Site C Clean Energy Project

Peace River and Site C Reservoir Water and Sediment Quality Monitoring Programs (Mon-8 and Mon-9)

Construction Year 3 (2017)

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August 20, 2018

Peace River and Site C Reservoir
2017 Water and Sediment Quality Monitoring Programs

PRESENTED TO

British Columbia Hydro and Power Authority

AUGUST 20, 2018
ISSUED FOR USE
FILE: 704-ENW.VENW3060-01

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EXECUTIVE SUMMARY

As part of the Water and Sediment Quality Monitoring Programs, the Saulteau EBA Environmental Services Joint Venture (SEES JV) conducted the water and sediment quality sampling program (Program) associated with Site C Clean Energy Project (the Project) on behalf of the BC Hydro and Power Authority (BC Hydro). The Project is located along the Peace River near the City of Fort St. John between the Districts of Hudson's Hope and Taylor, BC.

In accordance with the Provincial Environmental Assessment Certificate Condition No. 7 for the Project, BC Hydro has developed the Site C Fisheries and Aquatic Habitat Monitoring and Follow-up Program (FAHMFP). The overall FAHMFP includes two monitoring Programs focused on assessment of Project effects on water and sediment quality:

- Site C Mon-8 – Site C Reservoir Water and Sediment Quality Monitoring Program. This Program will investigate the effects of reservoir formation on water and sediment quality.
- Site C Mon-9 – Peace River Water and Sediment Quality Monitoring Program. This Program will investigate the effects of the Project on water and sediment quality in the Peace River downstream of the Project.

Mon-8 and Mon-9 were developed to monitor water and sediment quality in the Site C Reservoir and Peace River and to address the management questions listed in the FAHMFP; several years of data collection are required before the questions can be definitively addressed. This report presents the second year of data collection for these two monitoring Programs under the FAHMFP.

The Mon-8 study area includes monitoring of eight stations within the Site C reach, defined as the portion of the Peace River that will be inundated by the Project and includes the Peace River from the Peace Canyon Dam downstream to the Site C dam site, and those sections of the Halfway and Moberly rivers that will be inundated following reservoir creation. Four reference stations were selected to monitor water flowing into the Site C reach and are located near the Dinosaur and Williston reservoir outlets. The Mon-9 study area includes monitoring of nine stations within the Peace River downstream of the Project to Many Islands, Alberta.

A potential source of error was identified within the results for dissolved organic carbon concentrations, where dissolved organic carbon (DOC) concentrations were occasionally elevated above total organic carbon (TOC) concentrations, but less frequently than observed in 2016. DOC concentrations from May through August field blank samples were reported above 0 mg/L in field filtered deionized water provided by the lab. In 2016, one potential source of organic carbon was attributed to the field filtration equipment. ALS Environmental confirmed this to be a known contributor of organic carbon to analytical samples, and therefore, the concentrations reported are not considered to be an indicator of high concentrations of DOC in the water source. In 2017, we implemented flushing of the field equipment with a goal to reduce the incidence of false positives for DOC. This has not resolved the concern of organic carbon impacts from field equipment, some improvement was observed in 2017. The TOC concentrations are considered stable and mostly within natural levels for a lotic/ lentic system with elevated background turbidity conditions (BC MELP 1998).

Overall, water quality parameters were consistently below the guidelines except for regular exceedances of iron and manganese and intermittent exceedances of temperature, zinc, copper, aluminum, and selenium. Sediment quality parameters were consistently below the guidelines except for arsenic, cadmium, manganese, and nickel. Source(s) of the exceeded parameters could not be conclusively determined. Many Peace River tributaries are large systems characterized by high, vertical banks composed of fine materials which are subject to erosion during high flow periods. Given the location and parameters involved, it is possible that the exceedances were the result of natural processes (i.e., regional geology and erosion) and process error (i.e., natural variability among years).

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LIMITATIONS OF REPORT

This report and its contents are intended for the sole use of British Columbia Hydro and Power Authority and their agents. Saulteau EBA Environmental Services Joint Venture (SEES JV) does not accept any responsibility for the accuracy of any of the data, the analysis, or the recommendations contained or referenced in the report when the report is used or relied upon by any Party other than British Columbia Hydro and Power Authority, or for any Project other than the proposed development at the subject site. Any such unauthorized use of this report is at the sole risk of the user. Use of this document is subject to the Limitations on the Use of this Document attached in the Appendix or Contractual Terms and Conditions executed by both parties.

1.0 BACKGROUND

As part of the Water and Sediment Quality Monitoring Programs, the Saulteau EBA Environmental Services Joint Venture (SEES JV) conducted the sampling (May to October 2017) associated with Site C Clean Energy Project (the Project) on behalf of the BC Hydro and Power Authority (BC Hydro).

Historical baseline data collected in 2007, 2008, 2010, 2011, and 2015 was utilized as a design template to establish site locations, sampling frequency, and parameters analyzed for the Project. Historical data is documented within the "Site C Clean Energy Project: Environmental Impact Statement Technical Appendix: Water Quality Baseline Conditions in the Peace River Volume 2 Appendix E" (Golder, 2012). Once data volume is sufficient to conduct temporal and spatial statistical analysis, the historical baseline data will be incorporated for trend comparisons.

In accordance with Provincial Environmental Assessment Certificate Condition No. 7[1] for the Project, BC Hydro produced the Site C Fisheries and Aquatic Habitat Monitoring and Follow-up Program (FAHMFP[2]). The overall FAHMFP includes two monitoring programs (the Programs) focused on assessment of Project effects on water and sediment quality:

- Site C Mon-8 – Site C Reservoir Water and Sediment Quality Monitoring Program. This Program will investigate the effects of reservoir formation on water and sediment quality.
- Site C Mon-9 – Peace River Water and Sediment Quality Monitoring Program. This Program will investigate the effects of the Project on water and sediment quality in the Peace River downstream of the Project.

The timeline for the annual monitoring Programs encompasses Construction Years 2 to 10 (2016 to 2024) and Operation Years 1 to 10 of the Project (2025 to 2034). This report is an overview of the Mon-8 and Mon-9 monitoring programs for Construction Year 3. The 2017 Program duration was from May through October 2017.

The Project is located along the Peace River near the city of Fort St. John between the Districts of Hudson's Hope and Taylor, BC, accessible via Highways 97 and 29. A station location map is provided as Figure 1. All surface water monitoring stations (stations) are accessible by boat via public boat launch (road accessible). Station locations are shown in Figures 2a and 2b.

The Mon-8 study area includes monitoring of eight stations within the Site C reach, defined as the portion of the Peace River that will be inundated by the Project and includes the Peace River from the Peace Canyon Dam downstream to the Site C dam site, and those sections of the Halfway and Moberly rivers that will be inundated following reservoir creation (approximately 10 km sections). Two of the eight stations are in the upstream reaches of the Halfway and Moberly rivers and will only be included following reservoir filling in 2023 and 2024. Four reference stations (two shallow and two deep) were selected to monitor water flowing into the Site C reach and are located near the Dinosaur and Williston reservoir outlets.

The Mon-9 study area includes monitoring of nine stations within the Peace River from the Project downstream to the Many Islands area in Alberta, approximately 120 km.

[1] The EAC Holder must develop a Fisheries and Aquatic Habitat Monitoring and Follow-up Program to assess the effectiveness of measures to mitigate Project effects on healthy fish populations in the Peace River and tributaries, and, if recommended by a QEP or FLNR, to assess the need to adjust those measures to adequately mitigate the Project's effects.[2] Site C Fisheries and Aquatic Habitat Monitoring and Follow-up Program available at https://www.sitecproject.com/document-library/environmental-management-plans-and-reports

[2] Site C Fisheries and Aquatic Habitat Monitoring and Follow-up Program available at https://www.sitecproject.com/document-library/environmental-management-plans-and-reports

1.1 Program Objectives

The overall objectives of Mon-8 and Mon-9 in 2017 were to:

- Provide a qualitative description of the field site conditions, including representative photographs and geospatially referenced locations of each station;
- Collect field measured and laboratory analyzed parameters at each station;
- Provide a description of potential sources of error and steps taken as part of quality assurance; and
- Present the tabulated data in comparison to guidelines considered applicable to the monitoring Programs.

Sampling under these Programs will contribute to the information used to address the primary fisheries management questions listed in the FAHMFP:

- Mon-8: Does the construction and operation of the Project affect fish and fish habitat (as measured through water and sediment quality) in the reservoir and lower sections of reservoir tributaries?
- Mon-9: Does the construction and operation of the Project affect fish and fish habitat (as measured through water and sediment quality) in the Peace River downstream of the Project?

These broad questions require several smaller questions to be answered because of the various ways that the Project can affect fish and fish habitat:

Mon-8:

1. Is there a change in water or sediment quality in the Site C reach during the construction of the Project?
2. Is there a change in water or sediment quality in the Site C reach during the operation of the Project?
3. How effective are proposed mitigation methods in maintaining/protecting water and sediment quality in the Site C reach?

Mon-9:

1. Is there a change in water or sediment quality in the Peace River between the Site C dam site and the Many Islands area in Alberta during the construction of the Project?
2. Is there a change in water or sediment quality in the Peace River between the Site C dam site and the Many Islands area in Alberta during the operation of the Project?
3. How effective are proposed mitigation methods in maintaining/protecting water and sediment quality in the Peace River between the Site C dam site and the Many Islands area in Alberta?

1.2 Management Hypothesis

To address the management questions, the Program will test the following hypotheses, as provided in the monitoring plan:

Mon-8:

H_1: During construction, modeled water quality predictions presented in the Environmental Impact Statement (EIS) are like measured water quality in the Site C reach.

H_2: During operation, modeled water quality predictions presented in the EIS are like measured water quality in the Site C reach.

H_3: During construction, water and sediment quality for non-modeled parameters remain within background ranges of concentrations or comply with relevant environmental guidelines in the Site C reach.

H_4: During operation, water and sediment quality for non-modeled parameters remain within background ranges of concentrations or comply with relevant environmental guidelines in the Site C reach.

Two hypotheses related to the effectiveness of mitigation measures for water and sediment quality:

H_5: During construction, mitigation methods employed are effective in maintaining/protecting water and sediment quality in the Site C reach.

H_6: During operation, mitigation methods employed are effective in maintaining/protecting water and sediment quality in the Site C reach.

Mon-9:

H_1: During construction, modeled water quality predictions presented in the EIS are similar to measured water quality in the Peace River between the Site C dam site and the Many Islands area in Alberta.

H_2: During operation, modeled water quality predictions presented in the EIS are similar to measured water quality in the Peace River between the Site C dam site and the Many Islands area in Alberta.

H_3: During construction, water and sediment quality for non-modeled parameters remain within background ranges of concentrations or comply with relevant environmental guidelines in the Peace River between the Site C dam site and the Many Islands area in Alberta.

H_4: During operation, water and sediment quality for non-modeled parameters remain within background ranges of concentrations or comply with relevant environmental guidelines in the Peace River between the Site C dam site and the Many Islands area in Alberta.

Two hypotheses related to the effectiveness of mitigation measures for water and sediment quality.

H_5: During construction, mitigation methods employed are effective in maintaining/protecting water and sediment quality in the Peace River between the Site C dam site and the Many Islands area in Alberta.

H_6: During operation, mitigation methods employed are effective in maintaining/protecting water and sediment quality in the Peace River between the Site C dam site and the Many Islands area in Alberta.

The fisheries management questions and management hypotheses require several years of data to be collected. This report is the second year of data collection for these Programs under the FAHMFP.

2.0 METHODS

To maintain compliance with the FAHMFP Program objectives, we developed field sampling methodology for collecting water and sediment quality data representative of 17 stations included within the Program. Standard practices available from the British Columbia Field Sampling Manual (BC MOE 2013) were used to develop the following procedures:

- Sampling within surface water flow and away from the watercourse banks provides information on the quality of the channel flow and a general overview of water quality in the system. Areas of unusual flow characteristics (e.g., eddies or backwater areas) or floating debris were avoided.

- Samples were collected from near the bow via the side access of a jet engine boat, pointing the vessel upstream to collect upstream flow representative samples and to avoid contamination that could be introduced to the sample from the vessel.
  - In September 2017 as per BC Hydro direction, collection by grab sampling (i.e., submerging sample bottle directly into flow 0.2 m below surface from the side of the vessel) was replaced by a peristaltic pump and HDPE tubing with a 5 m intake length. In October 2017, the peristaltic pump was replaced with an electric diaphragm-operated pump (Pentair Shurflo; Model 4048-153-E75) and inert platinum-rinsed silicone tubing operating at 15 L/min. The purpose of this apparatus was for collecting and analyzing low-level concentrations of dissolved and total forms of mercury and methylmercury but was inherently used for collecting all water samples. The extension of the tubing allowed samples to be collected at least 5 m away from the aluminum hull of the jet boat, which could impact the results of low-level metals analysis.
- All samples were collected by boat, except for instances of low water conditions preventing boat access. In this case, samples were collected from the shore either by wading into the water towards the centre of channel or using a telescopic metal pole with a plastic container attached for collecting the water sample from flowing water conditions within the channel.
- Water quality samples were collected from each station within 0.2 m depth from surface, and additionally, depth profile sample data and water quality samples collected from 5.0 m below surface were collected from reservoir stations at Williston (W1) and Dinosaur (D1).
- Water quality samples were collected monthly from each station between May and October 2017; the first and final sampling periods included more extensive analytical testing than others.
- Sediment quality samples were collected from depositional areas of each lotic and lentic station during the October sampling period using a Wildco Petite Ponar sampling device. Depths of samples were determined in the field resulting from accessibility and obtaining samples representative of adequate quantities of sediment deposition within the water body (i.e., low coarse material content). Sediment samples collected using a grab sampling device were extracted from the centre of the soil mass collected.
- *In situ* surface water quality measurements were determined using a YSI ProDSS Multimeter (manufactured in Yellow Springs, OH, USA) which recorded sample depth, specific conductivity, electrical conductivity, pH, temperature, dissolved oxygen, salinity, Total Dissolved Solids (TDS), and turbidity of the source water.
- Water transparency within the reservoirs was recorded by measuring the depth of visibility of a Secchi disk.
- Where possible, laboratory analyte bottles were filled directly from the water source and/or tube sampling port to minimize cross contamination of samples collected at each station (i.e., surface water). Where additional handling was required, a new 1 L plastic bottle (i.e., routine sample bottle) was filled from the source, and sample water was decanted into other laboratory analysis bottles or filters. Depth profile samples were collected using a Wildco Kemmerer sampler. The introduction of the diaphragm pump collection method made direct filling of each laboratory analyte bottle possible without additional handling, including inline filtration and deep-water sample collection. The methodology for collecting depth profile measurements was developed in consultation with BC Hydro and with reference to the British Columbia Field Sampling Manual (BC MOE 2013)
- Decontamination of sampling equipment between monitoring locations by triple rinsing field parameter and sample collecting equipment.
- The use of clean, new nitrile gloves and filters at each new monitoring location during all water sampling.
- Required preservatives were added into the sample containers (e.g., dissolved metals and total metals – nitric acid, dissolved and total nutrients – sulfuric acid, dissolved and total mercury – hydrochloric acid).

