008	0.007	0.45
SP1 Snake Creek				Total	Iron	2.293	2.071	1.29
SP1 Snake Creek				Total	Nickel	0.039	0.032	0.56
SP1 Snake Creek				Dissolved	Chromium	0.001	0.00009	0.29
SP2 Snake Creek	<4.0	-	8.5	Total	Aluminum	0.852	1.228	7.52
SP2 Snake Creek				Total	Chromium	0.007	0.008	5.81
SP2 Snake Creek				Total	Iron	1.213	1.756	0.21
SP2 Snake Creek				Dissolved	Chromium	0.001	0.000	0.34
SP3 Snake Creek	-	13.0	10.3	Total	Aluminum	0.360	0.306	2.60
SP3 Snake Creek				Total	Chromium	0.004	0.002	2.71
US Snake Creek	<4.0	<4.0	<4.0	Total	Chromium	0.003	0.0001	1.77
US Snake Creek				Dissolved	Chromium	0.003	0.00006	1.73
DS Snake Creek	23.5	-	4.3	Total	Aluminum	1.210	1.740	11.10
DS Snake Creek				Total	Chromium	0.010	0.011	8.79
DS Snake Creek				Total	Copper	0.007	0.011	0.40
DS Snake Creek				Total	Iron	3.281	5.166	2.28
DS Snake Creek				Total	Nickel	0.113	0.188	3.53
DS Snake Creek				Dissolved	Chromium	0.002	0.00007	1.32

TABLE 14 *Ruby Creek total and dissolved metal values that exceeded the Guidelines for Canadian Drinking Water Quality. Samples were collected while the site was actively being mined, no gravel washing occurred, and the mine was discharging surface water into the creek.*

Sample Location	Total Suspended Solids (mg/L)			Metal	Parameter type	Mean	SD	Times Exceedance DW
SP2 Ruby Creek	9.2	12.3	12.3	Total	Aluminum	1.257	0.064	11.57
SP2 Ruby Creek				Total	Iron	1.080	0.046	2.60
SP2 Ruby Creek				Total	Manganese	0.059	0.002	0.18
SP3 Ruby Creek	14.3	14.5	14.4	Total	Aluminum	1.583	0.155	14.83
SP3 Ruby Creek				Total	Iron	1.357	0.025	3.52
SP3 Ruby Creek				Total	Manganese	0.060	0.001	0.19
Outfall Ruby Creek	14.0	22.0	35.3	Total	Aluminum	1.577	0.176	14.77
Outfall Ruby Creek				Total	Iron	1.467	0.153	3.89
Outfall Ruby Creek				Total	Manganese	0.067	0.012	0.35
US Ruby Creek	10.5	12.5	9.2	Total	Aluminum	0.234	0.167	1.34
US Ruby Creek				Total	Iron	0.307	0.226	0.02
US Ruby Creek				Dissolved	Aluminum	0.123	0.131	0.23
DS Ruby Creek	20.5	-	25.0	Total	Aluminum	0.731	0.101	6.31
DS Ruby Creek				Total	Iron	0.832	0.158	1.77

TABLE 15 *Ruby Creek total and dissolved metal values that exceeded the Guidelines for British Columbia Water Quality Guidelines for Aquatic Life. The samples were collected during active mining, no gravel washing occurred, and the mine was discharging surface water into the creek.*

Sample Location	Total Suspended Solids (mg/L)			Metal	Parameter type	Mean	SD	Times Exceedance
SP2 Ruby Creek	9.2	12.3	12.3	Total	Aluminum	1.257	0.064	11.57
SP2 Ruby Creek				Total	Chromium	0.004	0.0002	3.35
SP2 Ruby Creek				Total	Copper	0.005	0.0001	0.83
SP2 Ruby Creek				Total	Iron	1.080	0.046	0.08
SP3 Ruby	14.3	14.5	14.4	Total	Aluminum	1.583	0.155	14.83
SP3 Ruby				Total	Chromium	0.005	0.0001	4.35
SP3 Ruby				Total	Copper	0.005	0.00001	0.18
SP3 Ruby				Total	Iron	1.357	0.025	0.36
Outfall Ruby Creek	14.0	22.0	35.3	Total	Aluminum	1.577	0.176	14.77
Outfall Ruby Creek				Total	Arsenic	0.005	0.0004	0.05
Outfall Ruby Creek				Total	Chromium	0.006	0.001	4.81
Outfall Ruby Creek				Total	Copper	0.005	0.001	1.09
Outfall Ruby Creek				Total	Iron	1.467	0.153	0.47
Outfall Ruby Creek				Total	Vanadium	0.007	0.001	0.08
US Ruby Creek	10.5	12.5	9.2	Total	Aluminum	0.234	0.167	1.34
US Ruby Creek				Total	Chromium	0.001	0.001	0.17
US Ruby Creek				Dissolved	Aluminum	0.123	0.131	0.23
US Ruby Creek				Dissolved	Cadmium	0.000	0.000	1.38
DS Ruby Creek	20.5	-	25.0	Total	Aluminum	0.731	0.101	6.31
DS Ruby Creek				Total	Chromium	0.003	0.0003	1.96

DS Ruby Creek	Total	Copper	0.003	0.0003	0.30
DS Ruby Creek	Dissolved	Cadmium	0.00005	0.000002	0.37

TABLE 16 *Boulder Creek total and dissolved metal values that exceeded the Guidelines for Canadian Drinking Water Quality collected 5 days post-mining activity. No Outflow samples were collected from the underground Outflow.*

Sample Location	Total Suspended Solids (mg/L)			Metal	Parameter type	Mean	SD	Times Exceedance DW
SP3 Boulder Creek	89.0	72.0	-	Total	Aluminum	6.223	2.269	61.23
SP3 Boulder Creek				Total	Chromium	0.050	0.021	0.00
SP3 Boulder Creek				Total	Iron	11.143	4.152	36.14
SP3 Boulder Creek				Total	Lead	0.013	0.003	0.28
SP3 Boulder Creek				Total	Manganese	0.230	0.089	3.61
US Boulder Creek	<4.0	<4.0	<4.0	Total	Aluminum	0.126	0.043	0.26

TABLE 17 *Boulder Creek total and dissolved metal values that exceeded the Guidelines for British Columbia Water Quality Guidelines for Aquatic Life. The samples were collected 5 days since active mining and no samples were collected from the underground Outflow.*

Sample Location	Total Suspended Solids (mg/L)			Metal	Parameter type	Mean	SD	Times Exceedance
SP3 Boulder Creek	89.0	72.0	-	Total	Aluminum	6.223	2.269	61.23
SP3 Boulder Creek				Total	Chromium	0.050	0.021	49.00
SP3 Boulder Creek				Total	Copper	0.027	0.009	4.48
SP3 Boulder Creek				Total	Iron	11.143	4.152	10.14
SP3 Boulder Creek				Total	Nickel	0.137	0.050	4.50
SP3 Boulder Creek				Total	Vanadium	0.024	0.008	3.00
SP3 Boulder Creek				Total	Zinc	0.044	0.016	0.32
US Boulder Creek	<4.0	<4.0	<4.0	Total	Aluminum	0.126	0.043	0.26
DS Boulder Creek	16.3	17.3	13.5	Dissolved	Cadmium	0.00005	0.000003	0.49

TABLE 18 *Total Suspended Solids for Birch Creek collected during in inactive mining and no surface water discharge to creek occurred. No elevated levels of total or dissolved metals were recorded.*

Location	Total Suspended Solids (mg/L)		
US Birch Creek	<4.0	<4.0	<4.0
DS Birch Creek	<4.0	<4.0	<4.0

TABLE 19 *Spruce Creek total and dissolved metal values that exceeded the Guidelines for Canadian Drinking Water Quality collected during gravel washing. The focus of the washing was to provide clean aggregates for road construction rather than to recover gold. The settling pond drained to ground and therefore no Outflow samples were collected.*

Sample Location	Total Suspended Solids (mg/L)			Metal	Parameter type	Mean	SD	Times Exceedance DW
SP1 Spruce Creek	-	54.8	35.3	Total	Aluminum	0.242	0.241	1.42
SP1 Spruce Creek				Total	Iron	0.412	0.423	0.37
SP1 Spruce Creek				Dissolved	Aluminum	0.152	0.255	0.52

TABLE 20 *Spruce Creek total and dissolved metal values that exceeded the Guidelines for British Columbia Water Quality Guidelines for Aquatic Life collected during gravel washing. The focus of the washing was to provide clean aggregates for road construction rather than to recover gold. The settling pond had adequate capacity and therefore no surface water discharge was observed.*

Location	Total Suspended Solids (mg/L)			Metal	Parameter	Mean	SD	Times Exceedance
SP1 Spruce Creek	-	54.8	35.3	Total	Aluminum	0.242	0.241	1.42
SP1 Spruce Creek				Total	Chromium	0.002	0.002	1.39
SP1 Spruce Creek				Dissolved	Aluminum	0.152	0.255	0.52
SP1 Spruce Creek				Dissolved	Chromium	0.002	0.002	0.77
DS Spruce Creek	<4.0	<4.0	6.0	Total	Chromium	0.001	0.000	0.24

TABLE 21 *Total Metals per location where the downstream total metal values were greater than the upstream values (order highest to lowest values; N=30).Surface water discharge to the creek was present at Upper Otter Creek and Ruby Creek. Subsurface discharge to Lower Otter Creek occurred and no surface discharge was observed at Boulder Creek, Birch Creek, and Spruce Creek.*

Upper Otter Cr.	**Mid Otter Cr.**	**Lower Otter Cr.**	**Ruby Cr.**	**Boulder Cr.**	**Birch Cr.**	**Spruce Cr.**
Total Magnesium	Total Iron	Total Calcium	Total Aluminum	Total Calcium	Total Aluminum	Total Aluminum
Total Calcium	Total Calcium	Total Magnesium	Total Iron	Total Phosphorus	Total Iron	Total Titanium
Total Titanium	Total Magnesium	Total Aluminum	Total Titanium	Total Strontium	Total Calcium	Total Potassium
Total Nickel	Total Silicon	Total Potassium	Total Potassium	Total: 3	Total Titanium	Total Copper
Total Sodium	Total Phosphorus	Total Titanium	Total Phosphorus		Total Potassium	Total Barium
Total Strontium	Total Nickel	Total Phosphorus	Total Manganese		Total Phosphorus	Total Vanadium
Total Phosphorus	Total Potassium	Total Barium	Total Zinc		Total Manganese	Total Cobalt
Total Vanadium	Total Copper	Total Chromium	Total Silicon		Total Nickel	Total Zinc
Total Zirconium	Total Titanium	Total Silicon	Total Nickel		Total Silicon	Total Zirconium
Total Chromium	Total Zinc	Total Nickel	Total Copper		Total Copper	Total Arsenic
Total Lead	Total Strontium	Total Strontium	Total Arsenic		Total Zinc	Total Molybdenum
Total: 11	Total Zirconium	Total Vanadium	Total Lead		Total Barium	Total Lead
	Total Manganese	Total Sodium	Total Barium		Total Vanadium	Total Antimony
	Total Sodium	Total Zinc	Total Vanadium		Total Cobalt	Total Thallium
	Total Arsenic	Total Cobalt	Total Zirconium		Total Zirconium	Total Bismuth
	Total Cobalt	Total Zirconium	Total Cobalt		Total Strontium	Total Cadmium
	Total Lead	Total Cadmium	Total		Total	Total: 16

Total Molybdenum	Total Tin	Molybdenum Total Bismuth	Molybdenum Total Cadmium
Total Cadmium	Total Thallium	Total Tin	Total Antimony
Total Vanadium	Total: 19	Total Strontium	Total Thallium
Total Selenium		Total Cadmium	Total Silver
Total Antimony		Total Beryllium	Total: 21
Total Silver		Total Antimony	
Total Bismuth		Total Thallium	
Total: 24		Total Silver	
		Total: 25	

TABLE 22 *Eleven sediment total metals <63 µm recorded at the Upper Otter Creek site and the level to which they exceed the BC Interim Sediment Quality Guidelines and Ontario Sediment Quality Guidelines (Silver only).*

	US			DS			OUTFLOW		
Parameter	**Mean**	**SD**	**Times Exceedance**	**Mean**	**SD**	**Times Exceedance**	**Mean**	**SD**	**Times Exceedance**
Total Arsenic	15.500	0.770	1.627	6.207	5.587	0.052	6.907	0.574	0.171
Total Cadmium	0.751	0.020	0.252	0.386	0.198	-0.357	0.536	0.043	-0.107
Total Chromium	76.367	6.972	1.047	73.933	9.856	0.982	87.433	38.914	1.344
Total Copper	54.700	1.405	0.532	41.167	8.062	0.153	51.600	4.887	0.445
Total Iron	36200.000	1301.281	0.708	20633.333	3815.757	-0.027	24300.000	4232.021	0.146
Total Lead	22.393	0.909	-0.360	5.223	29.451	-0.851	5.507	0.453	-0.843
Total Manganese	2030.333	27.622	3.414	485.000	985.515	0.054	615.667	78.015	0.338
Total Nickel	101.533	12.342	5.346	117.333	15.127	6.333	141.567	68.152	7.848
Total Selenium	0.863	0.000	-0.568	0.500	0.195	-0.750	0.500	0.000	-0.750
Total Silver	0.344	0.017	-0.313	0.114	0.371	-0.771	0.152	0.077	-0.697
Total Zinc	93.267	3.607	-0.242	57.267	10.174	-0.534	68.567	5.358	-0.443

TABLE 23 *Eleven sediment total metals <63 µm recorded at the Mid Otter Creek site.*

	US			DS		
Parameter	**Mean**	**SD**	**Times Exceedance**	**Mean**	**SD**	**Times Exceedance**
Total Arsenic	4.820	1.179	-0.183	9.770	0.589	0.656
Total Cadmium	0.453	0.150	-0.245	0.799	0.087	0.331
Total Chromium	89.167	1.501	1.391	85.033	5.390	1.280
Total Copper	43.000	7.278	0.204	68.933	3.700	0.931
Total Iron	18300.000	1250.333	-0.137	31933.333	4084.116	0.506
Total Lead	4.780	0.569	-0.863	7.280	0.282	-0.792
Total Manganese	421.333	31.749	-0.084	489.000	173.483	0.063
Total Nickel	121.000	11.150	6.563	163.667	10.536	9.229
Total Selenium	0.643	0.111	-0.678	0.710	0.248	-0.645
Total Silver	0.121	0.039	-0.758	0.242	0.009	-0.515
Total Zinc	79.433	2.759	-0.354	98.933	16.362	-0.196

TABLE 24 Eleven *sediment total metals <63 µm recorded at the Lower Otter Creek site.*

	US			DS		
Parameter	**Mean**	**SD**	**Times Exceedance**	**Mean**	**SD**	**Times Exceedance**
Total Arsenic	13.567	2.787	1.299	11.977	2.376	1.030
Total Cadmium	0.541	0.063	-0.098	0.413	0.323	-0.311
Total Chromium	112.000	7.572	2.003	129.333	13.748	2.467
Total Copper	58.100	8.893	0.627	37.467	28.183	0.049
Total Iron	28566.667	907.377	0.347	24666.667	8548.879	0.164
Total Lead	6.247	0.379	-0.822	4.473	2.802	-0.872
Total Manganese	962.667	64.454	1.093	495.333	655.877	0.077
Total Nickel	201.000	24.826	11.563	199.667	19.672	11.479
Total Selenium	1.060	0.000	-0.470	0.500	0.792	-0.750
Total Silver	0.223	0.027	-0.553	0.101	0.145	-0.798
Total Zinc	70.333	7.895	-0.428	52.033	35.225	-0.577

TABLE 25 *Eleven sediment total metals <63 µm recorded at the Ruby Creek site.*

	US			DS			OUTFLOW		
Parameter	**Mean**	**SD**	**Times Exceedance**	**Mean**	**SD**	**Times Exceedance**	**Mean**	**SD**	**Times Exceedance**
Total Arsenic	21.900	2.801	2.712	39.667	5.039	5.723	70.700	5.981	10.983
Total Cadmium	1.081	0.074	0.802	1.597	0.118	1.661	2.330	0.171	2.883
Total Chromium	130.000	1.528	2.485	120.667	14.107	2.235	151.000	4.583	3.048
Total Copper	38.367	1.950	0.075	56.233	1.922	0.575	100.700	7.041	1.821
	29166.66	435.89		31400.00	1234.23		39100.00	1374.77	
Total Iron	7	0	0.376	0	4	0.481	0	3	0.844
Total Lead	13.367	2.517	-0.618	27.033	2.223	-0.228	43.700	3.816	0.249
Total Manganese	551.333	21.008	0.199	645.667	26.026	0.404	956.333	55.896	1.079
Total Nickel	215.333	2.309	12.458	230.667	23.459	13.417	389.333	6.807	23.333
Total Selenium	0.500	0.000	-0.750	0.500	0.000	-0.750	0.500	0.000	-0.750
Total Silver	0.226	0.034	-0.547	0.329	0.020	-0.342	0.430	0.060	-0.141
Total Zinc	99.633	2.517	-0.190	141.333	8.137	0.149	206.333	16.803	0.678

TABLE 26 *Eleven sediment total metals <63 µm recorded at the Boulder Creek site.*

	US			DS		
Parameter	**Mean**	**SD**	**Times Exceedance**	**Mean**	**SD**	**Times Exceedance**
Total Arsenic	23.000	0.426	2.898	7.477	6.056	0.267
Total Cadmium	1.169	0.042	0.948	0.540	0.167	-0.101
Total Chromium	216.000	5.859	4.791	114.667	36.497	2.074
Total Copper	79.500	1.058	1.227	23.300	11.401	-0.347
Total Iron	37500.000	1001.665	0.769	22133.333	3893.584	0.044
Total Lead	17.067	0.191	-0.512	6.427	3.232	-0.816
Total Manganese	618.667	16.643	0.345	383.000	23.180	-0.167
Total Nickel	314.333	6.658	18.646	165.667	65.041	9.354
Total Selenium	0.500	0.000	-0.750	0.500	0.000	-0.750
Total Silver	0.347	0.006	-0.305	0.113	0.129	-0.774
Total Zinc	112.000	2.996	-0.089	48.133	11.269	-0.609

TABLE 27 *Eleven sediment total metals <63 µm recorded at the Birch Creek site.*

	US			DS		
Parameter	Mean	SD	Times Exceedance	Mean	SD	Times Exceedance
Total Arsenic	10.953	0.862	0.856	10.553	2.500	0.789
Total Cadmium	0.352	0.045	-0.413	0.443	0.038	-0.262
Total Chromium	150.000	2.309	3.021	144.667	13.528	2.878
Total Copper	29.067	2.203	-0.186	52.233	1.234	0.463
Total Iron	24333.333	700.000	0.148	30100.000	1501.111	0.420
Total Lead	7.577	0.084	-0.784	7.093	2.413	-0.797
Total Manganese	435.333	19.425	-0.054	546.333	40.278	0.188
Total Nickel	310.667	17.349	18.417	365.000	46.801	21.813
Total Selenium	0.500	0.000	-0.750	0.500	0.000	-0.750
Total Silver	0.155	0.009	-0.690	0.173	0.043	-0.655
Total Zinc	43.200	2.425	-0.649	62.000	4.715	-0.496

TABLE 28 *Eleven sediment total metals <63 µm recorded at the Spruce Creek site.*

	US			DS		
Parameter	Mean	SD	Times Exceedance	Mean	SD	Times Exceedance
Total Arsenic	9.383	0.503	0.590	12.533	2.674	1.124
Total Cadmium	0.516	0.050	-0.141	0.480	0.065	-0.199
Total Chromium	206.667	6.506	4.541	171.333	25.106	3.593
Total Copper	41.633	2.608	0.166	62.867	4.960	0.761
Total Iron	34600.000	1050.397	0.632	36833.333	5666.569	0.737
Total Lead	5.487	0.186	-0.843	5.553	0.527	-0.841
Total Manganese	998.000	93.007	1.170	917.667	211.310	0.995
Total Nickel	298.667	9.539	17.667	295.000	66.711	17.438
Total Selenium	0.830	0.000	-0.585	0.500	0.171	-0.750
Total Silver	0.125	0.027	-0.751	0.110	0.013	-0.780
Total Zinc	81.967	3.790	-0.334	83.467	3.002	-0.321

Appendix 5: Laboratory and Field Minimum Reporting Levels, Units, and Water and Sediment Guidelines.