- Where dissolved parameters were filtered by laboratory staff, the samples were not preserved in the field. Dissolved parameters filtered in the field (using new high capacity Waterra filters) were field preserved.
- The sample ID, date, and location on container label were recorded using water resistant labelling.
- One blind duplicate sample was submitted per every 10 ambient samples submitted.
- One trip blank and one field blank were submitted per sampling period, unless otherwise noted.
- Samples were stored in a cooler with ice packs to lower temperature and maintain them below 4°C.
- All field activities were recorded on formatted field data sheets concurrently with ongoing field activities and supported by GPS referencing at each monitoring station.
- Chain-of-custody forms including analytical selection were completed for the samples. The analytical testing for the 2017 monitoring Program is derived from the British Columbia Approved and Working Water Quality Guidelines (BC MOE 2017a and 2017b).
- Samples were delivered to the ALS Environmental laboratory depot in Fort St. John, BC.

Tables 1 and 2 in the appendix section summarize selected parameters from the program; the list is based on sampled parameters represented by available BC WQGs, subsequently discussed within the Results (Section 4.0). The BC WQG does not include guidelines for all parameters included in the Program (BC MOE 2017a).

Field parameter measurements and laboratory analytical results have been compiled in Tables 3 to 11 in the appendix section of this report; Laboratory Certificates of Analysis are included in Appendix A. Table 2-1 summarizes parameters sampled and collection periods for the Program.

Table 2-1. Laboratory Analyzed Parameters and Sampling Collection Periods

Sampling Period:	May 24 to 27, 2017	June 27 to 30, 2017	July 18 to 21, 2017	August 9 to 12, 2016	Septembe r 17 to 20, 2017	October 17 to 20, 2017
Surface Water Parameters Sampled: Colour, alkalinity, pH, total dissolved solids, total suspended solids, dissolved organic carbon, total organic carbon, ammonia, nitrate, nitrite, total Kjeldahl nitrogen, total nitrogen, total phosphorus, total dissolved phosphorus, soluble reactive phosphorus;	All Stations	All Stations	All Stations	All Stations	All Stations	All Stations
Surface Water Parameters Sampled: Major ions (calcium, magnesium, potassium, sodium), total and dissolved metals and metalloids (aluminum, antimony, arsenic, barium, beryllium, boron, cadmium, chromium, cobalt, copper, iron, lead, lithium, manganese, mercury, dissolved methylmercury, molybdenum, nickel, selenium, silver, thallium, tin, titanium, uranium, vanadium, and zinc)	All Stations					All Stations
Surface Water Parameters Sampled: Low-level analysis of total and dissolved forms of mercury and methylmercury					All Stations	All Stations
Surface Water Parameters Sampled: Chlorophyll-a	W1 and D1 (Deep and Shallow)	W1 and D1 (Deep and Shallow)	W1 and D1 (Deep and Shallow)	W1 and D1 (Deep and Shallow)	W1 and D1 (Deep and Shallow)	W1 and D1 (Deep and Shallow)
Sediment Parameters Sampled: Particle size, nutrients, and total metals (aluminum, antimony, arsenic, barium, beryllium, boron, cadmium, chromium, cobalt, copper, iron, lead, lithium, manganese, mercury, molybdenum, nickel, selenium, silver, thallium, tin, titanium, uranium, vanadium, and zinc).						All Stations

3.0 REGULATORY GUIDELINES

The British Columbia Water Quality Guidelines (WQG) provide policy direction to those making decisions affecting water quality. Although WQGs do not have any direct legal standing, once approved, WQGs must be considered in any decision affecting water quality made within the British Columbia Ministry of Environment (BC MOE). WQGs are used to assess water quality and may be used as the basis for determining the allowable limits in waste discharge authorizations. Exceeding a WQG does not imply that unacceptable risk exists, but rather that

the potential for adverse effects may be increased and additional investigation may be required" (BC MOE 2017a).

Table 3-1 describes the application of the regulatory guidelines used in comparison with the Program data.

Table 3-1. Application of Regulatory Guidelines within the Program

Regulatory Guideline	Monitoring Program Results Guidelines were Compared With	Rationale for Use
British Columbia Approved Water Quality Guidelines (BC AWQG), for freshwater aquatic life and short-term maximums (BC MOE 2017a)	All surface water quality results	The overall guidelines were developed to represent safe levels of substances that protect different water uses, including: drinking water, recreation, aquatic life, wildlife, and agriculture. Short-term maximum or "acute" guidelines are set to protect against severe effects such as lethality or other equivalents to the most sensitive species and life stage over a defined short-term exposure period (BC MOE 2017a). The requirement for applying long-term average guidelines is that five samples are collected at a station over a 30-day period.
British Columbia Working Water Quality Guidelines (BC WWQG; BC MOE 2017b)	No application to surface water quality results	The BC WWQG were reviewed and determined not to be applicable for water quality parameters based on the sampling frequency selected (e.g., sampled parameters were presented as long-term averages within the guidelines, which do not apply to monitoring Program sampling frequency).
British Columbia Working Water Quality Guidelines (BC WWQG; BC MOE 2017b)	Sediment quality results	The sediment quality results were compared to the BC WWQG because approved guidelines for sediment quality are not available. The BC WWQG for sediment quality parameters are applied using lower and upper surface water quality guidelines (SWQG). The Lower SWQG is based on "a concentration set to protect aquatic life from adverse effects of a toxic substance in most situations and is equivalent to the Canadian Council of Ministers of the Environment's (CCME) Threshold Effect Level or Interim Sediment Quality Guidelines (TEL or ISQGs; CCME, 2001)". The Upper SWQGs is based on "a concentration that if exceeded will likely cause severe effects on aquatic life (equivalent to CCME's Probable Effect Level (PEL; CCME, 2001)". As the guidelines are considered a working document, caution in applying the guidelines should be exercised. The sediment quality guidelines within the BC WWQG are based on levels of toxic substances found in the sediment where biological effects have been measured and are not based on cause-effect studies (BC MOE 2017b).

Guidelines determined to be applicable to the analyzed parameters were compiled from the BC AWQG and BC WWQG and presented in the appendix. Guidelines for cadmium, copper, fluoride, lead, manganese, silver, and zinc are provided, where applicable, in Tables 1 to 11 as a referenced equation, which vary with hardness,

pH, and temperature. Parameter specific equations used to calculate the applicable guideline values are provided in the notes of the tables.

4.0 RESULTS

Results, both *in situ* and laboratory, were compared among the sampling seasons and among stations (from upstream to downstream reaches). The objective of data analysis was to identify differences and identify parameter concentrations that differ from guidelines.

Water quality results are presented in Tables 3 to 11 and Appendix A (laboratory reports), attached to this report, and include the following for each sampling location:

- Field parameter measurements and field observations;
- Laboratory analytical results for each sample submitted, including duplicate, trip blank, and field blank analysis; and
- Exceedances of the BC AWQG and BC WWQG, bolded and shaded in grey.

The GPS coordinates of each station is provided in Figures 2a and 2b (Figure Section). Photographs of Surface Water Quality Monitoring Stations (Photos 1 to 17) are presented within the Photograph Section of this report.

4.1 Williston and Dinosaur Reservoirs Water and Sediment Quality Results

Four reference stations were selected to monitor water flowing into the Site C reach from Dinosaur and Williston reservoirs.

Reference Station Sample IDs:

- Williston (W1) – Deep and Shallow; and
- Dinosaur (D1) – Deep and Shallow.

Water samples were collected at least 25 m from the shoreline, within the middle of the reservoir towards the outlet. Depth profiles were developed by measuring field parameters throughout the water column, however a distinct hypolimnion was not identified within the first 9.0 m of the thermocline during the May 2016 sampling period. Due to limitations of light penetration below 5 m, measurements within the reservoirs were collected at 0.5 m intervals between 0.2 m and 5.0 m depths moving forward from May 2016 and reflected within the description of Methods in Section 2.0; a water sample was collected for laboratory analysis from 0.2 m and 5.0 m depths.

Sediment quality samples were collected for D1 and W1 within the near-shore littoral zones adjacent to the water sample location to collect samples with a high fine to coarse material ratio. Particle size analysis of each sample determined that Dinosaur Reservoir sediment was classified as sandy loam and Williston Reservoir sediment as clay (Table 5).

Reservoir depth profiles for W1 and D1 are provided in Tables 3 and 4; reservoir sediment quality results for W1 and D1 are presented in Table 5. Surface water quality results for both W1 and D1 (Shallow and Deep samples) are presented as monthly reports in Tables 6 to 11; all are located within the appendix section.

Throughout the sampling periods, dissolved oxygen, electrical conductivity and specific electrical conductivity remained generally stable within both W1 and D1; dissolved oxygen levels decreased slightly throughout the sampling periods but remained within guidelines and supportive of aquatic life. Field measured water

temperatures generally increased then decreased with the seasonal changes from May to October; surface temperatures exceeded BC AWQG in June and July at D1 and in July and August at W1. Throughout the water column, temperatures generally decreased with depth, however a distinct hypolimnion was not identified as there was no stratification observed within the top 5 m at any time. Measurements collected in June and July were the most elevated temperatures recorded over the course of each sampling period (Tables 3 and 4).

The pH values remained within guidelines throughout the water column measurements of both reservoirs over the course of each sampling period. Laboratory analyzed pH is considered secondary to field measured pH by a calibrated instrument due to the exceeded hold times (15 minutes) of all laboratory analyzed pH values. Hardness concentrations ranged from 79.0 mg/L to 90.8 mg/L for samples collected in May and October, which is considered moderately hard to hard water (ESRD 2014;Tables 6 to 11).

Colour, TSS, TDS, and turbidity were moderate to low throughout the sample set and over each sampling period, except for D1, where turbidity levels during the May sampling period were noticeably elevated, however, this was likely due to the increased amount of debris, dam operation, and management of water levels during spring runoff conditions. Secchi depths ranged from 0.4 m to 7.0 m below surface for D1 and 2.0 m to 7.0 m for W1. It is likely that the shallow Secchi depth results were due to significant precipitation runoff events observed in June to August (Tables 6 to 11).

Since the BC AWQG for turbidity and TSS rely on daily sample collection over a 30-day period (for long-term average guideline) or the use of automated data collection over a 24-hour period (short-term maximum guideline), the individual samples collected in 2017 were not compared to guidelines.

Anions and nutrients analyzed within the lentic sample set did not exceed available guidelines and were consistent with analysis conducted for the Peace River samples, which are located downstream of W1 and D1. TOC concentrations were within normal range (1 mg/L to 30 mg/L) for natural waterbodies (BC MELP 1998). In some instances, DOC concentrations were found to exceed the TOC concentration, which was attributed to the use of polyethersulfone based filters and is discussed within Section 5.0 (Discussion) of this report (Tables 6 to 11).

Total and dissolved metals and metalloid analysis for water quality was conducted for May and October sampling periods only. No exceedance of guidelines was observed within the lentic sample set for metals or metalloid parameters, except for total manganese (D1 and W1 shallow and deep) in both May and October, as well as total iron (D1 shallow and deep) in May (Tables 6 and 11).

All samples analyzed for ultra-low-level detection of mercury and methylmercury resulted in concentrations below detection limits (Tables 10 and 11).

Other than total iron and manganese, and temperature readings which exceeded the BC WQG, no other exceedances of the guidelines were observed within the sample sets (Tables 6 and 11).

Sediment anions and nutrient levels were considered moderately low and close to detection limits, and pH was within a normal range. W1 exceeded the Lower SWQG guidelines for arsenic, cadmium, manganese, and nickel; D1 exceeded the Lower SWQG guidelines for arsenic, cadmium, and nickel. No metal concentrations within sediments collected from either reservoir exceeded the Upper SWQC (Table 5).

Other than the metals exceedances stated, no other exceedances of the BC WWQG were observed within the sample sets.

4.2 Peace River Water Quality Results: Site C Reservoir

The Mon-8 study area includes monitoring of eight stations within the Site C Reach, defined as the portion of the Peace River that will be inundated by the Project and includes the Peace River from the Peace Canyon Dam downstream to the Site C dam site, and those sections of the Halfway and Moberly rivers that will be inundated following reservoir creation (approximately 10 km sections).

Site C Reservoir Station IDs:

- Peace Canyon (PC1)
- Upper Site C Reservoir (PR1)
- Middle Site C Reservoir (PR2)
- Halfway River Upstream (HU) and Downstream (HD)
- Lower Site C Reservoir (PR3)
- Moberly River Upstream (MU) and Downstream (MD)

Following the 2016 field season, we determined that HU and MU would not be sampled until reservoir inundation due to access restrictions related to turbulent water conditions carrying large debris (i.e., safety hazard) or low water levels making the river impassable by boat. Following filling of the reservoir, HU and MU will be incorporated into the Program again.

PC1 is considered the most upstream sample location and PR3 and MD (tributary) are considered the most downstream sample locations within the future Site C reservoir lotic sample set. Samples were collected from designated stations relating to the sample names. Peace River samples were collected from mid-channel flow locations, isolating source water considered to be well mixed within the Peace River. Tributary river samples were collected upstream of the Peace River confluence to isolate mid-channel flow source prior to it mixing with the main Peace River channel.

All parameters analyzed were within the BC AWQG guidelines for the samples collected during 2017 except for intermittent exceedances above the guideline for dissolved aluminum, total copper, total selenium, and total zinc, and regular exceedances above the guideline for total manganese and iron. During the June, July, and August sampling periods, temperature readings were elevated above the BC AWQG for tributaries only (Tables 6 to 11).

All samples analyzed throughout the May and October sampling periods exceeded the BC AWQG for total manganese (see Tables 6 and 11). Manganese is a naturally occurring element due to the weathering of rocks and minerals.

All samples analyzed throughout the May sampling period exceeded the BC AWQG for total iron (see Table 6). Iron is a naturally occurring element due to the weathering of rocks and minerals but has also been associated with acidic mine water drainage, landfill leachates, sewage effluents, and iron-related industries.

The HD sample collected in October exceeded the BC AWQG for dissolved aluminum (see Table 11). Aluminum is a naturally occurring element due to erosion of watershed areas and is also used as a coagulant in drinking water treatment facilities.

The HD sample collected in May exceeded the BC AWQG for total selenium (see Table 6). Selenium is a naturally occurring element due to the weathering of rocks and minerals, but is also released from coal fired power plants, mining, and the refining of metals.

The HD, PR3, and MD samples collected in May exceeded the BC AWQG for total copper (see Table 6). Copper is a naturally occurring element due to the weathering of rocks and minerals.

The HD, PR3, and MD samples collected in May exceeded the BC AWQG for total zinc (see Table 6). Zinc is a naturally occurring element, but also related to industrial and domestic emissions.

Field measurements of temperature from MD in June through August, and from HD in July and August indicated levels exceeding the BC AWQG (see Tables 7 to 9). Overall, the temperatures measured within tributaries were found to be higher than that of the Peace River, except for the October sampling period when temperatures within the tributaries were lower relative to Peace River values.

The pH values remained within guidelines throughout the sample set and sampling periods. The range of field measured pH values was 7.29 to 8.47 over the sampling period. Laboratory analyzed pH is considered secondary to field measured pH by a calibrated instrument due to the exceeded hold times (15 minutes) of all laboratory analyzed pH values (Tables 6 to 11).

TSS, TDS, and turbidity were consistent throughout the sample set and over each sample period, with elevated concentrations observed within the tributaries (HD and MD) as well as for all samples collected in May. These parameters were not compared against BC WQG, as short-term maximum guidelines were not provided in the publication (Tables 6 to 11).

Anions and nutrients analyzed within the sample set did not exceed the BC MOE 2017 guidelines, however results for the tributary source waters were generally observed to be elevated relative to the Peace River samples. Total organic carbon (TOC) concentrations were within normal range (1 mg/L to 30 mg/L) for natural waterbodies (BC MELP 1998; Tables 6 to 11). Dissolved organic carbon (DOC) concentrations were occasionally found to exceed the TOC concentration, which was likely attributable to the use of polyethersulfone based filters and is discussed further within Section 5 of this report.

Hardness within the tributary source waters was generally higher than that of the Peace River; hardness varied between 85.0 mg/L to 255.0 mg/L for samples collected during the May and October sampling period, which ranged from moderately hard to very hard water (ESRD 2014; Tables 6 and 11).

All samples analyzed for ultra-low-level detection of mercury and methylmercury resulted in concentrations either below or within an order of magnitude of detection limits (Tables 10 and 11).

Other than total forms of iron, selenium, copper, zinc, manganese, dissolved aluminum, and temperature exceeding the BC AWQG, no other exceedances of the guidelines were observed within the sample sets. Sediment quality samples were collected for all Site C reservoir samples within the near-shore littoral zones adjacent to the water sample location to collect samples with a high fine to coarse material. Particle size analysis of each sample determined that sediment varied between silt and sandy loam soil textures (Table 5).

Sediment anions and nutrient levels were considered moderately low and close to detection limits, and pH was within a normal range. The BC WWQG Lower SWQG were exceeded for arsenic (HD, PR3, MD), cadmium (PC1, PR2, PR3, and MD), and nickel (PC1, PR1, PR3, HD, and MD); No metal concentrations within sediments collected from the Site C reach exceeded the Upper SWQC (Table 5).

Other than the metals exceedances stated, no other exceedances of the BC WWQG were observed within the sample sets.

4.3 Peace River Water Quality Results: Downstream Reach

The Mon-9 study area includes monitoring of nine stations within the Peace River from the Site C dam site downstream to the Many Islands area in Alberta, approximately 120 km.

Downstream Reach Station IDs:

- Peace at Pine (PD1)
- Pine River (PINE)
- Peace at Beatton (PD2)
- Beatton River (BEA)
- Peace at Kiskatinaw River (PD3)
- Kiskatinaw River (KR)
- Peace at Pouce Coupe (PD4)
- Pouce Coupe (POUCE)
- Peace at Many Islands (PD5)

PD1 is considered the most upstream sample location and PD5 is considered the most downstream sample location within the downstream reach lotic sample set. Samples were collected from designated stations relating to the sample names. Peace River samples were collected from mid-channel flow locations, isolating source water considered to be well mixed within the Peace River. Tributary river samples were collected upstream of the Peace River confluence to isolate mid-channel flow source prior to it mixing with the main Peace River channel.

All parameters analyzed met the BC AWQG for the samples collected during 2017 except for intermittent exceedances above the guideline for dissolved aluminum and iron, and regular exceedances above the guideline for total copper, iron, manganese, and zinc. During the May, June, July, and August sampling periods, temperature readings were elevated above the BC AWQG for tributaries only, except for PD5 in July (Tables 6 to 11).

All samples analyzed throughout the May and October sampling periods exceeded the BC AWQG for total manganese (see Tables 6 and 11). Manganese is a naturally occurring element due to the weathering of rocks and minerals.

All samples analyzed throughout the May sampling period exceeded the BC AWQG for total iron, except for PD1 and POUCE in October. Samples collected in May (PINE, BEA, and POUCE) and October (BEA and PD5) also exceeded the BC AWQG for dissolved iron (see Tables 6 and 11). Iron is a naturally occurring element due to the weathering of rocks and minerals but has also been associated with acidic mine water drainage, landfill leachates, sewage effluents, and iron-related industries.

The PINE and POUCE samples collected in May and the KR sample collected in October exceeded the BC AWQG for dissolved aluminum (see Table 11). Aluminum is a naturally occurring element due to erosion of watershed areas and is also used as a coagulant in drinking water treatment facilities.

All samples collected in May exceeded the BC AWQG for total copper (see Table 6). Copper is a naturally occurring element due to the weathering of rocks and minerals.

All samples collected in May exceeded the BC AWQG for total zinc (see Table 6). Zinc is a naturally occurring element, but also related to industrial and domestic emissions.

Field measurements of temperature in June through August indicated levels exceeding the BC AWQG for all tributaries. MD temperatures in June and PD5 temperatures in July also exceeded the BC AWQG (see Tables 6 to 9). Overall, the temperatures measured in the tributaries were found to be higher than that of the Peace River, except for the October sampling period when temperatures within the tributaries were lower relative to the Peace River.

The pH values remained within guidelines throughout the sample set and sampling period. The range of field measured pH values was 7.75 to 8.68 over the sampling period. Laboratory analyzed pH is considered secondary to field measured pH by a calibrated instrument due to the exceeded hold times (15 minutes) of all laboratory analyzed pH values (Tables 6 to 11).

TSS, TDS, and turbidity were consistent throughout the sample set and over each sample period, with generally elevated concentrations observed within the tributaries compared to the Peace River samples. Measurements and concentrations observed in May and June during higher spring flows were higher than other sampling periods in the Program (Tables 6 to 11). These parameters were not compared against BC WQG, as short-term maximum guidelines were not provided in the publication.

Anions and nutrients analyzed within the sample set were not observed to exceed the BC MOE 2017 guidelines, however results for the tributary source waters were generally observed to be elevated relative to the Peace River samples. TOC concentrations were within normal range (1 mg/L to 30 mg/L) for natural waterbodies (BC MELP 1998). DOC concentrations were occasionally found to exceed the TOC concentration, which was likely attributable to the use of polyethersulfone based filters and is discussed further within Section 5.0 of this report (Tables 6 to 11).

Hardness within the tributary source waters was generally higher than that of the Peace River. Hardness varied between 56.8 mg/L to 197.0 mg/L for samples collected during the May and October sampling periods, which ranged from soft to very hard water (ESRD 2014; Tables 6 and 11).

All samples analyzed for ultra-low-level detection of mercury and methylmercury resulted in concentrations either below or within an order of magnitude of detection limits (Tables 10 and 11).

Other than intermittent exceedances above the BC AWQG for temperature, dissolved aluminum and iron, and regular exceedances above the BC AWQG for total copper, iron, manganese, and zinc, no other exceedances of the guidelines were observed within the sample sets.

Sediment quality samples were collected for all downstream reach samples within the near-shore littoral zones adjacent to the water sample location to collect samples with a high fine to coarse material ratio. Particle size analysis of each sample determined that sediment varied between loamy sand and sandy loam soil textures (Table 5).

Sediment anions and nutrient levels were considered moderately low and close to detection limits, and pH was within a normal range. All samples exceeded the BC WWQG Lower SWQG for arsenic and nickel; PD1 and PD4 exceeded the BC WWQG for cadmium. No metal concentrations within sediments collected from the Downstream Reach exceeded the Upper SWQC (Tables 5).

Other than the metals exceedances stated, no other exceedances of the BC WWQG were observed within the sample sets.

4.4 Quality Assurance and Quality Control

The quality assurance and quality control (QA/QC) programs for water and sediment quality sampling are implemented to assess and/or quantify field, laboratory and data reduction quality.

Laboratory QA/QC reports are required by environmental laboratories accredited by the Canadian Association of Environmental Analytical Laboratories (CAELA), such as ALS Environmental, and can be requested to be attached to the laboratory data or requested from the lab directly. Laboratory QA/QC data reviewed by the assessor is generally limited to percentage recovery of added surrogates. The reported detection limits (RDL) of the analytical methods are presented on the analytical reports and in Tables 12 to 14.

Field quality control includes procedures and documentation, and occasionally collection of quality assurance samples. Field quality assurance sampling programs are used to measure the precision and accuracy of the field sampling using blank and duplicate samples.

The field sampling and laboratory testing reproducibility of the sample-duplicate pairs is evaluated using the relative percentage difference (RPD) method, involving calculation of RPD as follows:

$$RPD\ \% = [Sample - Duplicate]/(X)*100$$

where X is the average concentration of the sample and its duplicate.

The duplicate analysis is compared to the sample by evaluating the RPD, where the target RPD is less than a 30% difference. RPD is calculated for results that are higher than five times the reported detection limit. Results of RPD analysis are presented in Tables 12 and 13. Approximately 3% of all water quality duplicates and 41% of all sediment quality duplicates were found to generate an exceedance of 30% RPD analysis. The water quality exceedances were attributed to the following parameters: dissolved uranium, magnesium, cadmium, colour, DOC, TSS, and phosphorus. The sediment quality exceedances were attributed to soil textures, TOC, nitrogen, ammonium, phosphate, aluminum, antimony, arsenic, beryllium, cadmium, calcium, chromium, cobalt, copper, lead, lithium, magnesium, manganese, mercury, molybdenum, nickel, potassium, uranium, vanadium, and zinc. Overall, 3% exceedance of water quality parameters is within an acceptable quality control range. The exceedance of 41% sediment quality parameters is considerably higher, however, sediments tend to be heterogeneous due to differential factors such as deposition from the water column and upstream sources, therefore, there is a higher potential for variability within sediments than in water.

Trip or travel blanks are deionized water sealed in a bottle provided by the laboratory and are introduced for travelling with the samples for the duration of the sampling period. Elevations above the reported detection limit may indicate laboratory or transit introduced errors outside of the field methodology. Table 14 indicates elevations above reported detection limits for TKN and ammonia in June. A one-time elevation of a parameter does not indicate major error.

Field blanks are deionized water filled into bottles using the same field methodology applied to the analyzed sample set. All bottles and water are provided by the laboratory and are introduced for evaluating the field methodology and potential for analytical interference using equipment or sampling practices. Elevations above the reported detection limit may indicate field level introduced errors. Table 14 indicates elevations above reported detection limits for hardness, total chromium and manganese, dissolved aluminum, calcium, and manganese in September; and dissolved and total manganese in October. A one-time elevation of a parameter does not indicate major error. The occurrence of manganese in the field blanks for September and October are consistent with the observation of manganese throughout the sampling Program.

The pH value reported for each field and trip blank were below the normal range of 6.5 to 9.0 and considered acidic. This is likely attributed to the acidity of the deionized water and not sampling and analytical methodologies. For this reason, as well as limited hold times of 15 minutes, field measured pH and not laboratory analyzed pH was interpreted for data analysis.

5.0 DISCUSSION

The overall objectives of Mon-8 and Mon-9 in 2017 were to contribute to the overall FAHMFP by qualifying and quantifying the surface water and sediment conditions within the Peace River and its tributaries as it relates to the Site C Energy Project.

5.1 Management Hypotheses

Mon-8 and Mon-9 were developed to monitor water and sediment quality in the Site C Reservoir and Peace River to address the management questions listed in the FAHMFP (see Section 1.0).

The management questions and management hypotheses outlined in Section 1.0 will require several years of data collection before the questions may be definitively addressed. This report is the second year of data collection for these two monitoring Programs under the FAHMFP. Discussion of Results

A discussion of the 2017 monitoring Program results is presented here to identify key findings and potential sources of error:

DOC concentrations in 2017 were occasionally elevated above TOC concentrations in contrast to more consistent results of DOC concentrations elevated above TOC concentrations observed in 2016. DOC concentrations of May through August field blank samples were reported above 0 mg/L in field filtered deionized water provided by the lab. In 2016, one potential source of organic carbon was attributed to the field filtration equipment. ALS Environmental confirmed that this is a known contributor of organic carbon to analytical samples, and therefore, the concentrations reported are not considered to be an indicator of high concentrations of source water DOC. In 2017, we implemented flushing of the field equipment with a goal to reduce the incidence of false positives for DOC. Although this has not resolved the concern of organic carbon impacts from field equipment, some improvement was observed in 2017. The TOC concentrations are considered stable and mostly within natural levels for a lotic/ lentic system with elevated background turbidity conditions (BC MELP 1998).

Water quality parameters were consistently below the guidelines except for regular exceedances for iron and manganese and intermittent exceedances of temperature, zinc, copper, aluminum, and selenium. Sediment quality parameters were consistently below the guidelines except for arsenic, cadmium, manganese, and nickel. Source(s) of the exceeded parameters could not be conclusively determined. Many Peace River tributaries are large systems characterized by high, vertical banks composed of fine materials which are subject to erosion during high flow periods. Given the location and parameters involved, it is possible that the exceedances are the result of natural processes (i.e., regional geology and erosion) and process error (i.e., natural variability among years).