TABLE 29 *Laboratory and field minimum reporting levels, Aquatic Life BCWGW, GCDWQ, and ISQG/OSQG standards.*

					Method					
	Water	Sed	Water	Sed		Field	Analytical			
Property or constituent	**Units**	**Units**	**RDL**	**RDL**	**Water**	**Sed**		Sediment Standard[1]	GCDWQ[2]	Aquatic Life BCWQG[3]
pH	pH		0.01		YSI probe					
Conductivity	µS/cm		0.1		YSI probe					
Discharge	m^3/s		0.0001		Flow Tracker					
Total suspended solids	mg/L		4		Grab-discrete					
Total Hardness (CaCO3)	mg/L		0.5		Grab-discrete		ICPMS			
Antimony (Sb)	mg/L	mg/kg	0.00002	100	Grab-discrete	Grab-composite	ICPMS		0.006	0.02
Aluminum (Al)	mg/L	mg/kg	0.0002	0.1	Grab-discrete	Grab-composite	ICPMS		0.1	0.1
Arsenic (As)	mg/L	mg/kg	0.00002	0.5	Grab-discrete	Grab-composite	ICPMS	5.9 ISQG	0.01	0.005
Barium (Ba)	mg/L	mg/kg	0.00002	0.1	Grab-discrete	Grab-composite	ICPMS		1	5
Beryllium (Be)	mg/L	mg/kg	0.00001	0.4	Grab-discrete	Grab-composite	ICPMS			0.005
Bismuth (Bi)	mg/L	mg/kg	0.00001	0.1	Grab-discrete	Grab-composite	ICPMS			
Boron (B)	mg/L		0.05		Grab-discrete	Grab-composite	ICPMS		5	1.2
Cadmium (Cd)	mg/L	mg/kg	0.00001	0.05	Grab-discrete	Grab-composite	ICPMS	0.6 ISQG	0.005	10 exp (0.86[log{hardness}]-3.2) µg/L
Calcium (Ca)	mg/L	mg/kg	0.00001	100	Grab-discrete	Grab-composite	ICPMS			
Chromium (Cr)	mg/L	mg/kg	0.0001	1	Grab-discrete	Grab-composite	ICPMS	37.3 ISQG	0.05	0.001
Cobalt (Co)	mg/L	mg/kg	0.00001	0.3	Grab-discrete	Grab-composite	ICPMS			0.11
Copper (Cu)	mg/L	mg/kg	0.00005	0.5	Grab-discrete	Grab-composite	ICPMS	35.7 ISQG	1	(0.094(hardness)+2) µg/L
Iron (Fe)	mg/L	mg/kg	0.001	100	Grab-discrete	Grab-composite	ICPMS	21200 ISQG	0.3	1
Lead (Pb)	mg/L	mg/kg	0.00001	0.1	Grab-discrete	Grab-composite	ICPMS	35 ISQG	0.01	3 µg/L if $CaCO_3$ < 8 mg/L and e(1.273 ln (hardness) -1.460)

										if $CaCO_3$ > 8mg/L
Lithium (Li)	mg/L	-	0.0005	-	Grab-discrete	Grab-composite	ICPMS			0.87
Magnesium (Mg)	mg/L	mg/kg	0.00005	100	Grab-discrete	Grab-composite	ICPMS			
Manganese (Mn)	mg/L	mg/kg	0.00005	0.2	Grab-discrete	Grab-composite	ICPMS	460 ISQG	0.05	0.01102 (hardness) + 0.54
Molybdenum (Mo)	mg/L	mg/kg	0.00005	0.1	Grab-discrete	Grab-composite	ICPMS			2
Nickel (Ni)	mg/L	mg/kg	0.00002	0.8	Grab-discrete	Grab-composite	ICPMS	16 ISQG		25 µg/L at hardness of 0 to 60mg/L, 65 µg/L at hardness 60 to 120, 110 at hardness of 120 to 180, 150 at hardness > 180 mg/L
Phosphorus (P)		mg/kg		10	Grab-discrete	Grab-composite	ICPMS			
Potassium (K)	mg/L	mg/kg	0.05	100	Grab-discrete	Grab-composite	ICPMS			432
Selenium (Se)	mg/L	mg/kg	0.00004	0.5	Grab-discrete	Grab-composite	ICPMS	2 ISQG	0.01	0.002
Silicon (Si)	mg/L	mg/kg	0.1		Grab-discrete	Grab-composite	ICPMS			
Silver (Ag)	mg/L	mg/kg	0.00001	0.05	Grab-discrete	Grab-composite	ICPMS	0.5 OSQG		1 µg/L with hardness ≤ 100 mg/L, 3 µg/L with hardness ≥ 100 mg/L
Sodium (Na)	mg/L	mg/kg	0.05		Grab-discrete	Grab-composite	ICPMS		200	
Sulphur (S)	mg/L		0.01		Grab-discrete	Grab-composite	ICPMS			
Thallium (Tl)	mg/L	mg/kg	0.000002	0.05	Grab-discrete	Grab-composite	ICPMS			0.0017
Tin (Sn)	mg/L	mg/kg	0.0002	0.1	Grab-discrete	Grab-composite	ICPMS			0.000008
Titanium (Ti)	mg/L	mg/kg	0.0005	1	Grab-discrete	Grab-composite	ICPMS			2
Strontium (Sr)	mg/L	mg/kg	0.00005	0.1	Grab-discrete	Grab-composite	ICPMS			
Uranium (U)	mg/L		0		Grab-discrete	Grab-composite	ICPMS		0.02	0.3
Vanadium (V)	mg/L	mg/kg	0.0002	2	Grab-discrete	Grab-composite	ICPMS			0.006
Zinc (Zn)	mg/L	mg/kg	0.0001	1	Grab-discrete	Grab-composite	ICPMS	123	5	33 + 0.75 x (hardness -90)
Zirconium (Zr)	mg/L	mg/kg	0.0001	0.5	Grab-discrete	Grab-composite	ICPMS			

Appendix 6: Hydrology, Water Quality, and Total and Dissolved Metals Data

TABLE 30 *Total metals raw data from water samples collected in September and October, 2012 and analysed at the Maxxam Analytics Laboratory.*

		Total Hardness (CaCO3)	Total Aluminum (Al)	Total Antimony (Sb)	Total Arsenic (As)	Total Barium (Ba)	Total Beryllium (Be)	Total Bismuth (Bi)	Total Boron (B)	Total Cadmium (Cd)	Total Chromium (Cr)	Total Cobalt (Co)	Total Copper (Cu)	Total Iron (Fe)
LOCATION	**UNITS**	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
DS Lower Otter Creek	**REG/1**	130	345	0.147	1.31	70.2	0.010	0.0050	<50	0.0210	2.76	0.901	3.06	747
DS Lower Otter Creek	**RP1/2**	130	466	0.143	1.30	71.0	0.017	0.0070	<50	0.0260	3.51	1.09	3.58	951
DS Lower Otter Creek	**RP2/3**	131	367	0.139	1.18	68.4	0.013	0.0060	<50	0.0200	2.88	0.965	3.17	803
DS Spruce Creek	**REG/1**	125	64.7	0.041	0.268	23.2	<0.010	<0.0050	<50	<0.0050	1.15	0.191	0.661	124
DS Spruce Creek	**RP1/2**	126	37.9	0.040	0.233	22.7	<0.010	<0.0050	<50	0.0050	0.98	0.0960	0.537	82.5
DS Spruce Creek	**RP2/3**	125	54.4	0.039	0.261	23.0	<0.010	<0.0050	<50	0.0060	1.58	0.135	0.653	122
DS Birch Creek	**REG/1**	65.5	23.0	0.036	0.794	11.9	<0.010	<0.0050	<50	0.0050	0.72	0.0620	0.620	31.5
DS Birch Creek	**RP1/2**	67.4	25.1	0.037	0.848	11.9	<0.010	<0.0050	<50	<0.0050	0.75	0.0670	0.664	34.4
DS Birch Creek	**RP2/3**	68.2	42.7	0.043	0.822	12.5	<0.010	<0.0050	<50	0.0050	0.82	0.120	0.703	61.2
DS Boulder Creek	**REG/1**	30.1	12.7	0.048	0.536	8.27	0.058	<0.0050	<50	0.0490	0.29	0.0130	0.571	14.0
DS Boulder Creek	**RP1/2**	30.1	13.8	0.036	0.511	8.10	0.062	<0.0050	<50	0.0470	0.25	0.0120	0.568	6.3
DS Boulder Creek	**RP2/3**	30.3	18.7	0.039	0.560	8.29	0.068	<0.0050	<50	0.0520	0.45	0.0310	0.754	29.4
DS Mid Otter Creek	**REG/1**	105	44.0	0.048	0.245	64.0	<0.010	<0.0050	<50	0.0120	0.95	0.166	0.939	199
DS Mid Otter Creek	**RP1/2**	104	29.0	0.052	0.171	64.4	<0.010	<0.0050	<50	0.0080	0.73	0.0980	0.739	155
DS Mid Otter Creek	**RP2/3**	102	128	0.049	0.318	64.4	<0.010	<0.0050	<50	0.0150	1.31	0.313	1.35	370
DS Ruby Creek	**REG/1**	36.0	642	0.118	2.79	8.99	0.307	0.0610	<50	0.0910	2.66	0.815	2.71	711
DS Ruby Creek	**RP1/2**	37.1	710	0.128	2.86	10.3	0.338	0.0670	<50	0.111	2.89	0.894	2.82	774
DS Ruby Creek	**RP2/3**	37.9	841	0.133	3.11	10.7	0.349	0.0750	<50	0.0990	3.33	1.31	3.35	1010
DS Snake Creek	**REG/1**	100	3210	0.115	3.34	537	0.327	0.0190	<50	2.70	22.1	12.2	20.3	9240
DS Snake Creek	**RP1/2**	89.0	375	0.066	0.404	32.9	0.010	<0.0050	<50	0.0300	4.92	0.894	1.57	546
DS Snake Creek	**RP2/3**	83.6	46.1	0.078	0.204	25.8	<0.010	<0.0050	<50	0.0070	2.36	0.0750	0.414	57.8
DS Upper Otter Creek	**REG/1**	85.2	1020	0.086	0.636	83.9	0.040	0.0230	<50	0.138	5.97	2.55	12.0	1580
DS Upper Otter Creek	**RP1/2**	85.0	1070	0.089	0.654	85.6	0.042	0.0230	<50	0.134	6.07	2.61	12.2	1610
DS Upper Otter Creek	**RP2/3**	84.5	1130	0.095	0.666	89.0	0.037	0.0250	<50	0.140	6.24	2.55	12.0	1690
Outfall Ruby Creek	**REG/1**	43.4	1480	0.207	4.89	13.0	0.502	0.210	<50	0.0740	5.50	1.52	5.02	1350
Outfall Ruby Creek	**RP1/2**	42.2	1470	0.189	5.16	13.0	0.497	0.206	<50	0.0870	5.49	1.58	5.10	1410
Outfall Ruby Creek	**RP2/3**	42.4	1780	0.204	5.68	16.5	0.614	0.256	<50	0.111	6.43	2.11	6.13	1640
Outfall Upper Otter Creek	**REG/1**	100	2830	0.120	1.32	133	0.107	0.0640	<50	0.443	15.7	7.25	34.8	4200
Outfall Upper Otter Creek	**RP1/2**	97.7	3040	0.134	1.33	142	0.118	0.0620	<50	0.447	16.1	7.77	35.0	4260
Outfall Upper Otter Creek	**RP2/3**	98.0	2800	0.115	1.17	132	0.116	0.0600	<50	0.411	16.9	7.05	34.3	4210

		Total Hardness (CaCO3)	Total Aluminum (Al)	Total Antimony (Sb)	Total Arsenic (As)	Total Barium (Ba)	Total Beryllium (Be)	Total Bismuth (Bi)	Total Boron (B)	Total Cadmium (Cd)	Total Chromium (Cr)	Total Cobalt (Co)	Total Copper (Cu)	Total Iron (Fe)
LOCATION	**UNITS**	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
SP1 Lower Otter Creek	**REG/1**	5070	27800	0.45	16.0	5160	5.00	<0.050	<500	23.7	76.5	1570	619	158000
SP1 Lower Otter Creek	**RP1/2**	2330	130000	1.60	61.9	7590	11.5	<0.050	<500	31.1	564	1130	2190	209000
SP1 Lower Otter Creek	**RP2/3**	3910	29700	0.68	14.0	6030	5.46	<0.050	<500	24.6	90.3	1390	634	138000
SP1 Snake Creek	**REG/1**	89.7	198	0.026	0.164	30.9	<0.010	<0.0050	<50	0.0110	2.51	0.432	1.33	238
SP1 Snake Creek	**RP1/2**	97.0	3080	0.046	1.02	111	0.121	<0.0050	<50	0.165	22.2	9.04	14.5	4380
SP1 Snake Creek	**RP2/3**	89.2	1600	0.044	0.673	65.7	0.051	<0.0050	<50	0.0810	11.4	4.84	7.52	2260
SP1 Spruce Creek	**REG/1**	137	236	0.054	0.393	20.5	<0.010	<0.0050	<50	0.0100	2.15	0.601	1.39	378
SP1 Spruce Creek	**RP1/2**	129	4.10	0.051	0.306	16.5	<0.010	<0.0050	<50	<0.0050	0.75	0.0480	0.526	6.5
SP1 Spruce Creek	**RP2/3**	132	486	0.062	0.485	25.5	0.013	0.0050	<50	0.0160	4.26	1.41	2.59	850
SP1 Upper Otter Creek	**REG/1**	954	130000	<0.20	17.9	6120	6.55	0.171	<500	13.1	398	367	2070	154000
SP1 Upper Otter Creek	**RP1/2**	836	116000	<0.20	15.8	5500	5.50	0.165	<500	11.6	355	326	1920	139000
SP1 Upper Otter Creek	**RP2/3**	783	110000	<0.20	14.8	5190	5.28	0.172	<500	10.7	333	308	1830	131000
SP2 Lower Otter Creek	**REG/1**	132	582	0.119	1.29	81.2	0.024	<0.0050	<50	0.0450	4.42	1.73	5.24	1290
SP2 Lower Otter Creek	**RP1/2**	138	1120	0.138	2.22	96.9	0.046	0.0050	<50	0.0800	8.69	3.69	9.57	2470
SP2 Lower Otter Creek	**RP2/3**	135	551	0.119	1.19	80.1	0.020	0.0050	<50	0.0430	4.32	1.70	5.23	1310
SP2 Mid Otter Creek	**REG/1**	119	1410	1.53	2.86	227	0.074	0.0570	<50	0.194	8.86	5.09	30.7	2980
SP2 Mid Otter Creek	**RP1/2**	115	1170	1.54	2.96	220	0.065	0.0540	<50	0.156	7.59	4.10	27.1	2540
SP2 Mid Otter Creek	**RP2/3**	138	3420	1.20	4.24	314	0.188	0.151	<50	0.427	23.0	12.9	81.5	7710
SP2 Ruby Creek	**REG/1**	41.6	1230	0.149	4.56	13.5	0.496	0.0890	<50	0.0700	4.20	1.43	4.63	1040
SP2 Ruby Creek	**RP1/2**	44.0	1330	0.161	4.50	13.2	0.523	0.121	<50	0.0830	4.53	1.50	4.79	1130
SP2 Ruby Creek	**RP2/3**	43.1	1210	0.150	4.65	12.5	0.508	0.108	<50	0.0770	4.31	1.39	4.90	1070
SP2 Snake Creek	**REG/1**	81.2	112	0.022	0.171	24.8	<0.010	<0.0050	<50	0.0070	2.05	0.229	0.581	159
SP2 Snake Creek	**RP1/2**	92.0	2270	0.151	0.886	73.3	0.072	0.0160	<50	0.0930	16.0	5.80	9.24	3240
SP2 Snake Creek	**RP2/3**	82.0	175	0.026	0.188	26.5	<0.010	<0.0050	<50	0.0110	2.37	0.406	0.869	241
SP2 Upper Otter Creek	**REG/1**	669	87700	<0.20	13.0	4310	4.55	0.289	<500	10.1	336	269	1500	116000
SP2 Upper Otter Creek	**RP1/2**	625	86900	<0.20	11.8	4190	4.52	0.298	<500	9.76	330	254	1380	111000
SP2 Upper Otter Creek	**RP2/3**	662	87700	<0.20	11.9	4380	4.21	0.299	<500	10.3	340	268	1460	114000