5.2 Quality Assurance and Quality Control

The QA/QC programs for water and sediment quality sampling are implemented to assess and/or quantify field, laboratory and data reduction quality.

Except for DOC attributed to the use of polyethersulfone based filters, all elevations of field blank parameters above the RDL are attributed to residual water left in the tube equipment between samples used in September and October. All field equipment is triple rinsed between sampling locations. Infrequent elevations do not indicate major error, but the introduction of tube intake sampling in September and October (to replace grab sampling methods previously used) suggests that additional flushing time with source water between sampling locations is advised. The volume of water flushed through equipment following each sample was increased following the September sampling period and the use of HDPE intake tubing was replaced with platinum-rinsed silicone tubing, which is considered a more inert sampling material.

In general, the QA/QC program confirmed that most blank and duplicate parameter concentrations are within acceptable quality ranges, therefore the overall analytical program is considered to accurately characterize water quality conditions at the sample stations.

6.0 CLOSURE

We trust this report meets your present requirements. If you have any questions or comments, please contact the undersigned.

Respectfully submitted,
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TABLES

Table 1. Summary of Surface Water Quality Parameters Compared to BC Approved Water Quality Guidelines

Parameters Represented within the BC Approved Water	Unit	Reported Detection Limit (RDL)	BC MOE 2017 (Approved Guidelines for freshwater aquatic life and short-term maximum)	Common Sources of Parameter
Physical Parameters and Field Measurements				
Temperature	°C	-	15	The temperature guideline is designed to protect aquatic life in fresh, estuarine and coastal marine waters from excessive temperature fluctuations that are influenced by anthropogenic activities during sensitive periods. Given the large variation in water temperatures throughout British Columbia due both to the geographical range of the province as well as the large differences in elevation, ambient temperatures are factored into the guidelines so that they adhere closely to the natural temperature regime to which sensitive organisms have adapted through evolutionary processes (BC MOE 2017a). Deviation from the guideline value indicates variance of water temperatures outside of normal environmental conditions; natural variance outside of the normal range due to seasonal ambient temperature extremes may cause water temperatures to exceed guidelines and is reported accordingly.
Dissolved Oxygen (DO)	mg/L	-	Minimum 5 [#1]	Oxygen is the single most important component of surface water for self-purification processes and the maintenance of aquatic organisms which utilize aerobic respiration. The guideline value presented focuses on the effects of minimum oxygen levels on aquatic life. Dissolved oxygen is not a known concern for other water uses other than for some industries, where corrosion can be a concern (ESRD, 2014).
Hardness as CaCO3	mg/L	0.5		The hardness of water is generally due to the presence of calcium and magnesium in the water; the main natural sources of hardness in water are sedimentary rocks and runoff from soils (Health Canada, 1979a). The BC AWQG established for several water quality parameters, such as total copper, lead and zinc are hardness dependent. The toxicity of metals such as copper, lead and zinc can be reduced as hardness increases (Cavanagh et al, 1998). Water hardness varies from soft to hard water conditions based on the following scale: very soft water(0 - 30); soft to moderately soft (31 - 75 mg/L); moderately soft/hard to hard (76 - 180 mg/L); very hard (181 - 250 mg/L) (ESRD, 2014).
pH	pH Units	-	6.5-9.0	The pH of water is determined by the geology of the watershed and is influenced by the seasonal and daily variations in photosynthesis, respiration and decomposition (Sanderson et al, 2012). pH is an important water quality parameter as it affects the solubility and bioavailability of some nutrients and metals. For example, heavy metals tend to be more toxic in water with lower pH because they are more soluble (Michaud, 1991 in Sanderson et al, 2012, page 92). Laboratory analyzed pH is considered secondary to field measured pH by a calibrated instrument due to the exceeded hold times (15 minutes) of all laboratory analyzed pH values.
Anions and Nutrients				
Ammonia as N	mg/L	0.005	See narrative [#2]	Naturally occurring; released from agricultural or industrial wastes; added as part of chloramination for drinking water disinfection (Health Canada, 2017)
Chloride	mg/L	0.5	600	Naturally occurring (seawater intrusion); dissolved salt deposits, highway salt, industrial effluents, oil well operations, sewage, irrigation drainage, refuse leachates (Health Canada, 2017).
Fluoride	mg/L	0.02	See equation [#3]	Naturally occurring (rock and soil erosion); may be added drinking water sources to promote dental health and subsequently present within anthropogenic effluents discharged into surface waters (Health Canada, 2017).
Nitrate (as N)	mg/L	0.005	32.8	Naturally occurring; leaching or runoff from agricultural fertilizer use, manure and domestic sewage; may be produced from excess ammonia or nitirification in the distribution system (Health Canada, 2017).
Nitrite (as N)	mg/L	0.001	0.06-0.60 [#4]	Naturally occurring; leaching or runoff from agricultural fertilizer use, manure and domestic sewage; may be produced from excess ammonia or nitirification in the distribution system (Health Canada, 2017).
Total Metals				
Arsenic	µg/L	0.0005	0.005	Arsenic is a natural component of the earth's crust and is widely distributed throughout the environment in the air, water and land (WHO, 2016). It Arsenic occurs naturally as a result of weathering of rock and soil. Levels of arsenic in natural source waters ranges between 2 and 50 µg/L (CCME, 2001). Arsenic is highly toxic in its inorganic form and long-term exposure can cause considerable health issues in humans.
Cobalt	mg/L	0.0003	0.11	
Copper	mg/L	0.001	See equation [#5]	Copper is a natural constituent of most rock types, with igneous rock containing the highest concentrations, followed by sedimentary rocks such as shale, sandstone and limestone (Singleton, 1987). Bertine and Goldberg (1971, in Singleton, 1987, page 6) estimated that 40 to 67% of total copper inputs are the result of natural weathering. Copper is acutely toxic to most forms of aquatic life at relatively low concentrations but is generally found in freshwater at trace concentrations ranging from 1- to 10 µg/L (Cavanagh et al., 1998), but can be as high as 50 µg/L (CCREM, 1987). The toxicity of copper is highly influenced by water hardness, increasing with decreased hardness. The BC AWQG for copper is hardness dependent (calculated as is calculated as 0.094(H)+2) .
Iron	mg/L	0.03	1	Iron is a common element and is occurs naturally through weathering of sulphide ores and leaching of sandstones (CCREM, 1987). Iron can be a significant constituent of soils, especially clays (Phippen et al, 2008). Anthropogenic sources are often related to mining. It is a requirement for all lifeforms but can be toxic at high concentrations. The concentrations of iron in Canadian surface waters are generally below 10 mg/L (Health Canada, 1978a). The BC AWQG for total iron is 1 mg/L, the Health Canada aesthetic objective for iron in drinking water is ≤ 0.3 mg/L (Health Canada, 1978).
Lead	mg/L	0.0005	See equation [#6]	Lead has been observed in natural waters ranging from trace levels up to 40 µg/L, in both the soluble and particulate forms (McNeely et al., 1979 in Sanderson et al, 2012, page 174), and in regions with sulphide ores in the underlying geology, concentrations can reach 0.8 mg/L (Cavanagh et al., 1998). The toxicity of lead is dependent on the hardness, pH, alkalinity, and dissolved oxygen content of the water; toxicity increases as hardness decreases (CCREM, 1987). The BC AWQG for total lead is hardness dependent (calculated as 3 µg/L at H<8 mg/L, or calculated as e(1.273*ln(H)-1.460) when H>8 mg/L).
Manganese	mg/L	0.0001	See equation [#7]	Naturally occurring (erosion and weathering of rocks and minerals; Health Canada, 2017).
Molybdenum	mg/L	0.001	2	Molybdenum occurs in nature as a chemical combination with other elements (predomnately in porphyry copper ore deposits of molybdenite mined from central BC). Drainage from molybdenum-bearing mineral deposits and molybdenum mines is the only known source of molybdenum discharged to surface waters in BC (BC MOE 2017a).
Selenium	mg/L	0.00005	0.002	Selenium occurs naturally in sedimentary rocks, shales, coal and phosphate deposits and soils and generally occurs together with sulfides of metals such as copper, zinc and lead (US EPA, 2016). Selenium is bioaccumulative and can be toxic to aquatic life. Surface waters in most areas contain less than 1.0 µg/L (Lakin and Davidson, 1967 in CCREM, 1987 page 412). Concentrations of selenium in central Canadian waters typically range from 0.1 to 4 µg/L (CCREM, 1987).
Silver	mg/L	0.00002	0.0001 or 0.003 [#8]	Naturally occurring (erosion and weathering of rocks and soils; Health Canada, 2017).
Zinc	mg/L	0.005	See equation [#9]	Although relatively non-toxic to terrestrial organisms, zinc can be both acutely and chronically toxic to aquatic organisms (Cavanagh et al., 1998). Several factors such as water hardness, salinity, temperature, and the presence of other contaminants influence zinc toxicity in aquatic environments (Nagpal, 1999). Its toxicity decreases with increasing hardness, increases with increasing temperature, and increases with decreasing dissolved oxygen (Cavanagh et al.,1998). Natural concentrations range from 1 to 96 µg/L (0.001 to 0.0096 mg/L), but do not typically exceed 40 µg/L (0.04 mg/L) in river water (Environment Canada 1984 in Health Canada, 1987b, page 2). In certain waters, such as in mining areas or acidic waters, concentrations 10- to 1000 times greater can be found (CCREM, 1987).

Table 1. Summary of Surface Water Quality Parameters Compared to BC Approved Water Quality Guidelines

Parameters Represented within the BC Approved Water	Unit	Reported Detection Limit (RDL)	BC MOE 2017 (Approved Guidelines for freshwater aquatic life and short-term maximum)	Common Sources of Parameter
Dissolved Metals				
Aluminum (Filtered)	mg/L	0.005	0.1 #10	Aluminum is generally found in concentrations of less than 1000 µg/L (Cavanagh et al., 1998). The dissolved form of aluminum is more toxic than the particulate form, with the greatest toxicity occurring in waters with pH less than 6 (CCREM, 1987). A large fraction of total aluminum may not be bioavailable so toxicity may be overestimated, especially in highly turbid water (Butcher, 2001).
Cadmium (Filtered)	mg/L	0.000005	See equation #11	Cadmium, which has been shown to bioaccumulate, is highly toxic in all its forms, though dissolved cadmium is more bioavailable. The toxicity of cadmium is highly influenced by water hardness; the toxicity increases with decreased water hardness (CCME, 2014). Presence of other heavy metals like zinc and copper have has been shown to increase cadmium's toxicity (Cavanagh et al., 1998). Weathering of rock and forest fires are the most common natural pathways for cadmium to enter surface water therefore, cadmium may occur at higher concentrations naturally because of the underlying geology.
Iron (Filtered)	mg/L	0.03	0.35	Iron is a common element and is occurs naturally through weathering of sulphide ores and leaching of sandstones (CCREM, 1987). Iron can be a significant constituent of soils, especially clays (Phippen et al, 2008). Anthropogenic sources are often related to mining. It is a requirement for all lifeforms but can be toxic at high concentrations. The concentrations of iron in Canadian surface waters are generally below 10 mg/L (Health Canada, 1978a). The BC AWQG for total iron is 1 mg/L, the Health Canada aesthetic objective for iron in drinking water is ≤ 0.3 mg/L (Health Canada, 1978).

NOTES:

BC MOE 2017 — British Columbia Ministry of Environment (BC MOE). 2017. British Columbia approved water quality guidelines: Aquatic life, wildlife & agriculture. Water Protection and Sustainability Branch. Victoria, British Columbia, Canada.

H — Hardness. Where hardness values exceed the range applied for guideline use, site specific assessment may be required.

#1 — Dissolved Oxygen guideline protects all life stages other than buried embryo/alevin, based on instantaneous measurement.

#2 — Guideline for ammonia nitrogen (NH_3) varies with pH and temperature, and is derived from Table 26D of the BC MOE, 2017 BCWQGs, ranging from 0.681 to 28.7 mg/L for pH 6.5-9.0 and temperature 0.0-20.0 degC.

#3 — Guideline for fluoride varies with H. Guideline is 0.4 mg/L when H <10 mg/L. Calculated in mg/L and based on equation: [-51.73 + 92.57*log(Hardness)]x0.01 when H =10-385 mg/L.

#4 — Guideline for nitrite varies with chloride concentrations.

#5 — Guideline for copper varies with H and is calculated in mg/L and based on equation: [0.094(H)+2]/1000, when H =13-400 mg/L.

#6 — Guideline for lead varies with H. Guideline is 0.003 mg/L when H<8 mg/L. Calculated in mg/L and based on equation: $[e^{(1.273*ln(H)-1.460)}]/1000$ when H=8-360 mg/L

#7 — Guideline for manganese varies with H and is calculated in mg/L and based on equation: (0.01102*H)+0.54, when H =25-259 mg/L.

#8 — Guideline for silver varies with H. Guideline is 0.0001 mg/L when H<100 mg/L or 0.003 mg/L when H>100 mg/L

#9 — Guideline for zinc varies with H. Guideline is 0.033 mg/L when H is <90 mg/L. Calculated in mg/L and based on equation: [33+0.75*(H-90)]/1000, when H=90-500 mg/L.

#10 — Guideline for aluminum varies with pH. Guideline is 0.1 mg/L if pH ≥ 6.5. Calculated in mg/L and based on equation: $e^{(1.209-2.426(pH)+0.286K)}$ where $K=(pH)^2$ and pH < 6.5.

#11 — Guideline for cadmium varies with H and is calculated in mg/L and based on equation: $[e^{(1.03*ln(H)-5.274)}]/1000$, when H=7-455 mg/L.

Table 2. Summary of Sediment Quality Parameters Compared to BC Working Water Quality Guidelines

Parameter	Unit	Reported Detection Limit (RDL)	BC MOE 2017 (mg/kg in dry weight) Lower SWQG	BC MOE 2017 (mg/kg in dry weight) Upper SWQG	Common Sources of Parameter
Metals (Soil)					
Arsenic	mg/kg	0.1	5.9[#1]	17[#2]	Arsenic is a natural component of the earth's crust and is widely distributed throughout the environment in the air, water and land (WHO, 2016). It Arsenic occurs naturally as a result of weathering of rock and soil. Arsenic is highly toxic in its inorganic form and long-term exposure can cause considerable health issues in humans.
Cadmium	mg/kg	0.02	0.6[#1]	3.5[#2]	Cadmium, which has been shown to bioaccumulate, is highly toxic in all its forms, though dissolved cadmium is more bioavailable. Presence of other heavy metals like zinc and copper have has been shown to increase cadmium's toxicity (Cavanagh et al., 1998). Weathering of rock and forest fires are the most common natural pathways for cadmium to enter surface water therefore sediments; cadmium may occur at higher concentrations naturally because of the underlying geology.
Chromium	mg/kg	0.5	37.3[#1]	90[#2]	Leaching from topsoil and rocks is the most important natural source of chromium entry into bodies of water and underlying sediments (Agency for Toxic Disease and Substance Registry, 2008). However, more than 70% of chromium in the environment comes from anthropogenic sources, such as tanneries, electroplating, non-ferrous foundries, wood treatment facilities, urban storm water runoff, and discharges from thermal generating stations (Health Canada, 2015; Cavanagh et al., 1998). Chromium is generally present at low concentrations in Canadian surface waters (Health Canada, 1979b).
Copper	mg/kg	0.5	35.7[#1]	197[#2]	Copper is a natural constituent of most rock types, with igneous rock containing the highest concentrations, followed by sedimentary rocks such as shale, sandstone and limestone (Singleton, 1987). Bertine and Goldberg (1971, in Singleton, 1987, page 6) estimated that 40 to 67% of total copper inputs are the result of natural weathering. Copper is acutely toxic to most forms of aquatic life at relatively low concentrations (Cavanagh et al., 1998).
Iron	mg/kg	50	21,200 (about 2%)[#3]	43,766 (about 4%)[#3]	Iron is a common element and is occurs naturally through weathering of sulphide ores and leaching of sandstones (CCREM, 1987). Iron can be a significant constituent of soils, especially clays (Phippen et al, 2008). Anthropogenic sources are often related to mining. It is a requirement for all lifeforms but can be toxic at high concentrations.
Lead	mg/kg	0.5	35[#1]	91.3[#2]	Lead has been observed in natural environments, occurring either naturally but is also present in older infrastructure (e.g. pipes, solder, brass fittings and lead service lines; Health Canada, 2017).
Manganese	mg/kg	1	460[#3]	1100[#3]	Naturally occurring (erosion and weathering of rocks and minerals; Health Canada, 2017).
Mercury	mg/kg	0.005	0.17[#1]	0.486[#2]	Mercury is found in the environment naturally from the weathering of rocks but atmospheric deposition is a major pathway to aquatic systems (Sanderson et al, 2012).
Nickel	mg/kg	0.5	16[#3]	75[#3]	Nickel naturally occurs as a chemical combination with other elements (erosion and weathering of rocks and minerals), and is also widely used in mettalurgical industry practices (BC MOE, 2017b).
Silver	mg/kg	0.1	0.5[#4]	N/A[#4]	Naturally occurring (erosion and weathering of rocks and soils; Health Canada, 2017).
Zinc	mg/kg	2	123[#1]	315[#2]	Although relatively non-toxic to terrestrial organisms, zinc can be both acutely and chronically toxic to aquatic organisms (Cavanagh et al., 1998). Several factors such as water hardness, salinity, temperature, and the presence of other contaminants influence zinc toxicity in aquatic environments (Nagpal, 1999). Concentrations within areas affected by mining or acidic water, concentrations, increased concentrations are found (CCREM, 1987).

NOTES:

BC MOE 2017	BC MOE. 2017. Working Water Quality Guidelines and Working Sediment Quality Guidelines for British Columbia. Water Protection and Sustainability Branch. British Columbia Ministry of Environment.
Lower SWQG	A concentration that will protect aquatic life from adverse effects of toxic substance in most situations (equivalent to CCME's Threshold Effect Level or Interim Sediment Quality Guidelines (TEL or ISQGs; CCME 2001))
Upper SWQG	A concentration that if exceeded will likely cause severe effects on aquatic life (equivalent to CCME's Probably Effect Level (PEL; CCME (2001)).
CCME 2001	Canadian Council of Ministers of the Environment (CCME). 2001. Canadian sediment quality guidelines. Canadian Council of Ministers of the Environment, Winnipeg. Accessed on-line at http://ceqg-rcqe.ccme.ca/en/index.html#void
AET	Apparent Effects Threshold
BA	Background Approach
CoA	Co-Occurrence analysis
EqP	Equilibrium Partitioning
ISQG	Interim Sediment Quality Guideline
NSTPA	National Status and Trends Program Approach
PEL	Probable Effect Level
SLC	Screening Level Concentration
#1	Lower SWQG is based on ISQG
#2	Upper SWQG is based on PEL
#3	Effect levels based on SLC
#4	Based on Ontario sediment guideline

Table 3: Williston Reservoir Water Quality Depth Profile Summary

Field Parameter	Sample Depth	Secchi Depth	Total Depth	Temperature	Dissolved Oxygen	Specific Conductivity	Electrical Conductivity	Salinity	Total Dissolved Solids	pH	ORP	Turbidity
Units	**m**	**m**	**m**	**°C**	**mg/L**	**SPCµS/cm**	**µS/cm**	**SAL-ppt**	**mg/L**		**mV**	**NTU**
BC MOE 2017 (Approved Guidelines for freshwater aquatic life and short-term maximum)		**-**		**15**	**Minimum 5 mg/L (All life stages other than buried embryo/alevin)**	**-**	**-**	**-**	**-**	**6.5-9.0**	**-**	**-**
Sample Date	**m**	**m**	**m**	**°C**	**mg/L**	**SPCµS/cm**	**µS/cm**	**SAL-ppt**	**mg/L**		**mV**	**NTU**
26-May-17	0.2	3.75	-	3.8	11.02	186.0	111.2	0.09	120.8	7.94	177.2	3.3
	0.5			3.7	11.34	185.9	110.6	0.09	120.9	7.96	180.6	3.3
	1.0			3.8	11.34	185.8	110.5	0.09	120.8	7.97	184.0	3.4
	1.5			3.8	11.37	185.9	110.1	0.09	120.8	7.97	188.4	3.3
	2.0			3.6	11.37	185.9	110.0	0.09	120.8	8.00	191.3	3.6
	2.5			3.7	11.37	185.9	110.0	0.09	120.9	8.01	194.0	3.4
	3.0			3.7	11.36	185.9	110.3	0.09	120.8	8.02	196.9	3.4
	3.5			3.6	11.38	185.9	109.8	0.09	120.8	8.03	200.1	3.5
	4.0			3.6	11.38	185.9	109.0	0.09	120.8	8.03	202.1	3.4
	4.5			3.6	11.38	185.9	110.0	0.09	120.8	8.04	204.0	3.5
	5.0			3.7	11.37	185.9	110.1	0.09	120.8	8.04	206.0	3.5
29-Jun-17	0.2	2.00	69	10.9	11.11	185.5	135.6	0.09	120.5	8.17	173.7	2.5
	0.5			10.9	11.11	185.5	135.6	0.09	120.6	8.18	177.6	2.5
	1.0			10.9	11.11	185.5	135.4	0.09	120.6	8.18	179.3	2.6
	1.5			10.9	11.12	185.5	135.4	0.09	120.6	8.17	181.6	2.7
	2.0			10.8	11.13	185.5	135.4	0.09	120.6	8.17	183.8	2.7
	2.5			10.8	11.13	185.4	135.3	0.09	120.6	8.18	185.9	2.8
	3.0			10.7	11.14	185.5	135.1	0.09	100.5	8.17	187.5	2.7
	3.5			10.7	11.15	185.4	135.0	0.09	120.5	8.17	189.3	2.7
	4.0			10.7	11.14	185.5	134.8	0.09	120.5	8.17	190.5	2.7
	4.5			10.6	11.15	185.5	134.7	0.09	120.6	8.17	192.3	2.6
	5.0			10.6	11.16	185.7	134.5	0.09	120.7	8.18	194.1	2.4
20-Jul-17	0.2	2.25	58	**15.7**	9.70	180.4	148.6	0.09	117.2	8.19	125.3	3.7
	0.5			**15.5**	9.77	180.5	148.9	0.09	117.2	8.16	114.9	3.6
	1.0			**15.4**	9.76	180.2	147.2	0.09	117.1	8.16	151.5	4.0
	1.5			**15.3**	9.77	180.2	147.0	0.09	117.1	8.15	159.2	4.5
	2.0			14.8	9.82	179.9	144.9	0.09	117.1	8.14	160.5	4.6
	2.5			14.7	9.84	179.9	144.6	0.09	116.9	8.13	167.3	4.9
	3.0			14.6	9.87	179.7	144.5	0.09	117.0	8.13	171.2	4.2
	3.5			14.5	9.92	179.8	144.0	0.09	116.9	8.11	176.6	3.7
	4.0			14.5	9.92	179.5	143.3	0.09	116.7	8.13	177.9	3.1
	4.5			14.4	9.93	179.5	143.3	0.09	116.7	8.13	180.1	3.2
	5.0			14.3	9.93	179.5	142.9	0.09	116.7	8.14	181.8	3.2
11-Aug-17	0.2	4.25	59	**19.1**	9.06	176.9	156.9	0.08	114.9	8.29	105.1	7.0
	0.5			**19.1**	9.07	176.6	166.9	0.08	115.0	8.90	106.0	7.0
	1.0			**19.0**	9.09	176.6	166.4	0.08	114.3	8.25	108.7	7.1
	1.5			**18.6**	9.12	177.2	165.8	0.08	114.1	8.27	107.9	7.2
	2.0			**18.5**	9.15	177.0	165.0	0.08	115.0	8.28	115.7	7.2
	2.5			**18.4**	9.17	176.7	164.0	0.08	114.8	8.28	116.6	7.4
	3.0			**18.3**	9.17	177.0	164.0	0.08	114.9	8.28	118.3	7.5
	3.5			**18.3**	9.17	176.8	164.1	0.08	114.9	8.27	110.4	7.5
	4.0			**18.1**	9.21	176.8	163.7	0.08	114.9	8.27	121.6	7.6
	4.5			**17.5**	9.25	176.9	161.9	0.08	114.8	8.27	122.6	8.3
	5.0			**16.8**	9.23	176.2	148.8	0.08	114.5	8.23	125.1	8.0
17-Sep-17	0.2	6.00	57	14.4	9.42	166.2	132.5	0.08	108.1	8.26	174.8	3.3
	0.5			14.4	9.42	166.2	132.5	0.08	108.1	8.26	173.9	3.3
	1.0			14.4	9.42	166.2	132.5	0.08	108.1	8.27	171.4	3.3
	1.5			14.3	9.42	166.2	132.4	0.08	108.1	8.27	170.3	3.3
	2.0			14.3	9.41	166.2	132.3	0.08	108.5	8.26	169.9	3.3
	2.5			14.3	9.41	166.2	132.3	0.08	108.5	8.26	168.8	3.3
	3.0			14.3	9.41	166.2	132.3	0.08	108.0	8.26	165.0	3.3
	3.5			14.3	9.40	166.2	132.3	0.08	108.0	8.26	163.8	3.3
	4.0			14.3	9.40	166.2	132.2	0.08	108.0	8.26	162.6	3.3
	4.5			14.3	9.40	166.2	132.2	0.08	108.0	8.27	160.3	3.3
	5.0			14.3	9.40	166.2	132.2	0.08	108.0	8.28	157.8	3.3
20-Oct-17	0.2	5.00	46	10.7	9.83	174.9	127.2	0.08	113.6	8.35	88.0	4.9
	0.5			10.7	9.84	174.7	127.1	0.08	113.6	8.26	94.5	4.9
	1.0			10.7	9.84	174.8	127.2	0.08	113.6	8.24	97.4	4.9
	1.5			10.7	9.83	174.7	127.1	0.08	113.6	8.23	101.6	4.9
	2.0			10.7	9.83	174.6	127.0	0.08	113.6	8.28	105.6	4.9
	2.5			10.7	9.83	174.7	127.0	0.08	113.6	8.19	112.4	4.9
	3.0			10.7	9.82	174.9	127.2	0.08	113.6	8.20	114.0	4.9
	3.5			10.7	9.82	174.8	127.1	0.08	113.6	8.20	117.2	5.0
	4.0			10.7	9.81	171.8	127.0	0.08	113.6	8.19	125.3	4.9
	4.5			10.7	9.81	174.7	127.0	0.08	113.6	8.19	126.4	1.8
	5.0			10.7	9.80	174.9	127.2	0.08	113.6	8.19	127.6	4.9

NOTES:

BC MOE 2017 British Columbia Ministry of Environment (BC MOE). 2017. British Columbia approved water quality guidelines: Aquatic life, wildlife & agriculture. Water Protection and Sustainability Branch. Victoria, British Columbia, Canada.

- No applicable standard/guideline or analysis was not conducted.
< Concentration is less than the laboratory detection limit indicated.
Bold Bold and shaded indicates an exceedance of one of the applicable standards/guidelines.