LOCATION	UNITS	Total Hardness (CaCO3)	Total Aluminum (Al)	Total Antimony (Sb)	Total Arsenic (As)	Total Barium (Ba)	Total Beryllium (Be)	Total Bismuth (Bi)	Total Boron (B)	Total Cadmium (Cd)	Total Chromium (Cr)	Total Cobalt (Co)	Total Copper (Cu)	Total Iron (Fe)
		mg/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
SP3 Boulder Creek	**REG/1**	67.5	3680	0.198	2.97	74.2	0.358	0.355	<50	0.289	25.8	6.52	17.1	6630
SP3 Boulder Creek	**RP1/2**	90.7	6950	0.191	4.28	138	0.580	0.493	<50	0.455	58.2	14.1	29.9	12000
SP3 Boulder Creek	**RP2/3**	96.9	8040	0.198	5.35	167	0.629	0.494	<50	0.518	66.0	15.5	34.9	14800
SP3 Ruby Creek	**REG/1**	42.5	1470	0.178	4.85	13.3	0.491	0.161	<50	0.0740	5.46	1.53	4.94	1330
SP3 Ruby Creek	**RP1/2**	43.1	1760	0.211	5.00	14.5	0.526	0.188	<50	0.0680	5.34	1.49	4.96	1380
SP3 Ruby Creek	**RP2/3**	42.7	1520	0.183	4.95	13.7	0.509	0.174	<50	0.0730	5.26	1.51	4.95	1360
SP3 Snake Creek	**REG/1**	87.8	713	0.037	0.581	51.7	0.032	<0.0050	<50	0.0630	6.24	2.34	4.85	1390
SP3 Snake Creek	**RP1/2**	80.3	182	0.025	0.206	28.4	<0.010	<0.0050	<50	0.0130	2.41	0.387	1.03	250
SP3 Snake Creek	**RP2/3**	82.0	184	0.028	0.175	29.1	<0.010	<0.0050	<50	0.0100	2.49	0.363	0.893	266
SP3 Upper Otter Creek	**REG/1**	91.7	2680	0.103	0.961	131	0.108	0.0250	<50	0.402	13.6	6.90	34.9	3860
SP3 Upper Otter Creek	**RP1/2**	93.7	2550	0.107	1.02	126	0.111	0.0220	<50	0.392	12.9	6.43	33.7	3660
SP3 Upper Otter Creek	**RP2/3**	92.2	2670	0.102	0.843	128	0.094	0.0260	<50	0.404	13.4	6.73	34.6	3670

LOCATION	UNITS	Total Lead (Pb)	Total Lithium (Li)	Total Manganese (Mn)	Total Molybdenum (Mo)	Total Nickel (Ni)	Total Selenium (Se)	Total Silicon (Si)	Total Silver (Ag)	Total Strontium (Sr)	Total Thallium (Tl)	Total Tin (Sn)	Total Titanium (Ti)	Total Uranium (U)
		ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
SP3 Boulder Creek	**REG/1**	9.51	5.55	129	0.205	80.3	0.115	11600	0.157	30.9	0.0900	<0.20	116	2.25
SP3 Boulder Creek	**RP1/2**	13.7	9.34	264	0.186	161	0.114	16900	0.211	34.6	0.180	<0.20	278	2.77
SP3 Boulder Creek	**RP2/3**	15.1	11.1	298	0.173	171	0.099	19200	0.221	36.5	0.193	<0.20	334	2.87
SP3 Ruby Creek	**REG/1**	2.49	9.46	59.7	11.3	21.5	<0.040	7530	0.0610	33.4	0.0380	<0.20	45.5	5.28
SP3 Ruby Creek	**RP1/2**	2.70	10.1	58.5	12.8	21.2	0.054	7830	0.0650	34.3	0.0430	<0.20	46.2	5.55
SP3 Ruby Creek	**RP2/3**	2.62	9.76	60.4	11.8	21.0	0.058	7550	0.0570	33.4	0.0360	<0.20	44.0	5.48
SP3 Snake Creek	**REG/1**	0.567	<0.50	137	0.198	19.2	0.340	5120	0.0260	81.4	0.0070	<0.20	12.8	0.252
SP3 Snake Creek	**RP1/2**	0.148	<0.50	11.5	0.357	4.30	0.255	4350	0.0090	75.1	0.0020	<0.20	4.75	0.165
SP3 Snake Creek	**RP2/3**	0.149	<0.50	11.3	0.370	3.77	0.393	4480	0.0120	77.1	0.0020	<0.20	4.91	0.165
SP3 Upper Otter Creek	**REG/1**	2.83	2.36	302	0.339	50.3	0.171	8080	0.313	79.5	0.0480	<0.20	47.2	2.82
SP3 Upper Otter Creek	**RP1/2**	2.68	2.18	294	0.241	47.1	0.166	8150	0.298	82.5	0.0430	<0.20	42.7	2.88
SP3 Upper Otter Creek	**RP2/3**	2.75	2.34	301	0.171	49.4	0.171	7970	0.330	80.8	0.0430	<0.20	50.2	2.77

		Total Hardness (CaCO3)	Total Aluminum (Al)	Total Antimony (Sb)	Total Arsenic (As)	Total Barium (Ba)	Total Beryllium (Be)	Total Bismuth (Bi)	Total Boron (B)	Total Cadmium (Cd)	Total Chromium (Cr)	Total Cobalt (Co)	Total Copper (Cu)	Total Iron (Fe)
LOCATION	**UNITS**	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
US Lower Otter Creek	**REG/1**	106	246	0.054	0.376	70.7	0.010	<0.0050	<50	0.0270	1.92	0.629	3.52	858
US Lower Otter Creek	**RP1/2**	107	256	0.055	0.391	71.0	<0.010	<0.0050	<50	0.0290	2.06	0.700	3.57	953
US Lower Otter Creek	**RP2/3**	107	240	0.057	0.329	73.3	0.010	<0.0050	<50	0.0320	1.88	0.623	3.32	880
US Birch Creek	**REG/1**	58.1	24.1	0.040	0.736	9.33	<0.010	<0.0050	<50	0.0070	0.43	0.0550	0.714	32.1
US Birch Creek	**RP1/2**	59.0	13.8	0.087	0.779	8.99	<0.010	0.0230	<50	0.0060	0.45	0.0380	0.908	16.4
US Birch Creek	**RP2/3**	57.2	26.5	0.041	0.786	9.39	<0.010	<0.0050	<50	<0.0050	0.42	0.0740	0.627	36.0
US Boulder Creek	**REG/1**	27.6	172	0.035	0.541	9.20	0.132	0.0080	<50	0.124	1.09	0.238	1.25	230
US Boulder Creek	**RP1/2**	27.6	119	0.039	0.541	8.89	0.098	0.0060	<50	0.103	0.89	0.138	0.981	143
US Boulder Creek	**RP2/3**	26.9	87.0	0.030	0.476	8.10	0.094	0.0050	<50	0.0940	0.70	0.0910	0.847	105
US Mid Otter Creek	**REG/1**	101	30.4	0.047	0.210	64.0	<0.010	<0.0050	<50	0.0100	1.01	0.113	0.871	156
US Mid Otter Creek	**RP1/2**	102	111	0.051	0.251	67.3	<0.010	<0.0050	<50	0.0130	1.45	0.261	1.26	320
US Mid Otter Creek	**RP2/3**	104	323	0.056	0.439	77.3	0.012	<0.0050	<50	0.0330	3.05	0.767	2.90	899
US Ruby Creek	**REG/1**	33.7	277	0.101	1.99	6.60	0.206	0.0080	<50	0.0900	1.37	0.354	1.60	366
US Ruby Creek	**RP1/2**	32.9	375	0.106	2.01	6.93	0.224	0.0180	<50	0.0930	1.84	0.540	1.76	497
US Ruby Creek	**RP2/3**	31.9	48.9	0.100	1.55	3.66	0.130	<0.0050	<50	0.0780	0.29	0.0340	0.852	56.6
US Snake Creek	**REG/1**	82.4	25.6	0.039	0.216	23.2	<0.010	<0.0050	<50	0.0050	2.77	0.0560	0.259	44.7
US Snake Creek	**RP1/2**	82.3	23.9	0.039	0.242	23.1	<0.010	<0.0050	<50	<0.0050	2.89	0.0750	0.242	42.9
US Snake Creek	**RP2/3**	79.9	13.6	0.038	0.239	23.4	<0.010	<0.0050	<50	<0.0050	2.65	0.0410	0.272	21.7
US Spruce Creek	**REG/1**	122	88.3	0.039	0.228	28.4	<0.010	<0.0050	<50	0.0070	1.13	0.122	0.607	165
US Spruce Creek	**RP1/2**	123	13.0	0.035	0.202	27.8	<0.010	<0.0050	<50	<0.0050	0.80	0.0390	0.468	63.4
US Spruce Creek	**RP2/3**	120	8.22	0.035	0.192	26.6	<0.010	<0.0050	<50	<0.0050	0.77	0.0380	0.425	52.6
US Upper Otter Creek	**REG/1**	64.1	9.74	0.032	0.136	55.3	<0.010	<0.0050	<50	0.0090	0.73	0.0270	0.517	38.5
US Upper Otter Creek	**RP1/2**	65.5	11.0	0.033	0.131	56.7	<0.010	<0.0050	<50	0.0110	0.74	0.0320	0.568	44.8
US Upper Otter Creek	**RP2/3**	69.1	22.7	0.031	0.167	58.0	<0.010	<0.0050	<50	0.0100	0.95	0.0720	0.540	101

		Total Lead (Pb)	Total Lithium (Li)	Total Manganese (Mn)	Total Molybdenum (Mo)	Total Nickel (Ni)	Total Selenium (Se)	Total Silicon (Si)	Total Silver (Ag)	Total Strontium (Sr)	Total Thallium (Tl)	Total Tin (Sn)	Total Titanium (Ti)	Total Uranium (U)
LOCATION	**UNITS**	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
DS Lower Otter Creek	**REG/1**	0.334	0.81	34.0	1.11	10.8	0.609	4810	0.0130	105	0.0060	<0.20	13.0	1.18
DS Lower Otter Creek	**RP1/2**	0.425	0.89	40.0	0.997	13.5	0.426	4980	0.0130	106	0.0080	<0.20	18.1	1.17
DS Lower Otter Creek	**RP2/3**	0.340	0.82	36.0	1.05	11.3	0.666	4940	0.0120	105	0.0060	<0.20	14.2	1.14
DS Spruce Creek	**REG/1**	0.0350	<0.50	7.26	0.563	3.11	0.100	4240	<0.0050	72.3	<0.0020	<0.20	2.74	0.324
DS Spruce Creek	**RP1/2**	0.0230	<0.50	4.70	0.592	2.51	0.082	4210	<0.0050	73.2	<0.0020	<0.20	1.72	0.329
DS Spruce Creek	**RP2/3**	0.0340	<0.50	6.47	0.686	3.03	0.098	4160	<0.0050	72.5	<0.0020	<0.20	2.64	0.327
DS Birch Creek	**REG/1**	0.0180	<0.50	0.771	0.594	2.86	0.133	4840	<0.0050	36.4	<0.0020	<0.20	0.61	0.138
DS Birch Creek	**RP1/2**	0.0190	<0.50	0.800	0.641	2.79	0.088	5210	<0.0050	36.4	<0.0020	<0.20	0.60	0.139
DS Birch Creek	**RP2/3**	0.0320	<0.50	1.56	0.660	3.45	0.137	5250	<0.0050	37.4	<0.0020	<0.20	1.68	0.139
DS Boulder Creek	**REG/1**	0.0170	2.02	0.736	0.438	1.16	<0.040	4970	<0.0050	20.8	0.0020	<0.20	<0.50	0.394
DS Boulder Creek	**RP1/2**	0.0200	2.05	0.806	0.449 (1)	1.16	0.055	4970	<0.0050	20.7	0.0020	<0.20	<0.50	0.409
DS Boulder Creek	**RP2/3**	0.0500	2.07	1.03	0.471	1.73	<0.040	5040	<0.0050	20.7	0.0020	0.27	<0.50	0.398
DS Mid Otter Creek	**REG/1**	0.0510	0.54	44.4	0.991	3.03	0.169	5180	<0.0050	76.3	<0.0020	<0.20	1.69	0.457
DS Mid Otter Creek	**RP1/2**	0.0230	0.60	41.6	1.07	2.73	0.220	5070	<0.0050	77.4	<0.0020	<0.20	0.98	0.471
DS Mid Otter Creek	**RP2/3**	0.104	0.62	49.1	0.948	4.30	0.186	5130	<0.0050	73.5	0.0030	<0.20	6.15	0.440
DS Ruby Creek	**REG/1**	0.907	5.94	25.5	13.3	12.8	0.070	6260	0.0230	29.1	0.0200	<0.20	24.3	1.72
DS Ruby Creek	**RP1/2**	0.968	6.05	27.6	14.0	13.4	<0.040	6460	0.0270	31.0	0.0200	<0.20	24.5	1.81
DS Ruby Creek	**RP2/3**	1.20	6.22	35.9	13.4	17.3	0.072	6780	0.0310	30.4	0.0280	<0.20	26.8	1.95
DS Snake Creek	**REG/1**	4.29	1.48	1760	0.310	330	0.215	8780	0.122	69.8	0.178	<0.20	41.9	1.16
DS Snake Creek	**RP1/2**	0.301	<0.50	30.9	0.449	8.81	0.237	4630	0.0100	55.9	0.0020	0.25	10.7	0.169
DS Snake Creek	**RP2/3**	0.0680	<0.50	2.71	0.501	1.20	0.274	4300	<0.0050	52.1	<0.0020	0.21	1.58	0.123
DS Upper Otter Creek	**REG/1**	0.975	1.09	119	0.414	20.9	0.168	6100	0.112	65.2	0.0190	<0.20	26.8	1.13
DS Upper Otter Creek	**RP1/2**	1.00	1.11	119	0.470	21.0	0.105	6140	0.112	67.7	0.0200	<0.20	28.5	1.21
DS Upper Otter Creek	**RP2/3**	1.07	1.22	123	0.434	21.7	0.151	6300	0.118	68.6	0.0220	<0.20	32.3	1.24
Outfall Ruby Creek	**REG/1**	2.58	9.61	59.9	12.1	21.2	0.064	7780	0.0590	32.7	0.0370	<0.20	47.9	5.27
Outfall Ruby Creek	**RP1/2**	2.59	9.27	61.4	11.8	21.7	0.052	7700	0.0570	31.8	0.0400	<0.20	47.2	5.12
Outfall Ruby Creek	**RP2/3**	3.21	10.1	80.8	12.0	26.3	0.071	7520	0.0740	33.7	0.0550	<0.20	61.5	5.70
Outfall Upper Otter Creek	**REG/1**	2.91	2.41	318	0.512	54.7	0.139	8860	0.308	82.2	0.0470	<0.20	54.5	2.96
Outfall Upper Otter Creek	**RP1/2**	3.11	2.66	321	0.363	69.1	0.230	8880	0.329	91.2	0.0500	<0.20	58.8	3.11
Outfall Upper Otter Creek	**RP2/3**	2.84	2.39	313	0.310	55.0	0.161	8940	0.313	83.1	0.0490	<0.20	59.9	2.92