Table 4: Dinosaur Reservoir Water Quality Depth Profile Summary

Field Parameter	Sample Depth	Secchi Depth	Total Depth	Temperature	Dissolved Oxygen	Specific Conductivity	Electrical Conductivity	Salinity	Total Dissolved Solids	pH	ORP	Turbidity
Units	m	m	m	°C	mg/L	SPCµS/cm	µS/cm	SAL-ppt	mg/L		mV	NTU
BC MOE 2017 (Approved Guidelines for freshwater aquatic life and short-term maximum)		-		15	Minimum 5 mg/L (All life stages other than buried embryo/alevin)	-	-	-	-	6.5-9.0	-	-
Sample Date	m	m	m	°C	mg/L	SPCµS/cm	µS/cm	SAL-ppt	mg/L		mV	NTU
26-May-17	0.2	0.40	-	7.5	11.21	179.3	119.3	0.09	116.6	8.01	256.1	32.2
	0.5			7.7	11.37	179.5	120.3	0.09	116.7	8.00	251.5	30.3
	1.0			6.2	11.57	180.1	116.0	0.08	116.7	8.00	250.5	30.2
	1.5			5.7	11.54	178.8	113.0	0.08	116.2	8.02	249.1	29.0
	2.0			5.6	11.52	178.7	112.4	0.08	116.2	8.02	248.2	28.6
	2.5			5.5	11.51	178.8	112.1	0.08	116.2	8.04	247.2	28.2
	3.0			5.3	11.52	179.0	111.5	0.08	116.3	8.04	246.8	27.2
	3.5			5.3	11.52	179.0	111.5	0.08	116.3	8.04	246.8	26.8
	4.0			5.4	11.50	179.0	112.2	0.08	116.4	8.05	246.2	25.8
	4.5			5.3	11.51	179.0	111.8	0.08	116.4	8.06	245.9	26.7
	5.0			5.3	11.51	179.1	111.9	0.08	116.4	8.06	245.5	28.6
29-Jun-17	0.2	5.50	-	**15.6**	10.73	191.4	151.7	0.09	123.8	8.21	146.1	1.0
	0.5			13.7	10.79	189.9	151.6	0.09	123.8	8.20	151.9	1.0
	1.0			13.5	10.97	189.6	147.9	0.09	123.3	8.21	154.9	1.2
	1.5			13.0	11.05	189.1	146.0	0.09	123.0	8.20	159.6	1.2
	2.0			12.6	11.09	189.2	144.5	0.09	123.0	8.21	164.2	1.3
	2.5			12.6	11.09	189.1	144.4	0.09	123.0	8.21	167.7	1.4
	3.0			12.5	11.09	189.2	143.8	0.09	123.0	8.21	171.2	1.3
	3.5			12.4	11.10	189.1	143.7	0.09	123.0	8.20	174.0	1.3
	4.0			12.1	11.10	189.5	142.7	0.09	123.1	8.21	176.7	1.3
	4.5			11.5	11.30	189.8	140.8	0.09	123.4	8.20	179.2	1.3
	5.0			11.1	11.30	188.8	138.5	0.09	123.8	8.19	183.6	1.4
20-Jul-17	0.2	5.00	-	**17.9**	9.83	187.9	159.4	0.09	121.8	8.21	172.6	1.0
	0.5			**16.6**	10.00	187.3	157.1	0.09	121.7	8.19	177.0	0.9
	1.0			**16.1**	10.08	186.9	155.3	0.09	121.7	8.20	187.0	1.0
	1.5			**15.7**	10.14	186.5	153.7	0.09	121.2	8.18	185.1	1.1
	2.0			**15.1**	10.26	186.3	152.4	0.09	121.2	8.18	187.5	1.1
	2.5			**15.0**	10.20	186.1	150.6	0.09	121.0	8.18	190.2	1.2
	3.0			14.7	10.21	186.0	149.8	0.09	121.0	8.18	192.4	1.2
	3.5			14.4	10.37	185.8	148.4	0.09	120.8	8.17	196.1	1.1
	4.0			12.9	10.58	185.6	142.9	0.09	120.6	8.15	199.7	1.2
	4.5			12.2	10.70	184.5	139.3	0.09	119.9	8.11	202.3	1.3
	5.0			11.7	10.74	182.6	136.3	0.09	119.3	8.07	202.3	1.4
11-Aug-17	0.2	7.00	22	11.7	10.47	183.2	138.9	0.09	119.4	8.01	157.9	6.30
	0.5			10.0	10.57	183.3	129.7	0.09	119.0	8.01	162.9	6.50
	1.0			9.6	10.67	183.0	129.3	0.09	119.1	8.03	165.3	6.50
	1.5			9.5	10.84	183.1	128.7	0.09	118.9	8.05	168.7	6.50
	2.0			9.6	10.57	182.5	128.7	0.09	118.7	8.03	172.0	6.50
	2.5			9.6	10.56	182.5	128.9	0.09	118.7	8.02	117.4	6.50
	3.0			9.5	10.57	182.5	128.5	0.09	118.7	8.01	178.5	6.50
	3.5			9.5	10.57	182.8	128.4	0.09	118.7	8.01	179.5	6.60
	4.0			9.4	10.57	182.8	128.2	0.09	118.7	8.01	180.1	6.60
	4.5			9.4	10.57	182.7	128.1	0.09	118.7	8.01	181.0	6.60
	5.0			9.4	10.56	182.7	128.1	0.09	118.7	8.00	182.0	6.60
17-Sep-17	0.2	4.00	46	12.2	10.03	169.9	128.5	0.08	110.4	8.18	171.80	3.50
	0.5			12.2	10.03	169.9	128.5	0.08	110.4	8.18	171.0	3.5
	1.0			12.2	10.03	169.9	128.5	0.08	110.4	8.18	171.0	3.5
	1.5			12.2	10.03	169.9	128.4	0.08	110.4	8.18	171.2	3.5
	2.0			12.2	10.04	169.9	128.4	0.08	110.4	8.18	172.0	3.4
	2.5			12.2	10.11	169.9	128.3	0.08	110.4	8.17	173.3	3.4
	3.0			12.2	10.01	169.9	128.3	0.08	110.4	8.19	160.8	3.4
	3.5			12.1	10.00	169.9	128.1	0.08	110.5	8.17	161.5	3.5
	4.0			12.1	10.00	169.9	128.0	0.08	110.5	8.18	160.9	3.5
	4.5			12.1	9.99	169.9	128.0	0.08	110.5	8.17	160.0	3.6
	5.0			12.1	9.99	169.9	128.0	0.08	110.5	8.17	158.8	3.5
20-Oct-17	0.2	7.00	15	10.2	10.02	176.2	126.6	0.08	114.6	8.29	101.4	5.2
	0.5			10.2	10.01	176.2	126.5	0.08	114.5	8.26	105.6	5.2
	1.0			10.2	10.01	176.4	126.7	0.08	114.4	8.25	108.0	5.3
	1.5			10.2	10.00	176.2	126.6	0.08	114.4	8.24	110.5	5.2
	2.0			10.2	10.00	176.1	126.5	0.08	114.5	8.23	112.3	5.2
	2.5			10.2	10.00	176.2	126.6	0.08	114.5	8.23	113.9	5.2
	3.0			10.2	10.00	176.3	126.6	0.08	114.6	8.22	116.6	5.2
	3.5			10.2	9.99	176.3	126.6	0.08	114.5	8.21	119.2	5.3
	4.0			10.2	9.99	176.5	126.6	0.08	114.6	8.21	121.2	5.4
	4.5			10.2	9.99	176.4	126.6	0.08	114.6	8.20	123.2	5.3
	5.0			10.2	9.99	176.0	126.4	0.08	114.4	8.19	126.6	5.3

NOTES:

BC MOE 2017 British Columbia Ministry of Environment (BC MOE). 2017. British Columbia approved water quality guidelines: Aquatic life, wildlife & agriculture. Water Protection and Sustainability Branch. Victoria, British Columbia, Canada.

- No applicable standard/guideline or analysis was not conducted.
< Concentration is less than the laboratory detection limit indicated.
Bold Bold and shaded indicates an exceedance of one of the applicable standards/guidelines.

Table 5: Summary of October Sediment Quality Results

Parameter	Unit	Reported Detection Limit (RDL)	BC MOE 2017 (mg/kg in dry weight) Lower SWQG	BC MOE 2017 (mg/kg in dry weight) Upper SWQG	WILLISTON (W1)	DINOSAUR (D1)	PEACE CANYON (PC1)	UPPER SITE C RESERVOIR (PR1)	MIDDLE SITE C RESERVOIR (PR2)	HALFWAY RIVER - DOWNSTREAM (HD)	LOWER SITE C RESERVOIR (PR3)	MOBERLY RIVER - DOWNSTREAM (MD)	PEACE AT PINE (PD1)	PINE RIVER (PINE)	PEACE AT BEATTON (PD2)	BEATTON RIVER (BEATTON)	PEACE AT KISKATINAW (PD3)	KISKATINAW RIVER (KR)	PEACE AT POUCE COUPE (PD4)	POUCE COUPE (POUCE)	PEACE AT MANY ISLANDS (PD5)
Matrix					soil	soil	soil	soil	soil	soil	soil	soil	soil	soil	soil	soil	soil	soil	soil	soil	soil
Sample Date					10/20/2017	10/20/2017	10/18/2017	10/18/2017	10/18/2017	10/18/2017	10/17/2017	10/17/2017	10/17/2017	10/17/2017	10/19/2017	10/19/2017	10/19/2017	10/19/2017	10/19/2017	10/19/2017	10/19/2017
Laboratory Identification Number					L2011210-1	L2011210-2	L2009937-3	L2009937-4	L2009937-2	L2009937-1	L2009110-2	L2009110-1	L2009110-3	L2009110-4	L2010677-1	L2010677-2	L2010677-3	L2010677-4	L2010677-5	L2010677-6	L2010677-7
Field Measurements																					
Sample Depth (bottom)	m	-	-	-	1.00	0.50	1.50	1.50	1.00	3.50	2.50	0.70	0.80	0.50	0.25	0.25	0.50	0.25	2.00	1.00	1.50
Particle Size (Soil)																					
% Sand (0.125mm - 0.063mm)	%	1.0	-	-	3.4	23.9	13.6	7.9	34.8	27.9	17	32.5	29.1	33.3	36.7	25.8	25.1	25.3	40.9	30.4	32.9
% Sand (0.25mm - 0.125mm)	%	1.0	-	-	7.7	23.8	13.5	9	30.5	27.3	1.9	20.9	3.5	22.3	7.3	14.5	27.5	32.1	9.6	41.7	8.5
% Sand (0.50mm - 0.25mm)	%	1.0	-	-	1.9	7.2	2.1	19.2	<1	10	<1	3.5	<1	<1	<1	7.3	3.3	1.6	<1	<1	<1
% Clay (<4um)	%	1.0	-	-	55.8	5.6	7.5	2.3	2.6	4.1	8.2	4.3	6.2	7.3	4.8	7	4.4	11.1	4.1	5.3	5.2
% Gravel (>2mm)	%	1.0	-	-	<1	1.5	<1	15.4	<1	1.3	<1	<1	<1	<1	<1	3.1	<1	2.3	<1	<1	<1
% Sand (1.00mm - 0.50mm)	%	1.0	-	-	<1	1.1	<1	18.3	<1	2.2	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
% Silt (0.0312mm - 0.004mm)	%	1.0	-	-	25.9	17.8	36.7	6.5	13	11.4	38.1	17.5	30	18.5	23.7	20.7	18.9	14.3	19.6	9.4	25.2
% Silt (0.063mm - 0.0312mm)	%	1.0	-	-	5	18.3	26.2	5.7	18.8	14.2	34.7	21.3	30.8	17.9	27.3	21	20.8	13	25.5	12.4	27.9
% Sand (2.00mm - 1.00mm)	%	1.0	-	-	<1	<1	<1	15.7	<1	1.6	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Carbon																					
Total Organic Carbon (TOC)	%	0.05			0.91	1.47	2.68	1.13	1.11	0.88	1.74	1.25	1.25	1.23	1.13	1.04	0.95	0.59	0.92	0.443	0.86
Physical Tests (Soil)																					
pH	pH Units	0.1	-	-	8.56	8	8.06	8.02	8.42	8.32	7.98	7.99	8.09	8.24	8.12	8.19	8.21	8.26	8.16	8.38	8.07
Anions and Nutrients (Soil)																					
Nitrogen (Total)	%	0.02	-	-	0.137	0.132	0.188	0.079	0.055	0.069	0.119	0.085	0.086	0.09	0.091	0.089	0.072	0.064	0.078	0.05	0.079
Plant Available Nutrients (Soil)																					
Ammonium	mg/kg	1	-	-	1.8	2.5	6.3	2.6	2.5	1.6	9	2.3	4.4	2.6	2	1.9	1.5	2.4	1.4	1.4	2.3
Nitrate (as NO3-N)	mg/kg	2	-	-	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Nitrate and Nitrite (as N)	mg/kg	2	-	-	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Phosphate	mg/kg	2	-	-	2.3	4	<2	<2	<2	<2	<2	<2	<2	<2	<2	2.9	<2	<2	<2	<2	<2
Metals (Soil)																					
Aluminum	mg/kg	50	-	-	8670	7220	5360	5890	4220	4980	7280	5860	5960	4700	4650	5550	4600	7390	7550	4180	5730
Antimony	mg/kg	0.1	-	-	0.93	0.73	0.56	0.48	0.55	0.6	0.82	0.7	0.7	0.63	0.51	0.79	0.65	0.52	0.71	0.38	0.59
Arsenic	mg/kg	0.1	5.9[#1]	17[#2]	6.11	6.47	5.67	5.57	5.03	7.37	8.08	6.87	7.09	7.08	6.43	9.26	8.28	7.87	8.2	9.2	7.29
Barium	mg/kg	0.5	-	-	120	284	204	129	250	388	524	400	449	284	310	440	375	316	375	326	394
Beryllium	mg/kg	0.1	-	-	0.32	0.37	0.29	0.3	0.23	0.38	0.5	0.41	0.4	0.39	0.36	0.43	0.37	0.45	0.53	0.33	0.39
Bismuth	mg/kg	0.2	-	-	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Boron - soluble	mg/kg	5	-	-	<5	5.4	<5	<5	<5	6.5	7.9	6.6	6.3	<5	<5	<5	<5	5.9	8.1	<5	5.6
Cadmium	mg/kg	0.02	0.6[#1]	3.5[#2]	1.04	1.07	0.629	0.582	0.629	0.57	0.871	0.664	0.674	0.429	0.472	0.558	0.477	0.335	0.68	0.179	0.517
Calcium	mg/kg	50	-	-	44,400	19,500	17,300	23,700	39,500	24,400	25,000	23,200	24,500	16,400	18,400	5850	13,800	13,400	19,700	6140	17,600
Chromium	mg/kg	0.5	37.3[#1]	90[#2]	22.8	18.3	14.5	15.7	12.5	11.2	16.2	13.1	13.9	9.19	10.7	13	10.6	16	16.2	9.84	12.7
Cobalt	mg/kg	0.1	-	-	14.7	6.92	5.89	5.72	4.57	5.59	7.71	6.5	6.65	6.06	5.67	8.55	6.78	7.29	7.78	6.67	6.45
Copper	mg/kg	0.5	35.7[#1]	197[#2]	19.8	15.4	14.7	14.8	11.4	16.8	19.1	15.3	14.8	11.2	11.7	14.4	10.7	14.2	18	6.91	13.2
Iron	mg/kg	50	21,200 (about 2%)[#3]	43,766 (about 4%)[#3]	20,000	18,000	15,600	16,300	12,300	16,300	18,500	15,700	16,400	16,400	15,300	20,700	18,300	17,800	19,500	15,300	17,300
Lead	mg/kg	0.5	35[#1]	91.3[#2]	9.03	9.04	6.91	7.37	4.99	7.11	9.41	7.9	8.01	7.28	6.95	8.32	7.12	8.14	9.94	5.71	7.59
Lithium	mg/kg	2	-	-	11.8	9	8.3	9.4	5.8	6.7	10.5	8.5	9.1	8.1	7.8	8.2	6.7	11.5	11.8	6.4	8.5
Magnesium	mg/kg	20	-	-	10,500	7490	8250	9900	11,600	5660	7740	6860	7660	4390	6120	3070	4430	4910	6500	2510	6260
Manganese	mg/kg	1	460[#3]	1100[#3]	691	313	172	232	181	172	230	217	208	219	196	298	247	231	301	214	225
Mercury	mg/kg	0.005	0.17[#1]	0.486[#2]	0.0204	0.0344	0.047	0.0433	0.0284	0.0322	0.0704	0.0516	0.0517	0.0441	0.0436	0.064	0.0374	0.0631	0.0829	0.0272	0.0483
Molybdenum	mg/kg	0.1	-	-	1.43	1.05	0.74	0.66	0.97	1.48	1.77	1.36	1.47	1.13	1.04	1.2	1.28	0.8	1.4	0.63	1.14
Nickel	mg/kg	0.5	16[#3]	75[#3]	40.6	22.3	20.3	20.7	15.4	18.7	25.9	20.9	21.5	19.2	18.9	24.2	20.5	22.7	26.6	17	21
Phosphorus	mg/kg	50	-	-	623	825	828	750	849	1150	987	883	909	764	829	658	833	646	892	521	852
Potassium	mg/kg	100	-	-	1130	1260	870	780	720	1140	1450	1210	1140	910	910	940	890	1230	1540	740	1090
Selenium	mg/kg	0.2	-	-	0.35	0.36	0.5	0.44	0.35	0.6	0.91	0.64	0.64	0.55	0.45	0.63	0.48	0.53	0.8	0.29	0.55
Silver	mg/kg	0.1	0.5[#4]	N/A[#4]	<0.1	0.19	0.14	0.13	0.11	0.13	0.25	0.19	0.18	0.13	0.15	0.16	0.11	0.14	0.22	<0.1	0.15
Sodium	mg/kg	50	-	-	115	75	86	83	77	85	105	85	84	60	61	102	61	96	84	76	71
Strontium	mg/kg	0.50	-	-	98.5	50.1	42.6	50.6	75	62.6	67.9	59.1	61.7	41.5	44.1	29.6	40.7	44	54.4	26.1	46.7
Sulphur	mg/kg	1000			<1000	<1000	<1000	1100	<1000	1500	1600	<1000	1000	<1000	1100	<1000	<1000	1100	1400	<1000	1300
Thallium	mg/kg	0.050	-	-	0.202	0.166	0.114	0.104	0.09	0.12	0.207	0.152	0.16	0.115	0.106	0.127	0.101	0.116	0.175	0.072	0.128
Tin	mg/kg	2.0	-	-	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Titanium	mg/kg	1.0	-	-	292	<110	104	157	134	<35	43.5	46.1	40.6	15.4	26.1	52.1	35.8	38	<39	<46	<45
Tungsten	mg/kg	0.5			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Uranium	mg/kg	0.05	-	-	0.722	0.651	0.671	0.642	0.719	0.897	1.1	0.89	0.969	0.718	0.788	0.914	0.922	0.838	0.991	0.542	0.832
Vanadium	mg/kg	0.2	-	-	45.2	40.8	28.5	32.4	29.2	27.5	36.1	30.1	30.1	21	22.7	26.8	24.6	27.8	35.8	23.3	27.9
Zinc	mg/kg	2	123[#1]	315[#2]	67.4	78.7	66.8	62.2	49.7	76	90.5	69.6	75	65.4	65.5	85.8	69	71.7	86.2	50.9	71.5
Zirconium	mg/kg	1	-	-	4.5	1.3	1.3	1.7	2.2	1.8	2	1.9	2	1.8	1.4	2.2	2	2.6	1.5	2.2	2

NOTES:

BC MOE 2017	BC MOE. 2017. Working Water Quality Guidelines and Working Sediment Quality Guidelines for British Columbia. Water Protection and Sustainability Branch. British Columbia Ministry of Environment.
Lower SWQG	A concentration that will protect aquatic life from adverse effects of toxic substance in most situations (equivalent to CCME's Threshold Effect Level or Interim Sediment Quality Guidelines (TEL or ISQGs; CCME 2001))
Upper SWQG	A concentration that if exceeded will likely cause severe effects on aquatic life (equivalent to CCME's Probably Effect Level (PEL; CCME (2001)).
CCME 2001	Canadian Council of Ministers of the Environment (CCME). 2001. Canadian sediment quality guidelines. Canadian Council of Ministers of the Environment, Winnipeg. Accessed on-line at http://ceqg-rcqe.ccme.ca/en/index.html#void
AET	Apparent Effects Threshold
BA	Background Approach
CoA	Co-Occurrence analysis
EqP	Equilibrium Partitioning
ISQG	Interim Sediment Quality Guideline
NSTPA	National Status and Trends Program Approach
PEL	Probable Effect Level
SLC	Screening Level Concentration
#1	Lower SWQG is based on ISQG
#2	Upper SWQG is based on PEL
#3	Effect levels based on SLC
#4	Based on Ontario sediment guideline
<	Concentration is less than the laboratory detection limit indicated.
-	No applicable standard or guideline
Unshaded	Concentration < Lower SWQG: Rarely associated with adverse biological effects (BC MOE, 2017)
Shaded only	Concentration > Lower SWQG but < Upper SWQG are occasionally associated with adverse biological effects (BC MOE, 2017)
Shaded and Bolded	Concentrations > Upper SWQG are frequently associated with adverse biological effects (BC MOE, 2017)