		Total Lead (Pb)	Total Lithium (Li)	Total Manganese (Mn)	Total Molybdenum (Mo)	Total Nickel (Ni)	Total Selenium (Se)	Total Silicon (Si)	Total Silver (Ag)	Total Strontium (Sr)	Total Thallium (Tl)	Total Tin (Sn)	Total Titanium (Ti)	Total Uranium (U)
LOCATION	**UNITS**	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
SP1 Lower Otter Creek	**REG/1**	12.2	38.2	85800	0.50	8930	1.84	54600	0.258	3930	0.503	<2.0	<5.0	3.20
SP1 Lower Otter Creek	**RP1/2**	139	84.1	35100	<0.50	7770	0.81	85600	1.87	1760	0.831	<2.0	48.1	30.6
SP1 Lower Otter Creek	**RP2/3**	19.7	34.5	70000	<0.50	7610	0.99	48700	0.391	3260	0.507	<2.0	6.5	4.66
SP1 Snake Creek	**REG/1**	0.114	<0.50	11.5	0.368	4.53	0.358	5090	<0.0050	81.9	0.0020	0.22	5.16	0.174
SP1 Snake Creek	**RP1/2**	2.59	1.77	285	0.147	68.6	0.388	8800	0.0310	84.4	0.0270	<0.20	28.8	0.410
SP1 Snake Creek	**RP2/3**	1.02	1.05	158	0.067	44.2	0.313	6940	0.0550	78.0	0.0150	0.22	26.6	0.304
SP1 Spruce Creek	**REG/1**	0.116	<0.50	26.5	0.826	6.35	0.092	5280	<0.0050	76.9	0.0040	<0.20	9.33	0.458
SP1 Spruce Creek	**RP1/2**	0.0090	<0.50	6.11	1.16	1.47	0.074	4600	<0.0050	75.8	<0.0020	<0.20	<0.50	0.455
SP1 Spruce Creek	**RP2/3**	0.243	0.70	46.4	0.646	13.6	0.091	5560	0.0060	77.6	0.0060	0.21	24.5	0.466
SP1 Upper Otter Creek	**REG/1**	123	109	16000	0.60	2150	0.58	84700	3.86	729	0.589	<2.0	157	21.7
SP1 Upper Otter Creek	**RP1/2**	112	98.4	14700	<0.50	1900	<0.40	79600	3.26	637	0.576	<2.0	211	19.8
SP1 Upper Otter Creek	**RP2/3**	104	94.2	13600	<0.50	1770	0.75	77600	3.26	596	0.576	<2.0	221	19.1
SP2 Lower Otter Creek	**REG/1**	0.592	0.87	66.7	0.573	19.3	0.377	5420	0.0170	106	0.0100	<0.20	19.6	1.13
SP2 Lower Otter Creek	**RP1/2**	1.19	1.29	122	0.361	39.1	0.541	6400	0.0360	110	0.0200	<0.20	38.4	1.20
SP2 Lower Otter Creek	**RP2/3**	0.585	0.95	66.2	0.544	18.5	0.582	5610	0.0200	106	0.0090	<0.20	18.0	1.10
SP2 Mid Otter Creek	**REG/1**	2.96	3.96	126	7.07	50.2	1.21	6920	0.134	248	0.0270	<0.20	24.2	2.09
SP2 Mid Otter Creek	**RP1/2**	2.55	3.67	80.5	6.73	42.8	1.31	6460	0.108	249	0.0210	<0.20	22.5	2.02
SP2 Mid Otter Creek	**RP2/3**	8.13	5.53	237	3.37	127	1.17	9990	0.305	264	0.0580	<0.20	38.1	2.25
SP2 Ruby Creek	**REG/1**	2.41	9.81	57.8	10.6	18.5	0.040	7110	0.0560	34.2	0.0330	<0.20	34.9	5.21
SP2 Ruby Creek	**RP1/2**	2.54	9.59	60.8	11.1	19.9	<0.040	7580	0.0570	34.2	0.0350	<0.20	35.5	5.41
SP2 Ruby Creek	**RP2/3**	2.47	9.52	59.0	10.7	18.4	0.060	7430	0.0560	33.3	0.0330	<0.20	35.1	5.26
SP2 Snake Creek	**REG/1**	0.0670	<0.50	6.71	0.381	2.61	0.269	4250	<0.0050	73.3	<0.0020	0.24	3.87	0.144
SP2 Snake Creek	**RP1/2**	1.35	0.68	188	0.145	51.6	0.375	7870	0.122	78.3	0.0220	<0.20	50.0	0.327
SP2 Snake Creek	**RP2/3**	0.715	<0.50	13.3	0.357	4.25	0.346	4360	0.0070	72.9	0.0030	<0.20	4.82	0.149
SP2 Upper Otter Creek	**REG/1**	98.1	66.4	10400	3.72	1650	0.95	72000	3.60	472	0.592	<2.0	178	16.8
SP2 Upper Otter Creek	**RP1/2**	98.3	66.3	9840	1.19	1590	<0.40	70800	3.49	456	0.706	<2.0	193	15.9
SP2 Upper Otter Creek	**RP2/3**	101	64.3	10500	0.73	1680	<0.40	70200	3.57	470	0.649	<2.0	172	16.8

		Total Lead (Pb)	Total Lithium (Li)	Total Manganese (Mn)	Total Molybdenum (Mo)	Total Nickel (Ni)	Total Selenium (Se)	Total Silicon (Si)	Total Silver (Ag)	Total Strontium (Sr)	Total Thallium (Tl)	Total Tin (Sn)	Total Titanium (Ti)	Total Uranium (U)
LOCATION	**UNITS**	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
US Lower Otter Creek	**REG/1**	0.283	0.61	98.5	0.574	6.79	0.181	5070	0.0160	82.1	0.0040	<0.20	7.56	0.610
US Lower Otter Creek	**RP1/2**	0.466	0.55	118	0.560	7.30	0.221	5180	0.0150	82.4	0.0040	<0.20	9.21	0.599
US Lower Otter Creek	**RP2/3**	0.294	0.60	118	0.574	6.77	0.161	5170	0.0130	83.5	0.0040	<0.20	7.66	0.606
US Birch Creek	**REG/1**	0.0270	<0.50	0.932	0.541	3.01	0.155	4870	<0.0050	32.3	<0.0020	<0.20	0.87	0.128
US Birch Creek	**RP1/2**	0.0220	<0.50	0.446	0.521	2.77	0.079	4910	<0.0050	31.8	<0.0020	<0.20	<0.50	0.125
US Birch Creek	**RP2/3**	0.0270	<0.50	1.00	0.553	3.02	0.081	4850	<0.0050	32.4	0.0020	<0.20	0.76	0.128
US Boulder Creek	**REG/1**	0.378	2.32	5.17	0.394	3.58	<0.040	5200	0.0070	20.1	0.0060	<0.20	7.48	0.446
US Boulder Creek	**RP1/2**	0.146	2.28	3.17	0.435	2.67	<0.040	5110	0.0060	20.4	0.0040	<0.20	3.77	0.440
US Boulder Creek	**RP2/3**	0.130	2.22	2.19	0.427	2.38	<0.040	5080	<0.0050	19.2	0.0030	<0.20	2.97	0.416
US Mid Otter Creek	**REG/1**	0.0270	<0.50	49.8	0.925	2.72	0.123	4980	<0.0050	71.9	<0.0020	<0.20	0.83	0.444
US Mid Otter Creek	**RP1/2**	0.0800	<0.50	59.8	0.970	3.86	0.194	5150	<0.0050	74.6	0.0020	<0.20	4.10	0.476
US Mid Otter Creek	**RP2/3**	0.242	0.68	102	0.847	8.21	0.188	5500	0.0120	77.6	0.0040	<0.20	13.0	0.518
US Ruby Creek	**REG/1**	0.267	4.71	11.2	13.9	7.43	<0.040	5590	0.0050	27.6	0.0100	<0.20	11.6	0.649
US Ruby Creek	**RP1/2**	0.333	4.60	16.4	14.9	8.93	<0.040	5400	0.0090	27.3	0.0110	<0.20	16.2	0.682
US Ruby Creek	**RP2/3**	0.0230	4.11	2.44	13.8	3.18	<0.040	4800	<0.0050	25.5	0.0040	<0.20	0.78	0.507
US Snake Creek	**REG/1**	0.0350	<0.50	2.71	0.509	0.921	0.136	3570	<0.0050	50.5	<0.0020	<0.20	1.20	0.127
US Snake Creek	**RP1/2**	0.0270	<0.50	2.36	0.500	1.04	0.182	3600	<0.0050	51.0	<0.0020	<0.20	0.56	0.126
US Snake Creek	**RP2/3**	0.0460	<0.50	1.11	0.537	0.737	0.153	3580	<0.0050	51.2	<0.0020	<0.20	0.61	0.137
US Spruce Creek	**REG/1**	0.0370	<0.50	14.2	0.595	3.27	0.093	4130	<0.0050	77.8	<0.0020	<0.20	2.10	0.378
US Spruce Creek	**RP1/2**	0.0200	<0.50	7.39	0.610	2.40	0.051	4110	<0.0050	77.3	<0.0020	<0.20	<0.50	0.364
US Spruce Creek	**RP2/3**	0.0150	<0.50	5.84	0.604	2.38	0.101	4010	<0.0050	75.6	<0.0020	<0.20	<0.50	0.351
US Upper Otter Creek	**REG/1**	0.0180	<0.50	6.92	0.671	0.982	0.075	3630	0.0050	48.8	<0.0020	<0.20	<0.50	0.0910
US Upper Otter Creek	**RP1/2**	0.0170	<0.50	10.5	0.653	1.01	0.123	3660	<0.0050	50.0	<0.0020	<0.20	<0.50	0.0890
US Upper Otter Creek	**RP2/3**	0.0200	<0.50	25.0	0.740	1.17	0.134	4010	<0.0050	50.2	<0.0020	<0.20	0.56	0.0930

		Total Vanadium (V)	Total Zinc (Zn)	Total Zirconium (Zr)	Total Calcium (Ca)	Total Magnesium (Mg)	Total Potassium (K)	Total Sodium (Na)	Total Sulphur (S)
LOCATION	**UNITS**	ug/L	ug/L	ug/L	mg/L	mg/L	mg/L	mg/L	mg/L
DS Lower Otter Creek	**REG/1**	1.38	2.66	0.13	31.8	12.3	0.978	2.49	<10
DS Lower Otter Creek	**RP1/2**	1.70	2.77	0.15	31.5	12.6	0.989	2.56	<10
DS Lower Otter Creek	**RP2/3**	1.49	2.68	0.13	32.1	12.3	0.968	2.50	<10
DS Spruce Creek	**REG/1**	0.61	1.02	<0.10	33.3	10.1	0.386	1.14	<10
DS Spruce Creek	**RP1/2**	0.50	0.85	<0.10	33.9	10.1	0.387	1.13	<10
DS Spruce Creek	**RP2/3**	0.64	1.03	<0.10	33.0	10.3	0.388	1.14	<10
DS Birch Creek	**REG/1**	0.75	0.40	<0.10	13.1	7.98	0.379	1.52	<10
DS Birch Creek	**RP1/2**	0.65	1.01	<0.10	14.2	7.75	0.360	1.48	<10
DS Birch Creek	**RP2/3**	0.71	1.70	<0.10	14.2	7.93	0.373	1.51	<10
DS Boulder Creek	**REG/1**	0.49	1.43	<0.10	7.64	2.67	0.505	1.58	<10
DS Boulder Creek	**RP1/2**	0.51	1.45	<0.10	7.72	2.63	0.493	1.54	<10
DS Boulder Creek	**RP2/3**	0.48	1.40	<0.10	7.68	2.71	0.493	1.56	<10
DS Mid Otter Creek	**REG/1**	<0.20	0.96	<0.10	27.5	8.81	0.451	1.74	<10
DS Mid Otter Creek	**RP1/2**	<0.20	0.57	<0.10	27.3	8.62	0.430	1.69	<10
DS Mid Otter Creek	**RP2/3**	0.25	1.64	<0.10	26.5	8.70	0.440	1.66	<10
DS Ruby Creek	**REG/1**	2.92	9.02	0.38	7.73	4.06	0.928	2.18	<10
DS Ruby Creek	**RP1/2**	3.13	9.42	0.42	7.93	4.19	0.932	2.23	<10
DS Ruby Creek	**RP2/3**	3.56	9.32	0.45	7.62	4.58	0.953	2.28	<10
DS Snake Creek	**REG/1**	9.39	64.1	<0.10	20.0	12.3	0.418	1.07	4.1
DS Snake Creek	**RP1/2**	1.44	2.85	<0.10	16.6	11.5	0.294	1.09	5.1
DS Snake Creek	**RP2/3**	0.33	1.02	<0.10	16.8	10.1	0.214	0.981	4.9
DS Upper Otter Creek	**REG/1**	4.17	8.90	0.30	20.2	8.42	0.676	1.50	<10
DS Upper Otter Creek	**RP1/2**	4.25	8.47	0.32	20.3	8.32	0.671	1.50	<10
DS Upper Otter Creek	**RP2/3**	4.20	9.00	0.33	20.4	8.17	0.657	1.46	<10
Outfall Ruby Creek	**REG/1**	6.20	9.94	0.79	8.87	5.16	1.31	2.94	<10
Outfall Ruby Creek	**RP1/2**	6.17	10.0	0.81	8.54	5.07	1.27	2.84	<10
Outfall Ruby Creek	**RP2/3**	7.16	11.2	1.00	8.19	5.32	1.35	2.92	<10
Outfall Upper Otter Creek	**REG/1**	11.8	25.3	0.37	18.4	13.2	1.23	1.78	<10
Outfall Upper Otter Creek	**RP1/2**	11.6	22.9	0.41	17.8	12.9	1.19	1.71	<10
Outfall Upper Otter Creek	**RP2/3**	11.2	22.2	0.37	18.1	12.9	1.22	1.76	<10

		Total Vanadium (V)	Total Zinc (Zn)	Total Zirconium (Zr)	Total Calcium (Ca)	Total Magnesium (Mg)	Total Potassium (K)	Total Sodium (Na)	Total Sulphur (S)
LOCATION	**UNITS**	ug/L	ug/L	ug/L	mg/L	mg/L	mg/L	mg/L	mg/L
SP1 Lower Otter Creek	**REG/1**	18.7	581	<1.0	1460	346	23.8	7.25	<100
SP1 Lower Otter Creek	**RP1/2**	604	1160	1.4	545	234	19.7	4.89	<100
SP1 Lower Otter Creek	**RP2/3**	42.6	526	<1.0	1110	276	21.2	6.24	<100
SP1 Snake Creek	**REG/1**	0.70	1.60	<0.10	19.3	10.1	0.297	1.33	7.3
SP1 Snake Creek	**RP1/2**	9.19	18.4	0.14	21.0	12.4	0.701	1.24	6.2
SP1 Snake Creek	**RP2/3**	5.20	10.2	0.13	19.3	10.4	0.409	1.19	5.8
SP1 Spruce Creek	**REG/1**	1.87	7.55	<0.10	35.0	12.0	0.559	1.23	<10
SP1 Spruce Creek	**RP1/2**	0.74	0.55	<0.10	33.1	11.3	0.503	1.23	<10
SP1 Spruce Creek	**RP2/3**	3.37	5.90	0.12	32.8	12.1	0.564	1.24	<10
SP1 Upper Otter Creek	**REG/1**	419	1150	<1.0	134	150	9.22	3.20	<100
SP1 Upper Otter Creek	**RP1/2**	377	1020	<1.0	114	134	8.85	3.02	<100
SP1 Upper Otter Creek	**RP2/3**	352	976	<1.0	106	126	8.53	2.84	<100
SP2 Lower Otter Creek	**REG/1**	2.11	4.05	0.15	32.0	12.6	0.945	2.44	<10
SP2 Lower Otter Creek	**RP1/2**	4.35	8.74	0.17	33.3	13.4	1.00	2.47	<10
SP2 Lower Otter Creek	**RP2/3**	2.04	4.68	0.16	33.5	12.4	0.929	2.41	<10
SP2 Mid Otter Creek	**REG/1**	6.24	21.0	0.68	23.7	14.5	1.30	5.01	<10
SP2 Mid Otter Creek	**RP1/2**	5.03	19.2	0.74	22.9	14.0	1.26	4.99	<10
SP2 Mid Otter Creek	**RP2/3**	14.5	70.3	1.00	26.6	17.4	1.57	5.06	<10
SP2 Ruby Creek	**REG/1**	5.31	7.79	0.42	8.49	4.96	1.30	2.76	<10
SP2 Ruby Creek	**RP1/2**	5.50	10.1	0.45	9.24	5.09	1.31	2.92	<10
SP2 Ruby Creek	**RP2/3**	5.54	7.90	0.39	8.87	5.09	1.32	2.84	<10
SP2 Snake Creek	**REG/1**	0.44	2.10	<0.10	18.1	8.76	0.248	1.19	<10
SP2 Snake Creek	**RP1/2**	6.82	11.7	<0.10	19.2	10.7	0.832	1.18	6.0
SP2 Snake Creek	**RP2/3**	0.61	2.23	<0.10	18.3	8.80	0.405	1.21	<10
SP2 Upper Otter Creek	**REG/1**	319	827	<1.0	84.4	111	8.18	2.77	<100
SP2 Upper Otter Creek	**RP1/2**	310	790	<1.0	76.9	105	8.06	2.61	<100
SP2 Upper Otter Creek	**RP2/3**	321	817	3.8	81.6	111	8.19	2.74	<100

		Total Vanadium (V)	Total Zinc (Zn)	Total Zirconium (Zr)	Total Calcium (Ca)	Total Magnesium (Mg)	Total Potassium (K)	Total Sodium (Na)	Total Sulphur (S)
LOCATION	**UNITS**	ug/L	ug/L	ug/L	mg/L	mg/L	mg/L	mg/L	mg/L
SP3 Boulder Creek	**REG/1**	14.7	25.8	0.55	12.7	8.73	1.70	1.76	<10
SP3 Boulder Creek	**RP1/2**	26.6	50.3	0.63	14.1	13.5	2.65	1.79	<10
SP3 Boulder Creek	**RP2/3**	30.7	54.6	0.35	14.3	14.9	2.98	1.81	<10
SP3 Ruby Creek	**REG/1**	5.94	8.67	0.70	8.50	5.15	1.34	2.85	<10
SP3 Ruby Creek	**RP1/2**	5.86	8.54	1.11	8.76	5.15	1.31	2.83	<10
SP3 Ruby Creek	**RP2/3**	5.94	8.68	0.78	8.59	5.16	1.33	2.85	<10
SP3 Snake Creek	**REG/1**	1.78	6.29	<0.10	19.9	9.28	0.402	1.15	6.2
SP3 Snake Creek	**RP1/2**	0.42	2.45	<0.10	17.8	8.68	0.305	1.15	<10
SP3 Snake Creek	**RP2/3**	0.47	2.54	<0.10	18.5	8.71	0.376	1.21	<10
SP3 Upper Otter Creek	**REG/1**	11.2	21.3	0.27	16.5	12.3	1.21	1.74	<10
SP3 Upper Otter Creek	**RP1/2**	10.8	21.7	0.33	17.2	12.3	1.23	1.79	<10
SP3 Upper Otter Creek	**RP2/3**	11.1	19.6	0.28	16.1	12.6	1.21	1.79	<10

		Total Vanadium (V)	Total Zinc (Zn)	Total Zirconium (Zr)	Total Calcium (Ca)	Total Magnesium (Mg)	Total Potassium (K)	Total Sodium (Na)	Total Sulphur (S)
LOCATION	**UNITS**	ug/L	ug/L	ug/L	mg/L	mg/L	mg/L	mg/L	mg/L
US Lower Otter Creek	**REG/1**	0.73	2.38	0.14	26.5	9.62	0.533	1.73	<10
US Lower Otter Creek	**RP1/2**	0.75	2.50	0.13	26.9	9.61	0.530	1.71	<10
US Lower Otter Creek	**RP2/3**	0.65	2.26	0.11	27.2	9.58	0.540	1.70	<10
US Birch Creek	**REG/1**	0.36	0.42	<0.10	12.3	6.65	0.356	1.47	<10
US Birch Creek	**RP1/2**	0.35	1.51	<0.10	12.6	6.70	0.359	1.49	<10
US Birch Creek	**RP2/3**	0.39	0.42	<0.10	12.2	6.49	0.352	1.43	<10
US Boulder Creek	**REG/1**	0.74	5.87	<0.10	6.96	2.48	0.510	1.67	<10
US Boulder Creek	**RP1/2**	0.54	2.88	<0.10	6.83	2.55	0.495	1.68	<10
US Boulder Creek	**RP2/3**	0.49	2.57	<0.10	6.70	2.47	0.474	1.73	<10
US Mid Otter Creek	**REG/1**	<0.20	0.81	<0.10	26.7	8.24	0.452	1.66	<10
US Mid Otter Creek	**RP1/2**	0.59	1.11	<0.10	27.0	8.48	0.454	1.69	<10
US Mid Otter Creek	**RP2/3**	1.20	3.45	<0.10	27.1	8.84	0.494	1.70	<10
US Ruby Creek	**REG/1**	1.71	8.18	0.22	7.29	3.77	0.833	2.14	<10
US Ruby Creek	**RP1/2**	1.93	7.95	0.31	6.83	3.85	0.821	2.17	<10
US Ruby Creek	**RP2/3**	1.09	6.16	<0.10	6.78	3.37	0.786	2.08	<10
US Snake Creek	**REG/1**	0.22	0.84	<0.10	16.2	10.2	0.186	0.959	<10
US Snake Creek	**RP1/2**	0.26	0.46	<0.10	16.2	10.2	0.185	0.981	<10
US Snake Creek	**RP2/3**	<0.20	0.46	<0.10	15.6	9.97	0.196	0.943	<10
US Spruce Creek	**REG/1**	<0.20	1.50	<0.10	33.5	9.31	0.415	1.08	<10
US Spruce Creek	**RP1/2**	<0.20	1.45	<0.10	33.5	9.45	0.412	1.10	<10
US Spruce Creek	**RP2/3**	<0.20	0.52	<0.10	32.6	9.35	0.412	1.09	<10

US Upper Otter Creek	**REG/1**	<0.20	0.41	<0.10	18.5	4.37	0.255	1.33	<10
US Upper Otter Creek	**RP1/2**	<0.20	0.61	<0.10	18.6	4.61	0.260	1.39	<10
US Upper Otter Creek	**RP2/3**	<0.20	0.62	<0.10	20.3	4.46	0.255	1.35	<10

TABLE 31 *Dissolved metals raw data from water samples collected in September and October, 2012 and analysed at the Maxxam Analytics Laboratory.*

		Dissolved Hardness (CaCO3)	**Dissolved Aluminum (Al)**	**Dissolved Antimony (Sb)**	**Dissolved Arsenic (As)**	**Dissolved Barium (Ba)**	**Dissolved Beryllium (Be)**	**Dissolved Bismuth (Bi)**	**Dissolved Boron (B)**	**Dissolved Cadmium (Cd)**	**Dissolved Chromium (Cr)**	**Dissolved Cobalt (Co)**	**Dissolved Copper (Cu)**	**Dissolved Iron (Fe)**
LOCATION	**UNITS**	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
DS Birch Creek	**REG/1**	67.4	4.54	0.039	0.769	11.8	<0.010	<0.0050	<50	<0.0050	0.64	0.0200	0.549	3.6
DS Birch Creek	**RP1/2**	68.5	6.21	0.039	0.765	12.0	<0.010	<0.0050	<50	<0.0050	0.67	0.0270	0.597	7.3
DS Birch Creek	**RP2/3**	68.1	4.89	0.040	0.803	12.3	<0.010	<0.0050	<50	0.0050	0.66	0.0260	0.656	4.7
DS Boulder Creek	**REG/1**	30.1	12.7	0.048	0.536	8.27	0.058	<0.0050	<50	0.0490	0.29	0.0130	0.571	14.0
DS Boulder Creek	**RP1/2**	30.1	13.8	0.036	0.511	8.10	0.062	<0.0050	<50	0.0470	0.25	0.0120	0.568	6.3
DS Boulder Creek	**RP2/3**	30.3	18.7	0.039	0.560	8.29	0.068	<0.0050	<50	0.0520	0.45	0.0310	0.754	29.4
DS Lower Otter Creek	**REG/1**	129	2.76	0.135	0.707	60.5	<0.010	<0.0050	<50	<0.0050	0.31	0.0420	0.734	5.4
DS Lower Otter Creek	**RP1/2**	126	3.08	0.140	0.724	60.3	<0.010	<0.0050	<50	<0.0050	0.31	0.0350	0.712	6.7
DS Lower Otter Creek	**RP2/3**	131	3.08	0.132	0.797	59.2	<0.010	<0.0050	<50	<0.0050	0.36	0.0360	1.10	6.9
DS Mid Otter Creek	**REG/1**	103	2.12	0.049	0.172	60.9	<0.010	<0.0050	<50	0.0060	0.55	0.0560	0.929	44.8
DS Mid Otter Creek	**RP1/2**	103	2.73	0.051	0.180	64.0	<0.010	<0.0050	<50	<0.0050	0.57	0.0500	0.617	47.3
DS Mid Otter Creek	**RP2/3**	105	2.37	0.049	0.178	61.0	<0.010	<0.0050	<50	0.0080	0.58	0.0570	0.694	47.7
DS Ruby Creek	**REG/1**	32.9	53.1	0.101	1.75	3.21	0.123	<0.0050	<50	0.0470	0.33	0.0710	0.902	61.9
DS Ruby Creek	**RP1/2**	32.9	37.9	0.127	1.71	2.97	0.114	<0.0050	<50	0.0480	0.33	0.0400	0.899	28.1
DS Ruby Creek	**RP2/3**	32.7	38.1	0.104	1.73	3.04	0.107	<0.0050	<50	0.0510	0.39	0.0360	0.927	28.2
DS Snake Creek	**REG/1**	80.2	2.23	0.043	0.191	23.6	<0.010	<0.0050	<50	<0.0050	2.37	0.0140	0.434	2.9
DS Snake Creek	**RP1/2**	81.1	2.93	0.042	0.204	23.8	<0.010	<0.0050	<50	<0.0050	2.24	0.0150	0.253	2.4
DS Snake Creek	**RP2/3**	80.1	3.41	0.054	0.157	25.2	<0.010	<0.0050	<50	0.0060	2.34	0.0170	0.198	3.8
DS Spruce Creek	**REG/1**	122	4.67	0.039	0.205	22.7	<0.010	<0.0050	<50	<0.0050	0.80	0.0290 (1)	0.513	17.7
DS Spruce Creek	**RP1/2**	123	3.18	0.041	0.223	23.0	<0.010	<0.0050	<50	<0.0050	0.72	0.0220	0.450	15.7
DS Spruce Creek	**RP2/3**	123	2.35	0.041	0.200	23.8	<0.010	<0.0050	<50	<0.0050	0.80	0.0220	0.424	14.0
DS Upper Otter Creek	**REG/1**	80.9	152	0.095	0.434	55.9	<0.010	<0.0050	<50	0.0260	3.33	0.444	2.65	305
DS Upper Otter Creek	**RP1/2**	77.5	9.13	0.097	0.402	53.2	<0.010	<0.0050	<50	0.0180	0.55	0.0610	1.76	17.6
DS Upper Otter Creek	**RP2/3**	75.6	6.13	0.092	0.423	50.9	<0.010	<0.0050	<50	0.0160	0.57	0.0550	2.12	15.8
OUTFALL Ruby Creek	**REG/1**	38.9	7.37	0.124	2.11	2.30	0.030	<0.0050	<50	0.0090	0.33	0.0370	0.741	7.6
OUTFALL Ruby Creek	**RP1/2**	36.6	22.6	0.123	1.98	2.46	0.067	<0.0050	<50	0.0300	0.39	0.0510	0.795	17.8
OUTFALL Ruby Creek	**RP2/3**	41.1	6.05	0.131	2.22	2.31	0.037	<0.0050	<50	0.0120	0.31	0.0450	0.741	5.0
OUTFALL Upper Otter Creek	**REG/1**	78.6	8.41	0.173 (1)	0.912	43.8	<0.010	<0.0050	<50	0.0210	0.39	0.0560	2.89	10.4
OUTFALL Upper Otter Creek	**RP1/2**	77.9	3.72	0.164 (1)	0.913	43.8	<0.010	<0.0050	<50	0.0200	0.30	0.0460	2.83	3.2
OUTFALL Upper Otter Creek	**RP2/3**	78.0	6.43	0.178 (1)	0.911	45.6	<0.010	<0.0050	<50	0.0240	0.32	0.0490	2.79	7.2

LOCATION	UNITS	Dissolved Hardness (CaCO3)	Dissolved Aluminum (Al)	Dissolved Antimony (Sb)	Dissolved Arsenic (As)	Dissolved Barium (Ba)	Dissolved Beryllium (Be)	Dissolved Bismuth (Bi)	Dissolved Boron (B)	Dissolved Cadmium (Cd)	Dissolved Chromium (Cr)	Dissolved Cobalt (Co)	Dissolved Copper (Cu)	Dissolved Iron (Fe)
		mg/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
SP1 Lower Otter Creek	**REG/1**	143	6.51	2.10 (1)	2.25	93.3	<0.010	<0.0050	<50	0.0200	<0.10	1.57	0.710	2.7
SP1 Lower Otter Creek	**RP1/2**	149	6.50	1.96 (1)	2.46	98.0	<0.010	<0.0050	<50	0.0160	0.10	1.22	0.785	2.5
SP1 Lower Otter Creek	**RP2/3**	138	8.17	1.50 (1)	3.04	99.7	<0.010	<0.0050	<50	0.0150	0.11	1.31	0.842	4.2
SP1 Snake Creek	**REG/1**	80.2	2.60	0.026	0.078	23.2	<0.010	<0.0050	<50	0.0060	1.39	0.0130	0.248	5.7
SP1 Snake Creek	**RP1/2**	78.2	1.97	0.023	0.093	23.2	<0.010	<0.0050	<50	<0.0050	1.21	0.0120	0.137	2.4
SP1 Snake Creek	**RP2/3**	79.4	1.58	0.020	0.076	22.1	<0.010	<0.0050	<50	<0.0050	1.28	0.0110	0.242	1.7
SP1 Spruce Creek	**REG/1**	127	4.95	0.053	0.271	16.8	<0.010	<0.0050	<50	<0.0050	0.73	0.0610	0.552	6.8
SP1 Spruce Creek	**RP1/2**	131	447 (1)	0.062	0.430 (1)	26.2 (1)	0.014	<0.0050	<50	0.0170	3.79 (1)	1.26 (1)	2.36 (1)	713 (1)
SP1 Spruce Creek	**RP2/3**	128	5.36	0.051	0.259	17.4	<0.010	<0.0050	<50	<0.0050	0.79	0.0460	0.527	4.8
SP1 Upper Otter Creek	**REG/1**	74.3	4.24	0.211	1.26	49.3	<0.010	<0.0050	<50	0.0300	0.35	0.0470	4.54	4.3
SP1 Upper Otter Creek	**RP1/2**	74.0	4.72	0.191	1.13	49.1	<0.010	<0.0050	<50	0.0310	0.40	0.0530	4.31	4.8
SP1 Upper Otter Creek	**RP2/3**	74.4	5.10	0.192	1.14	50.3	<0.010	<0.0050	<50	0.0390	0.38	0.0450	4.59	6.1
SP2 Lower Otter Creek	**REG/1**	129	4.13	0.113	0.535	62.6	<0.010	<0.0050	<50	0.0050	0.29	0.0720	0.753	12.3
SP2 Lower Otter Creek	**RP1/2**	127	6.14	0.117	0.515	62.6	<0.010	<0.0050	<50	<0.0050	0.36	0.0650	0.730	12.4
SP2 Lower Otter Creek	**RP2/3**	128	15.3	0.117	0.621	63.1	<0.010	<0.0050	<50	0.0080	0.37	0.108	0.957	31.5
SP2 Mid Otter Creek	**REG/1**	109	3.49	2.80 (1)	2.65	188	<0.010	<0.0050	<50	0.0280 (2)	<0.10	0.120	1.63	2.4
SP2 Mid Otter Creek	**RP1/2**	104	4.22	2.36 (1)	2.62	174	<0.010	<0.0050	<50	0.0210	0.12	0.0600	2.10	2.7
SP2 Mid Otter Creek	**RP2/3**	106	4.04	2.59 (1)	2.48	183	<0.010	<0.0050	<50	0.0240	0.12	0.0390	2.26	1.3
SP2 Ruby Creek	**REG/1**	40.4	9.52	0.125	2.36	3.02	0.037	<0.0050	<50	0.0120	0.35	0.0580	0.759	11.5
SP2 Ruby Creek	**RP1/2**	42.2	6.36	0.119	2.23	2.49	0.033	<0.0050	<50	0.0100	0.27	0.0520	0.601	6.1
SP2 Ruby Creek	**RP2/3**	40.0	6.73	0.113	2.23	2.37	0.030	<0.0050	<50	0.0110	0.36	0.0520	0.723	7.5
SP2 Snake Creek	**REG/1**	80.2	1.76	0.020	0.089	23.3	<0.010	<0.0050	<50	<0.0050	1.28	0.0120	0.201	3.4
SP2 Snake Creek	**RP1/2**	81.5	2.15	0.023	0.103	23.6	<0.010	<0.0050	<50	<0.0050	1.42	0.0160	0.240	3.1
SP2 Snake Creek	**RP2/3**	80.3	2.13	0.022	0.087	23.7	<0.010	<0.0050	<50	0.0080	1.31	0.0170	0.349	2.0
SP2 Upper Otter Creek	**REG/1**	72.4	4.99	0.209	1.13	50.2	<0.010	<0.0050	<50	0.0310	0.36	0.0460	4.36	5.8
SP2 Upper Otter Creek	**RP1/2**	72.8	4.67	0.219	1.22	50.7	<0.010	<0.0050	<50	0.0280	0.35	0.0560	4.30	4.7
SP2 Upper Otter Creek	**RP2/3**	72.1	5.75	0.214	1.21	50.1	<0.010	<0.0050	<50	0.0290	0.36	0.0500	4.54	6.2

LOCATION	UNITS	Dissolved Hardness (CaCO3)	Dissolved Aluminum (Al)	Dissolved Antimony (Sb)	Dissolved Arsenic (As)	Dissolved Barium (Ba)	Dissolved Beryllium (Be)	Dissolved Bismuth (Bi)	Dissolved Boron (B)	Dissolved Cadmium (Cd)	Dissolved Chromium (Cr)	Dissolved Cobalt (Co)	Dissolved Copper (Cu)	Dissolved Iron (Fe)
		mg/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
SP3 Boulder Creek	**REG/1**	47.8	9.67	0.111	0.886	13.7	<0.010	<0.0050	<50	0.0130	0.43	0.0590	0.869	30.7
SP3 Boulder Creek	**RP1/2**	49.1	16.9	0.104	0.861	13.8	<0.010	<0.0050	<50	0.0200	0.58	0.250	0.892	123
SP3 Boulder Creek	**RP2/3**	47.5	9.15	0.111	0.866	13.9	<0.010	<0.0050	<50	0.0160	0.42	0.0550	0.755	28.8
SP3 Ruby Creek	**REG/1**	40.6	46.8	0.128	2.38	2.65	0.041	0.0060	<50	0.0130	0.44	0.0760	0.837	38.5
SP3 Ruby Creek	**RP1/2**	40.6	6.57	0.132	2.21	2.35	0.036	<0.0050	<50	0.0100	0.31	0.0380	0.745	6.8
SP3 Ruby Creek	**RP2/3**	39.8	8.02	0.126	2.17	2.31	0.038	<0.0050	<50	0.0120	0.67	0.0560	2.96	42.2
SP3 Snake Creek	**REG/1**	80.7	2.10	0.024	0.083	23.4	<0.010	<0.0050	<50	0.0050	1.33	0.0260	0.331	4.0
SP3 Snake Creek	**RP1/2**	79.9	2.17	0.026	0.103	24.0	<0.010	<0.0050	<50	<0.0050	1.28	0.0180	0.182	3.3
SP3 Snake Creek	**RP2/3**	82.5	2.08	0.022	0.094	24.3	<0.010	<0.0050	<50	0.0050	1.36	0.0170	0.298	3.4
SP3 Upper Otter Creek	**REG/1**	75.4	6.24	0.179 (1)	0.938	41.2	<0.010	<0.0050	<50	0.0210	0.34	0.0620	2.76	7.9
SP3 Upper Otter Creek	**RP1/2**	78.2	4.27	0.175 (1)	0.970	41.3	<0.010	<0.0050	<50	0.0220	0.40	0.0600	3.06	7.0
SP3 Upper Otter Creek	**RP2/3**	77.3	5.27	0.185 (1)	0.888	42.7	<0.010	<0.0050	<50	0.0210	0.38	0.0530	3.41	5.5

LOCATION	UNITS	Dissolved Lead (Pb)	Dissolved Lithium (Li)	Dissolved Manganese (Mn)	Dissolved Molybdenum (Mo)	Dissolved Nickel (Ni)	Dissolved Selenium (Se)	Dissolved Silicon (Si)	Dissolved Silver (Ag)	Dissolved Strontium (Sr)	Dissolved Thallium (Tl)	Dissolved Tin (Sn)	Dissolved Titanium (Ti)	Dissolved Uranium (U)
		ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
SP3 Boulder Creek	**REG/1**	0.103	1.91	4.15	0.831 (1)	1.98	0.079	4880	<0.0050	25.1	0.0030	<0.20	0.72	1.02
SP3 Boulder Creek	**RP1/2**	0.119	1.91	5.13	0.856 (1)	6.33	0.069	5030	<0.0050	25.0	0.0020	<0.20	0.81	1.03
SP3 Boulder Creek	**RP2/3**	0.0850	1.97	3.74	0.855 (1)	1.98	0.052	4950	<0.0050	25.0	0.0030	<0.20	0.53	1.02
SP3 Ruby Creek	**REG/1**	0.0990	8.01	4.76	14.2 (1)	1.88	0.081	5610	<0.0050	31.4	0.0030	<0.20	1.00	3.64
SP3 Ruby Creek	**RP1/2**	0.0260	8.13	3.71	14.7	1.51	0.107	5660	<0.0050	31.4	0.0030	<0.20	<0.50	3.77
SP3 Ruby Creek	**RP2/3**	0.0530	8.11	3.69	14.4	11.7	0.065	5520	<0.0050	31.2	0.0020	0.25	<0.50	3.67
SP3 Snake Creek	**REG/1**	<0.0050	<0.50	2.51	0.435 (1)	0.517	0.345	4190	<0.0050	74.0	<0.0020	<0.20	<0.50	0.148
SP3 Snake Creek	**RP1/2**	0.0130	<0.50	1.22	0.419	0.464	0.237	4170	<0.0050	75.4	<0.0020	<0.20	<0.50	0.146
SP3 Snake Creek	**RP2/3**	0.0180	<0.50	1.39	0.431	0.533	0.293	4270	<0.0050	75.5	<0.0020	<0.20	<0.50	0.149
SP3 Upper Otter Creek	**REG/1**	0.0550	0.61	97.4	1.65 (1)	0.951	0.247 (1)	3960	0.0150	73.3	<0.0020	<0.20	<0.50	2.53
SP3 Upper Otter Creek	**RP1/2**	0.0140	<0.50	101	1.71 (1)	0.852	0.277 (1)	4070	0.0110	72.3	<0.0020	<0.20	<0.50	2.42
SP3 Upper Otter Creek	**RP2/3**	0.0210	<0.50	97.2	1.81 (1)	0.856	0.273 (1)	4100	0.0150	76.5	<0.0020	<0.20	<0.50	2.57

		Dissolved Hardness (CaCO3)	Dissolved Aluminum (Al)	Dissolved Antimony (Sb)	Dissolved Arsenic (As)	Dissolved Barium (Ba)	Dissolved Beryllium (Be)	Dissolved Bismuth (Bi)	Dissolved Boron (B)	Dissolved Cadmium (Cd)	Dissolved Chromium (Cr)	Dissolved Cobalt (Co)	Dissolved Copper (Cu)	Dissolved Iron (Fe)
LOCATION	**UNITS**	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
US Birch Creek	**REG/1**	58.4	5.01	0.040	0.822	9.03	<0.010	<0.0050	<50	<0.0050	0.34	0.0200	0.600	9.7
US Birch Creek	**RP1/2**	58.2	5.37	0.045	0.719	9.18	<0.010	<0.0050	<50	<0.0050	0.33	0.0210	0.569	12.5
US Birch Creek	**RP2/3**	58.3	4.73	0.042	0.791	8.91	<0.010	<0.0050	<50	0.0050	0.35	0.0200	0.566	6.1
US Boulder Creek	**REG/1**	26.1	15.9	0.037	0.394	7.04	0.077	<0.0050	<50	0.0910	0.27	0.0140	0.569	6.9
US Boulder Creek	**RP1/2**	26.3	13.9	0.032	0.369	7.12	0.081	<0.0050	<50	0.0870	0.25	0.0120	0.570	4.7
US Boulder Creek	**RP2/3**	26.4	14.5	0.033	0.366	7.22	0.072	<0.0050	<50	0.0860	0.30	0.0140	0.540	4.3
US Lower Otter Creek	**REG/1**	108	10.0	0.052	0.246	62.2	<0.010	<0.0050	<50	0.0070	0.19	0.105	0.677	52.3
US Lower Otter Creek	**RP1/2**	106	3.02	0.053	0.227	58.8	<0.010	<0.0050	<50	<0.0050	0.13	0.0950	1.04	36.2
US Lower Otter Creek	**RP2/3**	108	2.30	0.059	0.222	60.8	<0.010	<0.0050	<50	0.0050	0.16	0.0920	0.578	45.7
US Mid Otter Creek	**REG/1**	102	2.24	0.047	0.142	65.3	<0.010	<0.0050	<50	0.0060	0.73	0.0540	0.759	61.2
US Mid Otter Creek	**RP1/2**	101	2.33	0.049	0.160	65.2	<0.010	<0.0050	<50	0.0070	0.71	0.0540	0.618	56.9
US Mid Otter Creek	**RP2/3**	99.9	2.32	0.052	0.144	64.8	<0.010	<0.0050	<50	0.0070	0.70	0.0560	0.619	56.8
US Ruby Creek	**REG/1**	31.3	47.8	0.108	1.61	4.53	0.144	<0.0050	<50	0.0730	0.31	0.0260	0.765	37.0
US Ruby Creek	**RP1/2**	30.1	47.2	0.113	1.48	3.72	0.131	<0.0050	<50	0.0770	0.38	0.0340	1.16	38.3
US Ruby Creek	**RP2/3**	33.3	275	0.108	1.90	5.81	0.202	0.0130	<50	0.0960	1.31	0.387	1.46	348
US Snake Creek	**REG/1**	81.0	1.64	0.038	0.163	23.3	<0.010	<0.0050	<50	<0.0050	2.72	0.0160	0.197	1.3
US Snake Creek	**RP1/2**	79.9	2.11	0.039	0.181	22.3	<0.010	<0.0050	<50	<0.0050	2.79	0.0190	0.180	2.4
US Snake Creek	**RP2/3**	81.9	1.85	0.042	0.213	23.4	<0.010	<0.0050	<50	<0.0050	2.67	0.0170	0.141	4.5
US Spruce Creek	**REG/1**	123	2.49	0.039	0.202	26.0	<0.010	<0.0050	<50	<0.0050	0.75	0.0260	0.689	29.4
US Spruce Creek	**RP1/2**	121	2.43	0.042	0.151	26.5	<0.010	<0.0050	<50	<0.0050	0.80	0.0270	0.439	28.9
US Spruce Creek	**RP2/3**	120	2.87	0.040	0.171	26.0	<0.010	<0.0050	<50	<0.0050	0.76	0.0270	0.454	29.9
US Upper Otter Creek	**REG/1**	67.7	5.45	0.041	0.134	54.9	<0.010	<0.0050	<50	<0.0050	0.77	0.0270	0.503	27.5
US Upper Otter Creek	**RP1/2**	68.3	5.62	0.036	0.135	54.6	<0.010	<0.0050	<50	<0.0050	0.68	0.0180	0.585	27.3
US Upper Otter Creek	**RP2/3**	69.1	6.08	0.035	0.164	55.9	<0.010	<0.0050	<50	0.0070	0.73	0.0250	0.453	27.8

LOCATION	UNITS	Dissolved Lead (Pb)	Dissolved Lithium (Li)	Dissolved Manganese (Mn)	Dissolved Molybdenum (Mo)	Dissolved Nickel (Ni)	Dissolved Selenium (Se)	Dissolved Silicon (Si)	Dissolved Silver (Ag)	Dissolved Strontium (Sr)	Dissolved Thallium (Tl)	Dissolved Tin (Sn)	Dissolved Titanium (Ti)	Dissolved Uranium (U)
		ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
DS Birch Creek	**REG/1**	0.0080	<0.50	0.122	0.646	2.17	0.044	5430	<0.0050	36.6	<0.0020	<0.20	<0.50	0.136
DS Birch Creek	**RP1/2**	0.0080	<0.50	0.148	0.641	2.19	0.106	5620	<0.0050	37.1	<0.0020	<0.20	<0.50	0.139
DS Birch Creek	**RP2/3**	0.0270	<0.50	0.108	0.687	2.22	0.111	5430	<0.0050	37.1	<0.0020	<0.20	<0.50	0.141
DS Boulder Creek	**REG/1**	0.0170	2.02	0.736	0.438	1.16	<0.040	4970	<0.0050	20.8	0.0020	<0.20	<0.50	0.394
DS Boulder Creek	**RP1/2**	0.0200	2.05	0.806	0.449 (1)	1.16	0.055	4970	<0.0050	20.7	0.0020	<0.20	<0.50	0.409
DS Boulder Creek	**RP2/3**	0.0500	2.07	1.03	0.471	1.73	<0.040	5040	<0.0050	20.7	0.0020	0.27	<0.50	0.398
DS Lower Otter Creek	**REG/1**	0.0100	0.56	11.7	1.73 (1)	1.46	0.735	4290	<0.0050	104	<0.0020	<0.20	<0.50	1.13
DS Lower Otter Creek	**RP1/2**	0.0190	0.55	11.6	1.85 (1)	1.49	0.543 (1)	4200	<0.0050	105	<0.0020	<0.20	<0.50	1.13
DS Lower Otter Creek	**RP2/3**	0.0160	0.57	12.0	1.81 (1)	1.53	0.687	4500	<0.0050	104	<0.0020	<0.20	<0.50	1.11
DS Mid Otter Creek	**REG/1**	0.0200	<0.50	39.1	1.13	2.02	0.222 (1)	5130	<0.0050	73.7	<0.0020	<0.20	<0.50	0.434
DS Mid Otter Creek	**RP1/2**	0.0110	<0.50	39.2	1.10	2.13	0.184	5190	<0.0050	76.4	<0.0020	<0.20	<0.50	0.449
DS Mid Otter Creek	**RP2/3**	0.0120	<0.50	41.0	1.06	2.31	0.243 (1)	5140	<0.0050	73.1	<0.0020	<0.20	<0.50	0.425
DS Ruby Creek	**REG/1**	0.0270	5.23	3.98	13.6	2.95	<0.040	4880	<0.0050	27.4	0.0040	<0.20	0.95	1.18
DS Ruby Creek	**RP1/2**	0.0250	5.03	2.87	13.4	2.81	<0.040	4920	<0.0050	26.8	0.0030	<0.20	<0.50	1.18
DS Ruby Creek	**RP2/3**	0.0220	5.16	2.81	14.2	2.78	<0.040	4930	<0.0050	27.5	0.0040	<0.20	<0.50	1.24
DS Snake Creek	**REG/1**	0.0090	<0.50	0.171	0.454 (1)	0.626	0.201	3460	<0.0050	50.5	<0.0020	<0.20	<0.50	0.119
DS Snake Creek	**RP1/2**	0.0200	<0.50	0.183	0.488	0.601	0.233	3600	<0.0050	51.9	<0.0020	<0.20	<0.50	0.120
DS Snake Creek	**RP2/3**	0.0150	<0.50	0.406	0.610	0.612	0.195	3450	<0.0050	52.8	<0.0020	<0.20	<0.50	0.133
DS Spruce Creek	**REG/1**	0.0070	<0.50	2.05	0.660	1.80	0.124	4150	<0.0050	72.4	<0.0020	<0.20	<0.50	0.338
DS Spruce Creek	**RP1/2**	0.0090	<0.50	1.72	0.632	1.75	0.124	4190	<0.0050	73.3	<0.0020	<0.20	<0.50	0.349
DS Spruce Creek	**RP2/3**	0.0110	<0.50	1.77	0.685	1.71	0.071	4210	<0.0050	74.5	<0.0020	<0.20	<0.50	0.363
DS Upper Otter Creek	**REG/1**	0.220	<0.50	62.7	1.06 (1)	5.43	0.154	4230	0.0230	64.8	0.0030	<0.20	5.64	1.01
DS Upper Otter Creek	**RP1/2**	0.0150	<0.50	48.0	1.31	1.58	0.199	4070	0.0060	65.1	<0.0020	<0.20	<0.50	1.05
DS Upper Otter Creek	**RP2/3**	0.0110	<0.50	47.0	1.15 (1)	1.50	0.180	3880	0.0080	62.9	<0.0020	<0.20	<0.50	1.01
OUTFALL Ruby Creek	**REG/1**	0.0290	7.85	3.45	14.3	1.35	0.048	5440	<0.0050	31.2	0.0030	<0.20	<0.50	3.53
OUTFALL Ruby Creek	**RP1/2**	0.0350	7.07	3.23	14.9	2.05	0.061	5090	<0.0050	30.0	0.0030	<0.20	<0.50	2.68
OUTFALL Ruby Creek	**RP2/3**	0.0280	7.80	3.68	14.8	1.35	<0.040	5840	<0.0050	31.4	0.0030	<0.20	<0.50	3.56
OUTFALL Upper Otter Creek	**REG/1**	0.0260	<0.50	78.8	2.06 (1)	0.884	0.158	3870	0.0170	73.9	<0.0020	<0.20	<0.50	2.43
OUTFALL Upper Otter Creek	**RP1/2**	0.0090	0.52	74.4	1.80 (1)	0.777	0.204 (1)	4030	0.0140	73.2	0.0020	<0.20	<0.50	2.36
OUTFALL Upper Otter Creek	**RP2/3**	0.0160	0.51	75.6	1.70 (1)	0.829	0.267 (1)	3950	0.0160	76.4	<0.0020	<0.20	<0.50	2.49

LOCATION	UNITS	Dissolved Lead (Pb)	Dissolved Lithium (Li)	Dissolved Manganese (Mn)	Dissolved Molybdenum (Mo)	Dissolved Nickel (Ni)	Dissolved Selenium (Se)	Dissolved Silicon (Si)	Dissolved Silver (Ag)	Dissolved Strontium (Sr)	Dissolved Thallium (Tl)	Dissolved Tin (Sn)	Dissolved Titanium (Ti)	Dissolved Uranium (U)
		ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
SP1 Lower Otter Creek	**REG/1**	<0.0050	1.16	470	15.9 (1)	17.0	0.649	3760	<0.0050	135	0.0130	<0.20	<0.50	3.90
SP1 Lower Otter Creek	**RP1/2**	0.0060	1.02	333	13.1 (1)	15.7	0.930	4220	<0.0050	138	0.0110	<0.20	<0.50	3.94
SP1 Lower Otter Creek	**RP2/3**	0.0240	1.04	396	9.70 (1)	15.2	0.575	4380	<0.0050	130	0.0090	<0.20	<0.50	3.29
SP1 Snake Creek	**REG/1**	0.0140	<0.50	0.771	0.414	0.487	0.299	4300	<0.0050	75.1	<0.0020	<0.20	<0.50	0.146
SP1 Snake Creek	**RP1/2**	<0.0050	<0.50	0.704	0.445 (1)	0.384	0.380	4230	<0.0050	74.3	<0.0020	<0.20	<0.50	0.157
SP1 Snake Creek	**RP2/3**	<0.0050	<0.50	0.652	0.439 (1)	0.419	0.365	4270	<0.0050	71.1	<0.0020	<0.20	<0.50	0.140
SP1 Spruce Creek	**REG/1**	0.0100	<0.50	6.32	1.15 (1)	1.37	0.093	4660	<0.0050	74.7	<0.0020	<0.20	<0.50	0.484
SP1 Spruce Creek	**RP1/2**	0.229 (1)	0.63	42.3 (1)	0.716	12.5 (1)	0.133	5470	0.0070	82.0	0.0050	0.21	17.1 (1)	0.544
SP1 Spruce Creek	**RP2/3**	0.0070	<0.50	6.14	1.14 (1)	1.38	0.112	4620	<0.0050	77.7	<0.0020	<0.20	<0.50	0.496
SP1 Upper Otter Creek	**REG/1**	0.0210	<0.50	105	1.81 (1)	0.891	0.366	4430	0.0200	70.1	<0.0020	<0.20	<0.50	2.87
SP1 Upper Otter Creek	**RP1/2**	0.0170	<0.50	107	1.55 (1)	1.73	0.290	4350	0.0190	72.7	<0.0020	<0.20	<0.50	2.79
SP1 Upper Otter Creek	**RP2/3**	0.0140	<0.50	107	1.53 (1)	0.967	0.355	4420	0.0320	71.8	<0.0020	<0.20	<0.50	2.84
SP2 Lower Otter Creek	**REG/1**	0.0090	0.56	25.4	1.71 (1)	1.99	0.526 (1)	4540	<0.0050	104	<0.0020	<0.20	<0.50	1.06
SP2 Lower Otter Creek	**RP1/2**	0.0090	0.56	25.0	1.70 (1)	2.10	0.397	4420	<0.0050	104	<0.0020	<0.20	<0.50	1.08
SP2 Lower Otter Creek	**RP2/3**	0.0220	0.60	26.4	1.64 (1)	2.53	0.527	4470	<0.0050	104	<0.0020	<0.20	0.61	1.09
SP2 Mid Otter Creek	**REG/1**	0.0090	2.83	33.1	22.8 (1)	3.77	1.78 (1)	4500	<0.0050	254	0.0020	<0.20	<0.50	2.35
SP2 Mid Otter Creek	**RP1/2**	0.0180	2.47	10.1	17.9 (1)	2.96	1.62 (1)	4400	<0.0050	228	0.0030	<0.20	<0.50	1.96
SP2 Mid Otter Creek	**RP2/3**	0.0190	2.70	3.12	20.3 (1)	3.77	2.18 (1)	4360	<0.0050	239	0.0020	<0.20	<0.50	2.25
SP2 Ruby Creek	**REG/1**	0.0330	7.99	3.97	14.2 (1)	1.48	<0.040	5530	<0.0050	31.7	0.0030	<0.20	<0.50	3.40
SP2 Ruby Creek	**RP1/2**	0.0220	8.23	3.71	14.1 (1)	1.35	0.085	5710	<0.0050	31.5	0.0030	<0.20	<0.50	3.52
SP2 Ruby Creek	**RP2/3**	0.0260	7.97	3.94	14.0 (1)	2.12	0.044	5460	<0.0050	31.2	0.0030	<0.20	<0.50	3.47
SP2 Snake Creek	**REG/1**	0.0150	<0.50	1.21	0.427	0.499	0.253	4260	<0.0050	73.0	<0.0020	<0.20	<0.50	0.142
SP2 Snake Creek	**RP1/2**	0.0060	<0.50	1.23	0.462 (1)	0.502	0.425	4270	<0.0050	73.3	<0.0020	<0.20	<0.50	0.143
SP2 Snake Creek	**RP2/3**	0.0070	<0.50	1.57	0.451 (1)	0.588	0.307	4210	<0.0050	74.3	<0.0020	<0.20	<0.50	0.138
SP2 Upper Otter Creek	**REG/1**	0.0190	<0.50	100	1.79	0.950	0.346	4280	0.0220	70.5	<0.0020	<0.20	<0.50	2.96
SP2 Upper Otter Creek	**RP1/2**	0.0150	<0.50	103	1.83	0.939	0.327	4190	0.0180	71.7	<0.0020	<0.20	<0.50	3.01
SP2 Upper Otter Creek	**RP2/3**	0.0320	<0.50	100	1.93	1.06	0.249	4190	0.0300	72.7	<0.0020	<0.20	<0.50	3.19

LOCATION	UNITS	Dissolved Lead (Pb)	Dissolved Lithium (Li)	Dissolved Manganese (Mn)	Dissolved Molybdenum (Mo)	Dissolved Nickel (Ni)	Dissolved Selenium (Se)	Dissolved Silicon (Si)	Dissolved Silver (Ag)	Dissolved Strontium (Sr)	Dissolved Thallium (Tl)	Dissolved Tin (Sn)	Dissolved Titanium (Ti)
		ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
US Birch Creek	**REG/1**	0.0130	<0.50	0.138	0.544	2.37	0.046	5160	<0.0050	30.5	<0.0020	<0.20	<0.50
US Birch Creek	**RP1/2**	0.0120	<0.50	0.182	0.603	2.31	<0.040	5070	<0.0050	31.9	<0.0020	0.44	<0.50
US Birch Creek	**RP2/3**	0.0060	<0.50	0.131	0.560	2.23	0.073	5010	<0.0050	31.3	<0.0020	<0.20	<0.50
US Boulder Creek	**REG/1**	0.0150	2.10	0.286	0.429	1.29	<0.040	5090	<0.0050	19.0	0.0020	<0.20	<0.50
US Boulder Creek	**RP1/2**	0.0260	2.13	0.159	0.399	1.26	<0.040	5090	<0.0050	18.6	<0.0020	<0.20	<0.50
US Boulder Creek	**RP2/3**	0.0120	2.20	0.217	0.432	1.25	0.045	5190	<0.0050	19.1	<0.0020	<0.20	<0.50
US Lower Otter Creek	**REG/1**	0.0260	<0.50	93.6	1.01 (1)	2.33	0.157	4840	<0.0050	82.8	<0.0020	<0.20	<0.50
US Lower Otter Creek	**RP1/2**	0.0070	<0.50	97.2	1.11 (1)	2.20	0.170	4810	<0.0050	78.8	<0.0020	<0.20	<0.50
US Lower Otter Creek	**RP2/3**	0.0070	<0.50	105	1.11 (1)	2.07	0.182	4900	<0.0050	82.2	<0.0020	0.26	<0.50
US Mid Otter Creek	**REG/1**	0.0160	<0.50	45.1	1.09	2.20	0.150	5200	<0.0050	75.1	<0.0020	<0.20	<0.50
US Mid Otter Creek	**RP1/2**	0.0110	<0.50	45.1	1.09	2.22	0.122	5210	<0.0050	74.7	<0.0020	<0.20	<0.50
US Mid Otter Creek	**RP2/3**	0.0070	<0.50	44.0	0.998	2.26	0.198	5130	<0.0050	73.7	<0.0020	<0.20	<0.50
US Ruby Creek	**REG/1**	0.0250	4.37	2.42	14.6	3.11	<0.040	4800	<0.0050	27.2	0.0040	<0.20	<0.50
US Ruby Creek	**RP1/2**	0.0310	4.17	2.29	15.1	2.95	0.052	4600	<0.0050	26.2	0.0030	<0.20	<0.50
US Ruby Creek	**RP2/3**	0.254	4.41	11.1	14.3	6.94	0.093	5210	0.0070	27.0	0.0090	<0.20	12.2
US Snake Creek	**REG/1**	0.0170	<0.50	0.109	0.547	0.408	0.202 (1)	3650	<0.0050	52.4	<0.0020	<0.20	<0.50
US Snake Creek	**RP1/2**	0.342 (1)	<0.50	0.145	0.523	0.482	0.153	3570	<0.0050	50.3	<0.0020	0.28	<0.50
US Snake Creek	**RP2/3**	0.0100	<0.50	0.138	0.549	0.463	0.197	3700	<0.0050	51.7	<0.0020	<0.20	<0.50
US Spruce Creek	**REG/1**	0.0080	<0.50	4.74	0.660	2.28	0.155	4150	<0.0050	74.7	<0.0020	<0.20	<0.50
US Spruce Creek	**RP1/2**	0.0060	<0.50	4.71	0.653	2.19	0.093	4080	<0.0050	76.9	<0.0020	<0.20	<0.50
US Spruce Creek	**RP2/3**	0.0090	<0.50	4.73	0.730	2.10	0.127	4040	<0.0050	74.7	<0.0020	0.31	<0.50
US Upper Otter Creek	**REG/1**	0.0070	<0.50	5.13	0.737	0.949	0.156	3850	<0.0050	49.4	<0.0020	<0.20	<0.50
US Upper Otter Creek	**RP1/2**	0.0060	<0.50	5.37	0.647	0.958	0.149	3940	<0.0050	49.5	<0.0020	<0.20	<0.50
US Upper Otter Creek	**RP2/3**	0.0050	<0.50	5.22	0.704	1.04	0.126	3950	<0.0050	50.3	<0.0020	<0.20	<0.50

		Dissolved Vanadium (V)	Dissolved Zinc (Zn)	Dissolved Zirconium (Zr)	Dissolved Calcium (Ca)	Dissolved Magnesium (Mg)	Dissolved Potassium (K)	Dissolved Sodium (Na)	Dissolved Sulphur (S)
LOCATION	**UNITS**	ug/L	ug/L	ug/L	mg/L	mg/L	mg/L	mg/L	mg/L
DS Birch Creek	**REG/1**	0.64	0.27	<0.10	14.2	7.76	0.380	1.49	<10
DS Birch Creek	**RP1/2**	0.58	0.33	<0.10	14.7	7.70	0.378	1.48	<10
DS Birch Creek	**RP2/3**	0.58	1.02	<0.10	14.3	7.88	0.382	1.55	<10
DS Boulder Creek	**REG/1**	0.49	1.43	<0.10	7.64	2.67	0.505	1.58	<10
DS Boulder Creek	**RP1/2**	0.51	1.45	<0.10	7.72	2.63	0.493	1.54	<10
DS Boulder Creek	**RP2/3**	0.48	1.40	<0.10	7.68	2.71	0.493	1.56	<10
DS Lower Otter Creek	**REG/1**	<0.20	0.21	<0.10	32.1	11.9	0.928	2.50	<10
DS Lower Otter Creek	**RP1/2**	<0.20	0.31	<0.10	31.4	11.5	0.915	2.45	<10
DS Lower Otter Creek	**RP2/3**	0.21	0.35	<0.10	33.0	11.9	0.931	2.53	<10
DS Mid Otter Creek	**REG/1**	<0.20	0.57	<0.10	27.3	8.48	0.434	1.67	<10
DS Mid Otter Creek	**RP1/2**	<0.20	0.60	<0.10	27.4	8.49	0.433	1.63	<10
DS Mid Otter Creek	**RP2/3**	<0.20	0.50	<0.10	27.2	8.94	0.462	1.72	<10
DS Ruby Creek	**REG/1**	1.31	3.94	<0.10	7.19	3.64	0.837	2.21	<10
DS Ruby Creek	**RP1/2**	1.27	3.59	<0.10	7.12	3.67	0.863	2.21	<10
DS Ruby Creek	**RP2/3**	1.31	3.67	<0.10	7.11	3.62	0.849	2.22	<10
DS Snake Creek	**REG/1**	<0.20	0.31	<0.10	15.3	10.2	0.198	0.979	4.4
DS Snake Creek	**RP1/2**	<0.20	0.55	<0.10	15.7	10.2	0.199	0.985	4.3
DS Snake Creek	**RP2/3**	<0.20	0.32	<0.10	15.2	10.2	0.198	0.996	4.6
DS Spruce Creek	**REG/1**	<0.20	0.80	<0.10	32.3	10.0	0.405	1.11	<10
DS Spruce Creek	**RP1/2**	0.20	1.15 (2)	<0.10	32.7	9.95	0.413	1.10	<10
DS Spruce Creek	**RP2/3**	0.21		<0.10	32.9	10.0	0.412	1.11	<10
DS Upper Otter Creek	**REG/1**	1.40	8.18	<0.10	19.8	7.67	0.596	1.52	<10
DS Upper Otter Creek	**RP1/2**	0.91	0.48	<0.10	19.1	7.24	0.544	1.50	<10
DS Upper Otter Creek	**RP2/3**	0.98	0.33	<0.10	18.3	7.25	0.559	1.50	<10
OUTFALL Ruby Creek	**REG/1**	1.93	0.34	<0.10	8.23	4.45	1.16	2.77	<10
OUTFALL Ruby Creek	**RP1/2**	1.59	3.51	<0.10	7.74	4.20	1.05	2.62	<10
OUTFALL Ruby Creek	**RP2/3**	1.85	0.43	<0.10	8.87	4.60	1.20	2.88	<10
OUTFALL Upper Otter Creek	**REG/1**	2.37	1.55	<0.10	15.9	9.42	0.891	1.74	<10
OUTFALL Upper Otter Creek	**RP1/2**	2.36	0.18	<0.10	16.5	8.91	0.836	1.68	<10
OUTFALL Upper Otter Creek	**RP2/3**	2.33	0.18	<0.10	16.1	9.21	0.847	1.70	<10

		Dissolved Vanadium (V)	Dissolved Zinc (Zn)	Dissolved Zirconium (Zr)	Dissolved Calcium (Ca)	Dissolved Magnesium (Mg)	Dissolved Potassium (K)	Dissolved Sodium (Na)	Dissolved Sulphur (S)
LOCATION	**UNITS**	ug/L	ug/L	ug/L	mg/L	mg/L	mg/L	mg/L	mg/L
SP1 Lower Otter Creek	**REG/1**	0.61	0.24	<0.10	31.4	15.7	2.91	2.65	13
SP1 Lower Otter Creek	**RP1/2**	0.69	0.38	<0.10	31.9	16.8	2.57	2.79	<10
SP1 Lower Otter Creek	**RP2/3**	0.67	0.94	<0.10	30.5	15.0	2.83	2.62	<10
SP1 Snake Creek	**REG/1**	<0.20	0.94	<0.10	17.9	8.61	0.249	1.16	<10
SP1 Snake Creek	**RP1/2**	<0.20	0.51	<0.10	17.7	8.25	0.236	1.14	<10
SP1 Snake Creek	**RP2/3**	<0.20	0.20	<0.10	17.8	8.46	0.255	1.16	<10
SP1 Spruce Creek	**REG/1**	0.64	2.59	<0.10	32.2	11.4	0.555	1.23	<10
SP1 Spruce Creek	**RP1/2**	2.82 (1)	3.49 (1)	0.14	32.5	12.2	0.573	1.22	<10
SP1 Spruce Creek	**RP2/3**	0.58	0.79	<0.10	32.4	11.4	0.539	1.20	<10
SP1 Upper Otter Creek	**REG/1**	3.67	0.23	<0.10	15.4	8.72	0.957	1.69	<10
SP1 Upper Otter Creek	**RP1/2**	3.69	0.17	<0.10	15.2	8.72	0.943	1.70	<10
SP1 Upper Otter Creek	**RP2/3**	3.52	0.27	<0.10	15.4	8.72	0.950	1.68	<10
SP2 Lower Otter Creek	**REG/1**	<0.20	0.38	<0.10	32.3	11.9	0.863	2.48	<10
SP2 Lower Otter Creek	**RP1/2**	<0.20	0.48	<0.10	31.6	11.6	0.837	2.40	<10
SP2 Lower Otter Creek	**RP2/3**	<0.20	0.77	<0.10	32.0	11.8	0.875	2.49	<10
SP2 Mid Otter Creek	**REG/1**	0.90	0.57	<0.10	22.1	13.0	1.20	5.07	<10
SP2 Mid Otter Creek	**RP1/2**	1.10	0.50	<0.10	21.0	12.5	1.16	4.94	<10
SP2 Mid Otter Creek	**RP2/3**	1.07	0.88	<0.10	21.7	12.6	1.17	4.91	<10
SP2 Ruby Creek	**REG/1**	2.00	0.53	<0.10	8.46	4.68	1.19	2.85	<10
SP2 Ruby Creek	**RP1/2**	1.93	2.80	<0.10	9.20	4.66	1.20	2.85	<10
SP2 Ruby Creek	**RP2/3**	1.85	0.14	<0.10	8.41	4.62	1.19	2.82	<10
SP2 Snake Creek	**REG/1**	<0.20	0.93	<0.10	18.0	8.54	0.255	1.15	<10
SP2 Snake Creek	**RP1/2**	<0.20	0.81	<0.10	18.0	8.86	0.290	1.20	<10
SP2 Snake Creek	**RP2/3**	<0.20	1.21	<0.10	17.9	8.65	0.326	1.18	<10
SP2 Upper Otter Creek	**REG/1**	3.64	0.27	<0.10	15.1	8.43	0.926	1.64	<10
SP2 Upper Otter Creek	**RP1/2**	3.87	0.72	<0.10	14.9	8.66	0.956	1.67	<10
SP2 Upper Otter Creek	**RP2/3**	3.61	0.35	<0.10	14.8	8.53	0.945	1.67	<10

LOCATION	UNITS	Dissolved Vanadium (V)	Dissolved Zinc (Zn)	Dissolved Zirconium (Zr)	Dissolved Calcium (Ca)	Dissolved Magnesium (Mg)	Dissolved Potassium (K)	Dissolved Sodium (Na)	Dissolved Sulphur (S)
		ug/L	ug/L	ug/L	mg/L	mg/L	mg/L	mg/L	mg/L
SP3 Boulder Creek	**REG/1**	0.77	0.64	<0.10	11.2	4.81	1.18	1.58	<10
SP3 Boulder Creek	**RP1/2**	0.74	1.13	<0.10	11.4	4.97	1.15	1.54	<10
SP3 Boulder Creek	**RP2/3**	0.71	0.55	<0.10	11.2	4.74	1.15	1.53	<10
SP3 Ruby Creek	**REG/1**	2.12	1.96	<0.10	8.58	4.66	1.21	2.89	<10
SP3 Ruby Creek	**RP1/2**	1.85	0.27	<0.10	8.58	4.66	1.21	2.90	<10
SP3 Ruby Creek	**RP2/3**	1.84	1.63	<0.10	8.34	4.60	1.19	2.87	<10
SP3 Snake Creek	**REG/1**	<0.20	0.97	<0.10	18.0	8.68	0.278	1.18	<10
SP3 Snake Creek	**RP1/2**	<0.20	1.03	<0.10	17.7	8.65	0.261	1.16	<10
SP3 Snake Creek	**RP2/3**	<0.20	1.86	<0.10	18.5	8.80	0.319	1.21	<10
SP3 Upper Otter Creek	**REG/1**	2.44	0.28	<0.10	15.3	9.04	0.851	1.69	<10
SP3 Upper Otter Creek	**RP1/2**	2.58	0.38	<0.10	15.7	9.46	0.882	1.77	<10
SP3 Upper Otter Creek	**RP2/3**	2.43	0.39	<0.10	15.7	9.23	0.855	1.77	<10

LOCATION	UNITS	Dissolved Vanadium (V)	Dissolved Zinc (Zn)	Dissolved Zirconium (Zr)	Dissolved Calcium (Ca)	Dissolved Magnesium (Mg)	Dissolved Potassium (K)	Dissolved Sodium (Na)	Dissolved Sulphur (S)
		ug/L	ug/L	ug/L	mg/L	mg/L	mg/L	mg/L	mg/L
US Birch Creek	**REG/1**	0.30	0.57 (1)	<0.10	12.6	6.55	0.351	1.45	<10
US Birch Creek	**RP1/2**	0.36	0.43	<0.10	12.5	6.56	0.357	1.44	<10
US Birch Creek	**RP2/3**	0.31	0.12	<0.10	12.5	6.60	0.347	1.41	<10
US Boulder Creek	**REG/1**	0.25	2.57	<0.10	6.65	2.30	0.460	1.64	<10
US Boulder Creek	**RP1/2**	0.27	2.20	<0.10	6.66	2.34	0.468	1.63	<10
US Boulder Creek	**RP2/3**	0.24	2.06	<0.10	6.72	2.34	0.468	1.65	<10
US Lower Otter Creek	**REG/1**	<0.20	2.38	<0.10	27.6	9.49	0.523	1.79	<10
US Lower Otter Creek	**RP1/2**	<0.20	0.21	<0.10	26.9	9.38	0.493	1.77	<10
US Lower Otter Creek	**RP2/3**	<0.20	0.57	<0.10	27.7	9.43	0.498	1.77	<10
US Mid Otter Creek	**REG/1**	<0.20	0.33	<0.10	27.1	8.33	0.457	1.66	<10
US Mid Otter Creek	**RP1/2**	<0.20	0.36	<0.10	27.0	8.13	0.439	1.63	<10
US Mid Otter Creek	**RP2/3**	<0.20	0.53	<0.10	26.6	8.11	0.440	1.63	<10
US Ruby Creek	**REG/1**	1.16	6.71	<0.10	6.84	3.45	0.777	2.12	<10
US Ruby Creek	**RP1/2**	1.14	5.96	<0.10	6.56	3.34	0.772	2.09	<10
US Ruby Creek	**RP2/3**	1.82	7.68	0.14	6.92	3.55	0.787	2.01	<10
US Snake Creek	**REG/1**	<0.20	0.30	<0.10	15.8	10.1	0.192	0.971	<10
US Snake Creek	**RP1/2**	<0.20	0.46	<0.10	15.5	9.99	0.185	0.957	<10
US Snake Creek	**RP2/3**	<0.20	0.21	<0.10	16.1	10.1	0.186	0.959	<10
US Spruce Creek	**REG/1**	<0.20	0.59	<0.10	34.0	9.26	0.402	1.09	<10
US Spruce Creek	**RP1/2**	<0.20	0.44	<0.10	33.1	9.24	0.410	1.10	<10
US Spruce Creek	**RP2/3**	<0.20	1.07 (1)	<0.10	33.0	9.26	0.397	1.10	<10

US Upper Otter Creek	**REG/1**	<0.20	0.23	<0.10	19.7	4.48	0.257	1.36	<10
US Upper Otter Creek	**RP1/2**	<0.20	0.35	<0.10	20.0	4.45	0.255	1.35	<10
US Upper Otter Creek	**RP2/3**	<0.20	0.39	<0.10	20.2	4.53	0.267	1.36	<10

TABLE 32 *Total metals raw data from sediment samples collected in September and October, 2012 and analysed at the Maxxam Analytics Laboratory.*

	Total Metals by ICPMS	**Total Aluminum (Al)**	**Total Antimony (Sb)**	**Total Arsenic (As)**	**Total Barium (Ba)**	**Total Beryllium (Be)**	**Total Bismuth (Bi)**	**Total Cadmium (Cd)**	**Total Calcium (Ca)**	**Total Chromium (Cr)**	**Total Cobalt (Co)**	**Total Copper (Cu)**	**Total Iron (Fe)**
LOCATION	**UNITS**	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
OUTFALL Ruby Creek	**REG/1**	27300	1.69	64.0	132	5.76	3.42	2.15	5590	147	32.5	93.1	37900
OUTFALL Ruby Creek	**RP1/2**	31300	1.79	72.6	131	6.93	4.19	2.35	5550	150	33.6	102	38800
OUTFALL Ruby Creek	**RP2/3**	31900	1.98	75.5	142	7.69	4.27	2.49	6200	156	33.9	107	40600
DS Mid Otter Creek	**REG/1**	9220	0.68	10.4	166	<0.40	0.22	0.753	13600	85.9	18.4	70.5	32500
DS Mid Otter Creek	**RP1/2**	8960	0.58	8.41	161	<0.40	0.20	0.677	12800	83.3	17.0	61.0	30500
DS Mid Otter Creek	**RP2/3**	9300	0.72	10.5	164	<0.40	0.26	0.966	12200	85.9	18.4	75.3	32800
DS Ruby Creek	**REG/1**	18000	1.12	38.1	108	4.38	1.92	1.54	6460	119	23.0	56.2	31200
DS Ruby Creek	**RP1/2**	18300	1.06	38.0	104	4.43	1.87	1.57	6320	121	22.8	54.3	31100
DS Ruby Creek	**RP2/3**	18800	1.02	42.9	103	4.62	2.05	1.68	5920	122	24.1	58.2	31900
DS Upper Otter Creek	**REG/1**	7660	0.65	5.39	127	<0.40	0.11	0.386	7210	67.3	11.7	39.7	19300
DS Upper Otter Creek	**RP1/2**	8520	0.65	6.92	138	<0.40	0.13	0.405	7930	73.3	12.3	41.3	20700
DS Upper Otter Creek	**RP2/3**	9120	0.66	6.31	147	<0.40	0.12	0.366	8280	81.2	13.5	42.5	21900
OUTFALL Upper Otter Creek	**REG/1**	10200	0.62	6.79	167	<0.40	0.17	0.555	5770	90.0	14.9	48.2	23700
OUTFALL Upper Otter Creek	**RP1/2**	12300	0.72	7.53	201	<0.40	0.16	0.566	8190	125	20.6	57.2	28800
OUTFALL Upper Otter Creek	**RP2/3**	8730	0.67	6.40	168	<0.40	0.15	0.487	13500	47.3	11.1	49.4	20400
US Mid Otter Creek	**REG/1**	8530	0.54	4.70	148	<0.40	0.14	0.355	3890	83.3	13.5	42.3	19700
US Mid Otter Creek	**RP1/2**	9450	0.54	5.46	172	<0.40	0.14	0.484	4250	90.3	14.2	47.0	21500
US Mid Otter Creek	**RP2/3**	10400	0.54	4.30	187	<0.40	0.14	0.520	3880	93.9	12.5	39.7	13700
US Ruby Creek	**REG/1**	14100	0.67	16.1	116	1.75	0.68	0.964	9660	145	22.2	36.3	30200
US Ruby Creek	**RP1/2**	14300	0.72	25.2	92.9	4.18	1.30	1.20	6490	117	19.8	38.7	27800
US Ruby Creek	**RP2/3**	15200	0.75	24.4	94.9	4.06	1.07	1.08	7080	128	20.9	40.1	29500
US Upper Otter Creek	**REG/1**	8920	0.53	13.0	338	<0.40	0.14	0.826	5080	71.6	16.2	55.2	40600
US Upper Otter Creek	**RP1/2**	8810	0.68	11.6	205	<0.40	0.15	0.526	3550	87.7	17.8	62.5	34200
US Upper Otter Creek	**RP2/3**	9710	2.07	21.9	345	<0.40	0.16	0.901	4160	69.8	15.7	46.4	33800

	Total Metals by ICPMS	Total Lead (Pb)	Total Magnesium (Mg)	Total Manganese (Mn)	Total Molybdenum (Mo)	Total Nickel (Ni)	Total Phosphorus (P)	Total Potassium (K)	Total Selenium (Se)	Total Silicon (Si)	Total Silver (Ag)	Total Sodium (Na)	Total Strontium (Sr)	Total Thallium (Tl)
LOCATION	**UNITS**	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
OUTFALL Ruby Creek	**REG/1**	39.3	17900	892	6.79	384	888	2540	<0.50	283	0.361	353	35.3	0.933
OUTFALL Ruby Creek	**RP1/2**	45.7	17100	984	9.35	387	766	2790	<0.50	220	0.467	345	33.8	1.11
OUTFALL Ruby Creek	**RP2/3**	46.1	17700	993	9.58	397	838	2890	<0.50	153	0.461	363	36.4	1.09
DS Mid Otter Creek	**REG/1**	7.47	11300	525	2.97	168	584	674	0.69	150	0.240	104	32.5	0.085
DS Mid Otter Creek	**RP1/2**	6.64	10300	465	2.32	151	563	621	0.61	140	0.205	108	31.6	0.081
DS Mid Otter Creek	**RP2/3**	7.73	11200	477	3.27	172	571	743	0.83	160	0.282	111	30.6	0.088
DS Ruby Creek	**REG/1**	29.7	17800	645	4.67	232	891	1690	<0.50	279	0.368	488	36.1	0.544
DS Ruby Creek	**RP1/2**	24.7	17200	625	4.97	228	961	1630	<0.50	174	0.310	495	37.4	0.514
DS Ruby Creek	**RP2/3**	26.7	16900	667	5.33	232	1050	1670	<0.50	182	0.309	475	37.3	0.563
DS Upper Otter Creek	**REG/1**	4.19	10300	463	1.97	107	543	692	<0.50	160	0.095	<100	20.5	0.087
DS Upper Otter Creek	**RP1/2**	5.90	11100	476	2.16	114	574	757	<0.50	204	0.125	111	23.6	0.076
DS Upper Otter Creek	**RP2/3**	5.58	12800	516	2.08	131	588	787	<0.50	152	0.123	137	24.9	0.087
OUTFALL Upper Otter Creek	**REG/1**	5.26	12200	626	2.14	141	670	873	<0.50	128	0.105	<100	22.1	0.089
OUTFALL Upper Otter Creek	**RP1/2**	6.03	18400	688	1.95	210	656	983	<0.50	213	0.240	131	28.9	0.111
OUTFALL Upper Otter Creek	**RP2/3**	5.23	6680	533	2.44	73.7	592	829	<0.50	255	0.110	106	28.6	0.095
US Mid Otter Creek	**REG/1**	4.57	10200	469	1.53	120	519	626	<0.50	112	0.114	<100	17.3	0.076
US Mid Otter Creek	**RP1/2**	5.10	10900	566	1.91	132	574	714	<0.50	85.3	0.118	107	19.6	0.090
US Mid Otter Creek	**RP2/3**	4.67	9170	229	3.09	111	517	494	0.93	93.3	0.131	<100	18.0	0.087
US Ruby Creek	**REG/1**	10.8	23400	578	1.71	241	798	1340	<0.50	140	0.212	426	40.3	0.267
US Ruby Creek	**RP1/2**	14.7	17600	526	4.12	195	836	1380	<0.50	157	0.218	488	34.5	0.316
US Ruby Creek	**RP2/3**	14.6	19100	550	4.08	210	856	1430	<0.50	191	0.249	551	36.8	0.321
US Upper Otter Creek	**REG/1**	5.22	6800	2920	5.47	92.8	695	718	1.06	232	0.149	<100	20.4	0.100
US Upper Otter Creek	**RP1/2**	5.56	7800	971	4.88	119	568	765	0.67	262	0.111	<100	14.1	0.097
US Upper Otter Creek	**RP2/3**	56.4	7030	2200	4.03	92.8	570	772	0.86	272	0.771	<100	17.8	0.093

	Total Metals by ICPMS	Total Tin (Sn)	Total Titanium (Ti)	Total Vanadium (V)	Total Zinc (Zn)	Total Zirconium (Zr)
LOCATION	**UNITS**	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
OUTFALL Ruby Creek	**REG/1**	3.29	1570	86.1	188	20.1
OUTFALL Ruby Creek	**RP1/2**	4.00	1470	88.8	210	23.0
OUTFALL Ruby Creek	**RP2/3**	4.37	1700	94.6	221	21.1
DS Mid Otter Creek	**REG/1**	0.20	546	33.7	101	13.3
DS Mid Otter Creek	**RP1/2**	0.20	548	33.4	95.8	8.99
DS Mid Otter Creek	**RP2/3**	0.21	586	33.6	100	22.7
DS Ruby Creek	**REG/1**	2.10	1420	61.4	144	14.7
DS Ruby Creek	**RP1/2**	2.07	1510	64.0	139	16.4
DS Ruby Creek	**RP2/3**	2.33	1670	67.1	141	18.5
DS Upper Otter Creek	**REG/1**	0.19	502	28.1	53.8	2.20
DS Upper Otter Creek	**RP1/2**	0.22	614	30.2	57.0	3.08
DS Upper Otter Creek	**RP2/3**	0.27	637	32.8	61.0	2.89
OUTFALL Upper Otter Creek	**REG/1**	0.25	497	35.8	66.2	0.76
OUTFALL Upper Otter Creek	**RP1/2**	0.32	664	45.5	74.7	1.26
OUTFALL Upper Otter Creek	**RP2/3**	0.23	557	30.8	64.8	4.85
US Mid Otter Creek	**REG/1**	0.21	524	31.8	64.8	1.63
US Mid Otter Creek	**RP1/2**	0.22	527	34.1	76.4	1.43
US Mid Otter Creek	**RP2/3**	0.21	485	33.4	97.1	1.14
US Ruby Creek	**REG/1**	1.07	1100	56.0	90.9	9.76
US Ruby Creek	**RP1/2**	1.45	1190	54.0	107	12.0
US Ruby Creek	**RP2/3**	1.49	1270	56.0	101	13.6
US Upper Otter Creek	**REG/1**	0.74	321	26.9	87.9	0.66
US Upper Otter Creek	**RP1/2**	0.31	468	33.3	86.9	0.86
US Upper Otter Creek	**RP2/3**	0.34	379	26.6	105	0.54

TABLE 33 *Total suspended solids raw data from water samples collected in September and October, 2012 and analysed at the Maxxam Analytics Laboratory.*

		Total Suspended Solids
LOCATION	**UNITS**	mg/L
DS Birch Creek	**REG/1**	<4.0
DS Birch Creek	**RP1/2**	<4.0
DS Birch Creek	**RP2/3**	<4.0
DS Boulder Creek	**REG/1**	16.3
DS Boulder Creek	**RP1/2**	17.3
DS Boulder Creek	**RP2/3**	13.5
DS Lower Otter Creek	**REG/1**	21.0
DS Lower Otter Creek	**RP1/2**	43.0
DS Lower Otter Creek	**RP2/3**	24.3
DS Mid Otter Creek	**REG/1**	<4.0
DS Mid Otter Creek	**RP1/2**	<4.0
DS Mid Otter Creek	**RP2/3**	4.5
DS Ruby Creek	**REG/1**	20.5
DS Ruby Creek	**RP1/2**	41.5
DS Ruby Creek	**RP2/3**	25.0
DS Snake Creek	**REG/1**	23.5
DS Snake Creek	**RP1/2**	53.7
DS Snake Creek	**RP2/3**	4.3
DS Spruce Creek	**REG/1**	<4.0
DS Spruce Creek	**RP1/2**	<4.0
DS Spruce Creek	**RP2/3**	6.0
DS Upper Otter Creek	**REG/1**	36.0
DS Upper Otter Creek	**RP1/2**	31.0
DS Upper Otter Creek	**RP2/3**	30.0
Outfall Ruby Creek	**REG/1**	14.0
Outfall Ruby Creek	**RP1/2**	22.0
Outfall Ruby Creek	**RP2/3**	35.3
Outfall Upper Otter Creek	**REG/1**	80.0
Outfall Upper Otter Creek	**RP1/2**	61.3
Outfall Upper Otter Creek	**RP2/3**	72.8

		Total Suspended Solids
LOCATION	**UNITS**	mg/L
SP1 Lower Otter Creek	**REG/1**	211000
SP1 Lower Otter Creek	**RP1/2**	91500
SP1 Lower Otter Creek	**RP2/3**	110000
SP1 Snake Creek	**REG/1**	10.3
SP1 Snake Creek	**RP1/2**	<4.0
SP1 Snake Creek	**RP2/3**	54.0
SP1 Spruce Creek	**REG/1**	8.5
SP1 Spruce Creek	**RP1/2**	54.8
SP1 Spruce Creek	**RP2/3**	35.3
SP1 Upper Otter Creek	**REG/1**	25900
SP1 Upper Otter Creek	**RP1/2**	22100
SP1 Upper Otter Creek	**RP2/3**	19500
SP2 Lower Otter Creek	**REG/1**	22.0
SP2 Lower Otter Creek	**RP1/2**	47.7
SP2 Lower Otter Creek	**RP2/3**	40.0
SP2 Mid Otter Creek	**REG/1**	1760
SP2 Mid Otter Creek	**RP1/2**	153
SP2 Mid Otter Creek	**RP2/3**	1020
SP2 Ruby Creek	**REG/1**	9.2
SP2 Ruby Creek	**RP1/2**	12.3
SP2 Ruby Creek	**RP2/3**	12.3
SP2 Snake Creek	**REG/1**	<4.0
SP2 Snake Creek	**RP1/2**	223
SP2 Snake Creek	**RP2/3**	8.5
SP2 Upper Otter Creek	**REG/1**	12700
SP2 Upper Otter Creek	**RP1/2**	11900
SP2 Upper Otter Creek	**RP2/3**	11900

		Total Suspended Solids
LOCATION	**UNITS**	mg/L
SP3 Boulder Creek	**REG/1**	89.0
SP3 Boulder Creek	**RP1/2**	72.0
SP3 Boulder Creek	**RP2/3**	366 (1)
SP3 Ruby Creek	**REG/1**	14.3
SP3 Ruby Creek	**RP1/2**	14.5
SP3 Ruby Creek	**RP2/3**	14.4
SP3 Snake Creek	**REG/1**	40.3
SP3 Snake Creek	**RP1/2**	13.0
SP3 Snake Creek	**RP2/3**	10.3
SP3 Upper Otter Creek	**REG/1**	87.0
SP3 Upper Otter Creek	**RP1/2**	81.6
SP3 Upper Otter Creek	**RP2/3**	81.3
US Birch Creek	**REG/1**	<4.0
US Birch Creek	**RP1/2**	<4.0
US Birch Creek	**RP2/3**	<4.0
US Boulder Creek	**REG/1**	<4.0
US Boulder Creek	**RP1/2**	<4.0
US Boulder Creek	**RP2/3**	<4.0
US Lower Otter Creek	**REG/1**	7.8
US Lower Otter Creek	**RP1/2**	9.2
US Lower Otter Creek	**RP2/3**	8.2
US Mid Otter Creek	**REG/1**	7.3
US Mid Otter Creek	**RP1/2**	5.3
US Mid Otter Creek	**RP2/3**	<4.0
US Ruby Creek	**REG/1**	10.5
US Ruby Creek	**RP1/2**	12.5
US Ruby Creek	**RP2/3**	9.2
US Snake Creek	**REG/1**	<4.0
US Snake Creek	**RP1/2**	<4.0
US Snake Creek	**RP2/3**	<4.0
US Spruce Creek	**REG/1**	<4.0
US Spruce Creek	**RP1/2**	<4.0
US Spruce Creek	**RP2/3**	<4.0
US Upper Otter Creek	**REG/1**	<4.0
US Upper Otter Creek	**RP1/2**	<4.0
US Upper Otter Creek	**RP2/3**	<4.0