Table 6: Summary of May 2017 Event Surface Water Quality Results

				Existing Reservoir Sites				Future Site C Reservoir						Downstream of Site C Reservoir								
Parameter	**Unit**	**Reported Detection Limit (RDL)**	**BC MOE 2017 (Approved Guidelines for freshwater aquatic life and short-term maximum)**	**WILLISTON (W1 - Deep)**	**WILLISTON (W1 - Shallow)**	**DINOSAUR (D1 - Deep)**	**DINOSAUR (D1 - Shallow)**	**PEACE CANYON (PC1)**	**UPPER SITE C RESERVOIR (PR1)**	**MIDDLE SITE C RESERVOIR (PR2)**	**HALFWAY RIVER DOWNSTREAM (HD)**	**LOWER SITE C RESERVOIR (PR3)**	**MOBERLY RIVER DOWNSTREAM (MD)**	**PEACE AT PINE (PD1)**	**PINE RIVER (PINE)**	**PEACE AT BEATTON (PD2)**	**BEATTON RIVER (BEATTON)**	**PEACE AT KISKATINAW (PD3)**	**KISKATINAW RIVER (KISKATINAW)**	**PEACE AT POUCE COUPE (PD4)**	**POUCE COUPE (POUCE)**	**MANY ISLANDS (PDS)**
Matrix				surface water	surface water	surface water	surface water	surface water	surface water	surface water	surface water	surface water	surface water	surface water	surface water	surface water	surface water	surface water	surface water	surface water	surface water	surface water
Sample Date				5/26/2017	5/26/2017	5/26/2017	5/26/2017	5/24/2017	5/24/2017	5/24/2017	5/24/2017	5/25/2017	5/25/2017	5/25/2017	5/25/2017	5/27/2017	5/27/2017	5/27/2017	5/27/2017	5/27/2017	5/27/2017	5/27/2017
Laboratory Identification Number				L1932382-1/ L1938976-1	L1932382-2	L1932382-3	L1932382-4	L1931659-3	L1931659-4	L1931659-2	L1931659-1	L1931960-2	L1931960-1	L1931960-3	L1931960-4	L1932532-1	L1932532-2	L1932532-3	L1932532-4	L1932532-5	L1932532-6	L1932532-7
Field Measurements																						
Sample Depth	m	-		5.0	0.2	5.0	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Total Depth not collected due to malfunctioning equipment				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Temperature	°C	-	15	3.7	3.8	5.3	7.5	4.7	4.9	7.2	8.7	8.5	13.1	8.8	7.4	9.6	14.0	9.5	12.5	10.0	**16.7**	10.6
Dissolved Oxygen (DO)	mg/L	-	Minimum 5 [#1]	11.37	11.02	11.51	11.21	12.27	11.76	11.50	10.73	10.95	9.54	10.56	10.92	10.48	9.43	10.95	10.07	10.43	9.14	10.43
Specific Conductivity (SPC)	SPCµS/cm	-		185.9	186.0	179.1	179.3	180.8	180.9	188.8	240.0	227.3	148.5	225.1	137.5	223.5	131.2	213.4	237.9	211.5	249.2	210.4
Electrical Conductivity (EC)	SPCµS/cm	-		110.0	111.2	111.9	119.3	110.9	111.6	124.8	165.2	155.3	118.1	155.5	90.9	157.7	103.7	150.2	181.1	150.9	209.7	152.6
Salinity	parts per trillion	-		0.09	0.09	0.08	0.09	0.09	0.09	0.09	0.11	0.11	0.07	0.11	0.06	0.11	0.06	0.10	0.01	0.10	0.12	0.10
pH	pH Units	-	6.5-9.0	8.04	7.94	8.06	8.01	8.01	8.07	8.11	8.15	8.08	8.07	8.08	8.00	8.04	7.75	8.07	8.26	8.36	8.08	8.14
Turbidity	nephelometric units	-		3.5	3.3	28.6	32.2	50.4	43.5	160.8	900.0	565.7	1100.0	142.7	865.8	365.0	4.4	328.0	909.0	365.0	739.0	429.3
Total Dissolved Solids	mg/L	-		120.8	120.8	116.4	116.6	117.7	117.6	-	-	147.7	-	553.7	82.3	145.3	85.3	138.9	154.6	137.5	162.1	-
Physical Parameters																						
Colour	TCU	5		5.9	5.9	20.4	21.7	25.1	24.8	28.2	50.3	49	197	49.5	81.8	32	198	33.1	71.9	39.9	147	45.5
Electrical Conductivity (EC)	µS/cm	2		192	191	184	185	182	182	190	256	234	206	231	186	235	136	220	244	218	259	218
Hardness as CaCO3	mg/L	0.5		84.1	90.8	86.9	86.4	89.1	89.2	93.5	131	119	105	116	131	116	56.8	108	122	107	137	105
pH	pH Units	0.1	6.5-9.0	8.07	8.14	8.13	8.1	8.12	8.13	8.12	8.12	8.09	8.05	8.04	8.01	8.06	7.44	8.06	8.08	8.04	7.9	8.17
Total Suspended Solids (TSS)	mg/L	3		<3	<3	15.8	16.4	30	30.8	163	2450	1060	1280	1460	2230	757	660	754	1950	846	1600	817
Total Dissolved Solids (TDS)	mg/L	1		100	101	98.8	101	103	104	119	214	170	143	173	170	154	116	145	215	142	225	153
Turbidity	NTU	0.1		1.48	1.26	33.7	38.6	60.1	63.8	220	1610	922	904	1120	1300	507	505	460	2470	524	1580	573
Anions and Nutrients																						
Alkalinity (Bicarbonate as CaCO3)	mg/L	1		88	85.1	81.9	84.7	85.8	87	104	163	122	110	132	108	122	36.7	120	192	119	94.9	120
Alkalinity (Carbonate as CaCO3)	mg/L	1		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Alkalinity (Hydroxide) as CaCO3	mg/L	1		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Alkalinity (total as CaCO3)	mg/L	1		88	85.1	81.9	84.7	85.8	87	104	163	122	110	132	108	122	36.7	120	192	119	94.9	120
Ammonia as N	mg/L	0.005	See narrative [#2]	-	-	-	-	<0.005	<0.005	<0.005	0.0349	0.0249	0.0221	0.0254	0.0263	0.0186	0.0363	0.0178	0.0575	0.0183	0.0945	0.0199
Bromide	mg/L	0.05		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Chloride	mg/L	0.5	600	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.57	<0.5	<0.5	<0.5	2.67	<0.5
Fluoride	mg/L	0.02	See equation [#3]	0.038	0.037	0.043	0.044	0.045	0.045	0.05	0.092	0.074	0.073	0.076	0.058	0.071	0.072	0.066	0.081	0.067	0.113	0.069
Nitrate and Nitrite (as N)	mg/L	0.0051		0.0623	0.062	0.0932	0.0986	0.11	0.109	0.114	0.0735	0.0908	0.134	0.093	0.124	0.099	0.0118	0.104	0.0516	0.0991	0.0872	0.0951
Nitrate (as N)	mg/L	0.005	32.8	0.0623	0.062	0.0932	0.0986	0.11	0.109	0.114	0.0735	0.0908	0.133	0.093	0.123	0.099	0.0118	0.104	0.0499	0.0991	0.0793	0.0951
Nitrite (as N)	mg/L	0.001	0.06-0.60 [#4]	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.0012	<0.001	0.0015	<0.001	<0.001	<0.001	0.0017	<0.001	0.0079	<0.001
Total Kjeldahl Nitrogen (TKN)	mg/L	0.05		-	-	-	-	0.241	0.237	0.423	3.19	1.51	2.02	1.74	2.16	1.2	1.59	1.02	2.59	1.27	3.34	1.25
Nitrogen (Total)	mg/L	0.03		-	-	-	-	0.252	0.262	0.34	1.16	0.93	1	1.19	0.74	0.67	1.02	0.56	1.01	0.62	1.75	0.67
Orthophosphate (as P) (Filtered)	mg/L	0.001		<0.001	<0.001	0.0012	0.0013	0.002	0.002	0.0027	0.0098	0.0071	0.0055	0.0068	0.0052	0.0064	0.0074	0.0057	0.0074	0.0055	0.0138	0.0057
Phosphorus (Total Dissolved)	mg/L	0.002		-	-	-	-	0.0041	0.0042	0.0054	0.0142	0.012	0.0115	0.0119	0.0087	0.01	0.0252	0.0092	0.0148	0.009	0.0325	0.0108
Phosphorus	mg/L	0.002		-	-	-	-	0.0608	0.0608	0.212	2.27	1.38	1.33	1.59	1.38	0.822	0.547	0.63	1.57	0.78	1.11	0.69
Sulphate	mg/L	0.3		14.2	14.2	13.1	13.2	13.2	13.2	14.5	23.9	19.8	9.34	19.4	9.61	18.2	26.1	15.6	9.16	15.7	39.8	16.6
Silica	mg/L	0.5		4.44	4.19	4.32	4.32	4.13	4.39	4.16	3.63	3.97	3.62	3.77	2.85	3.72	4	3.5	4.32	3.55	3.42	3.41
Anions Total	meq/L			2.06	2	1.92	1.98	2	2.02	2.38	3.77	2.87	2.41	3.04	2.38	2.84	1.3	2.74	4.03	2.72	2.81	2.76
Cations Total	meq/L			1.68	1.81	1.74	1.73	1.78	1.78	1.87	2.64	2.38	2.1	2.33	3.42	2.32	1.4	2.17	2.61	2.15	3.9	2.19
Ionic Balance	N/A			-10.1	-4.9	-4.9	-6.7	-5.7	-6.3	-12.1	-17.7	-9.4	-6.7	-13.2	18	-9.9	3.7	-11.6	-21.3	-11.7	16.3	-11.4
Organic and Inorganic Carbon																						
Dissolved Organic Carbon (DOC) (Filtered)	mg/L	0.5		3.72	2.56	4.4	4.56	5.22	4.9	6.47	11	10	11.5	10.6	11.2	7.77	30.1	8.66	18	9.39	28.6	11.1
Total Organic Carbon (TOC)	mg/L	0.5		2.57	2.54	4.93	5.38	6.46	6.19	9.18	45.3	34.7	30.2	33.1	37.2	20.5	41.7	18.1	43.1	15.9	54.8	24.8
Plant Pigments																						
Chlorophyll A	µg/L	0.01		0.256	0.495	0.676	0.481	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Speciated Metals																						
Methylmercury (as MeHg)-Dissolved (Filtered)	ug/L	0.00005		<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	0.00009	0.000057	0.000062	<0.00005	0.000164	<0.00005	0.000297	<0.00005	0.000059	0.000112	<0.00005	0.000073
Total Metals																						
Aluminum	mg/L	0.005		0.0438	0.0442	1	1.08	1.02	1.01	3.37	15.3	10.9	12.2	11.9	13.4	7.25	7.63	6.94	21.6	8.1	19.6	8.27
Antimony	mg/L	0.0005		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.0008	0.0007	0.00052	0.0007	0.00067	0.00053	<0.0005	<0.0005	0.00061	<0.0005	<0.0005	<0.0005
Arsenic	µg/L	0.0005	0.005	<0.0005	<0.0005	0.00058	0.00064	0.00087	0.0008	0.00244	**0.0148**	**0.00978**	**0.00923**	**0.0109**	**0.0119**	**0.00672**	**0.00808**	**0.00624**	**0.0153**	**0.00731**	**0.0204**	**0.00744**
Barium	mg/L	0.02		0.032	0.032	0.072	0.075	0.086	0.086	0.15	1.01	0.615	0.634	0.706	0.786	0.415	0.328	0.375	0.9	0.428	0.636	0.402
Beryllium	mg/L	0.001		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.0013	<0.001	<0.001	<0.001	0.0011	<0.001	<0.001	<0.001	0.0015	<0.001	0.0013	<0.001
Bismuth	mg/L	0.2		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Boron - soluble	mg/L	0.1		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Cadmium	mg/L	0.000005		0.0000184	0.0000176	0.000052	0.0000561	0.0000839	0.0000802	0.000383	0.00312	0.0017	0.00103	0.00194	0.00155	0.000925	0.000549	0.000771	0.00182	0.00093	0.000712	0.000846
Calcium	mg/L	0.1		27.7	28	26.3	26.5	27.5	27.4	37.1	137	83.7	54.4	87.5	81.4	62.1	20.9	55	116	61	49.5	55.4
Chromium	mg/L	0.001		<0.001	<0.001	0.0019	0.0019	0.0019	0.0019	0.0064	0.031	0.0205	0.0207	0.0224	0.0235	0.0141	0.0141	0.0129	0.0368	0.0151	0.0328	0.0151
Cobalt	mg/L	0.0003	0.11	<0.0003	<0.0003	0.00039	0.00047	0.00068	0.00067	0.00255	0.0175	0.00988	0.0121	0.0114	0.0156	0.0067	0.0085	0.00629	0.0217	0.008	0.02	0.00769
Copper	mg/L	0.001	See equation [#5]	<0.001	<0.001	0.0019	0.002	0.0026	0.0026	0.0082	**0.0443**	**0.0261**	**0.0314**	**0.0307**	**0.0348**	**0.018**	**0.023**	**0.0165**	**0.0532**	**0.0201**	**0.0496**	**0.0202**
Iron	mg/L	0.03	1	0.065	0.059	**1.04**	**1.21**	**1.8**	**1.75**	**6.28**	**37**	**23.9**	**25.4**	**26.6**	**37.2**	**16.9**	**19.6**	**16.3**	**48.3**	**19.6**	**46**	**19.7**
Lead	mg/L	0.0005	See equation [#6]	<0.0005	<0.0005	0.00051	0.00061	0.00089	0.00088	0.00298	0.0205	0.0134	0.0151	0.015	0.0203	0.00886	0.0101	0.0083	0.0259	0.0101	0.0254	0.0102
Lithium	mg/L	0.001		0.0013	0.0013	0.0023	0.0025	0.0022	0.0021	0.0058	0.0288	0.0178	0.0196	0.0195	0.0251	0.0131	0.0154	0.0125	0.0342	0.0147	0.0358	0.0149
Magnesium	mg/L	0.1		6.39	6.42	6.77	6.78	6.69	6.58	9.76	31.4	19.8	16.8	21.2	20.7	15.2	6.88	13.5	29.7	14.9	16.9	13.9
Manganese	mg/L	0.0001	See equation [#7]	**0.00375**	**0.00349**	**0.0146**	**0.0168**	**0.0236**	**0.023**	**0.101**	**0.664**	**0.353**	**0.463**	**0.425**	**0.662**	**0.246**	**0.239**	**0.234**	**0.817**	**0.307**	**0.492**	**0.279**
Mercury	mg/L	<0.000005 - 5.7E-7		<0.000005	<0.000005	<0.000005	0.0000061	<0.0001	<0.0001	<0.0001	0.00013	0.000081	0.000095	0.000085	0.000071	<0.00005	0.000059	<0.00005	0.000107	0.000055	0.000109	0.000053
Molybdenum	mg/L	0.001	2	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	0.0033	0.0029	0.0011	0.0027	0.0013	0.0022	<0.001	0.0018	0.0013	0.0016	0.0012	0.0017
Nickel	mg/L	0.001		<0.001	<0.001	0.0022	0.0026	0.0034	0.0033	0.0099	0.0619	0.0369	0.0396	0.042	0.0496	0.0254	0.03	0.0232	0.072	0.0281	0.0631	0.0282
Phosphorus	mg/L	0.3		<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	2.97	1.37	1.13	1.53	1.86	0.78	0.55	0.66	1.59	0.85	1.23	0.74
Potassium	mg/L	2		<2	<2	<2	<2	<2	<2	<2	4.4	3.5	3.7	3.7	3.7	2.7	3.3	2.6	5.6	2.9	7.5	3
Selenium	mg/L	0.00005	0.002	0.000221	0.000245	0.000285	0.000319	0.000345	0.000328	0.000484	**0.00255**	0.00177	0.000932	0.00178	0.00132	0.00137	0.000905	0.00119	0.00128	0.00109	0.00131	0.00118
Silicon	mg/L	0.05		2.36	2.35	4.64	4.49	3.69	3.63	7.5	23.4	16.6	18.3	17.9	18.5	12.4	13.3	11.7	32.9	13.5	31.8	13.5
Silver	mg/L	0.00002	0.0001 or 0.003 [#8]	<0.00002	<0.00002	<0.00002	<0.00002	0.00003	0.000024	0.000062	0.000502	0.000414	0.000408	0.000464	0.00054	0.000182	0.000202	0.000178	0.00048	0.000197	0.00036	0.000198
Sodium	mg/L	2		<2	<2	<2	<2	<2	<2	<2	2.4	2	2.2	2.2	<2	2	5.1	<2	4.5	2.1	7.5	2.4
Strontium	mg/L	0.005		0.109	0.105	0.102	0.103	0.1	0.0996	0.124	0.387	0.247	0.137	0.252	0.184	0.192	0.0909	0.164	0.293	0.171	0.23	0.165
Thallium	mg/L	0.0002		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	0.00058	0.00041	0.00029	0.00044	0.00038	0.00028	0.00021	0.00024	0.00052	0.00026	0.00038	0.00026
Tin	mg/L	0.0005		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Titanium	mg/L	0.01		<0.01	<0.01	0.019	<0.024	0.01	0.01	0.055	0.047	0.05	0.059	0.043	0.034	0.037	0.032	0.036	0.061	0.034	0.048	0.037
Uranium	mg/L	0.0002		0.00049	0.00047	0.00047	0.00049	0.00045	0.00046	0.00064	0.00291	0.00202	0.00158	0.00222	0.00207	0.00134	0.00119	0.00113	0.00241	0.0013	0.00267	0.00126
Vanadium	mg/L	0.0005		<0.0005	<0.0005	0.00405	0.00435	0.00457	0.00442	0.0145	0.0784	0.0516	0.041	0.0554	0.0482	0.0339	0.0279	0.0306	0.0699	0.0335	0.0602	0.0339
Zinc	mg/L	0.005	See equation [#9]	<0.005	<0.005	0.0055	0.0068	0.0102	0.0094	0.030	**0.231**	**0.14**	**0.123**	**0.159**	**0.171**	**0.0866**	**0.0868**	**0.078**	**0.22**	**0.0909**	**0.184**	**0.0933**

Table 6: Summary of May 2017 Event Surface Water Quality Results

				Existing Reservoir Sites				Future Site C Reservoir						Downstream of Site C Reservoir							
Parameter	**Unit**	**Reported Detection Limit (RDL)**	**BC MOE 2017 (Approved Guidelines for freshwater aquatic life and short-term maximum)**	**WILLISTON (W1 - Deep)**	**WILLISTON (W1 - Shallow)**	**DINOSAUR (D1 - Deep)**	**DINOSAUR (D1 - Shallow)**	**PEACE CANYON (PC1)**	**UPPER SITE C RESERVOIR (PR1)**	**MIDDLE SITE C RESERVOIR (PR2)**	**HALFWAY RIVER DOWNSTREAM (HD)**	**LOWER SITE C RESERVOIR (PR3)**	**MOBERLY RIVER DOWNSTREAM (MD)**	**PEACE AT PINE (PD1)**	**PINE RIVER (PINE)**	**PEACE AT BEATTON (PD2)**	**BEATTON RIVER (BEATTON)**	**PEACE AT KISKATINAW (PD3)**	**KISKATINAW RIVER (KISKATINAW)**	**PEACE AT POUCE COUPE (PD4)**	**POUCE COUPE (POUCE)**	**MANY ISLANDS (PDS)**
Dissolved Metals																						
Aluminum (Filtered)	mg/L	0.005	0.1 #10	<0.005	<0.005	0.0088	0.0105	0.0138	0.0086	0.0083	0.0256	0.011	0.0138	0.0111	**4.58**	0.015	0.0687	0.0119	0.024	0.0128	**2.81**	0.0131
Antimony (Filtered)	mg/L	0.0005		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Arsenic (Filtered)	mg/L	0.0005		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.00176	<0.0005	0.00071	<0.0005	0.00063	<0.0005	0.00343	<0.0005
Barium (Filtered)	mg/L	0.02		0.032	0.058	0.049	0.047	0.048	0.048	0.044	0.06	0.054	0.095	0.056	0.26	0.062	0.041	0.062	0.072	0.062	0.231	0.06
Beryllium (Filtered)	mg/L	0.001		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Bismuth (Filtered)	mg/L	0.2		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Boron - soluble (Filtered)	mg/L	0.1		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Cadmium (Filtered)	mg/L	0.000005	See equation #11	0.0000143	0.0000125	0.0000162	0.0000184	0.0000159	0.0000163	0.0000269	0.0000263	0.0000197	0.0000152	0.0000166	0.000338	0.0000536	0.0000499	0.000039	0.0000121	0.0000323	0.000262	0.0000319
Calcium (Filtered)	mg/L	0.1		24.9	27.4	25.7	25.8	25.1	25.2	26.1	36.1	33	28.7	32.5	37.7	32.5	15.9	30.7	33.9	30.1	37.2	29.7
Chromium (Filtered)	mg/L	0.001		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.0071	<0.001	<0.001	<0.001	<0.001	<0.001	0.0046	<0.001
Cobalt (Filtered)	mg/L	0.0003		<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	0.00258	<0.0003	0.00046	<0.0003	<0.0003	<0.0003	0.00517	<0.0003
Copper (Filtered)	mg/L	0.001		<0.001	0.0011	<0.001	<0.001	<0.001	<0.001	0.001	0.0017	0.0014	0.0017	0.0014	0.0073	0.0012	0.0035	0.0012	0.0031	0.0014	0.0154	0.0016
Iron (Filtered)	mg/L	0.03	0.35	<0.03	<0.03	<0.03	<0.03	0.033	<0.03	<0.03	0.096	0.053	0.091	0.053	**4.36**	0.047	**0.611**	0.058	0.069	0.07	**7.43**	0.078
Lead (Filtered)	mg/L	0.0005		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.00369	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.00603	<0.0005
Lithium (Filtered)	mg/L	0.001		<0.001	<0.001	0.0011	0.0012	0.0018	0.0016	0.0024	0.0038	0.0031	0.0033	0.003	0.0068	0.003	0.0042	0.003	0.0021	0.003	0.0098	0.003
Magnesium (Filtered)	mg/L	0.1		5.35	5.43	5.53	5.33	6.4	6.39	6.85	10	8.8	8.1	8.6	8.93	8.49	4.16	7.71	8.97	7.8	10.7	7.42
Manganese (Filtered)	mg/L	0.0001		0.0015	0.00163	0.00351	0.00355	0.00406	0.00381	0.00562	0.00785	0.00535	0.00713	0.00449	0.136	0.00462	0.0309	0.00473	0.00501	0.00537	0.157	0.00422
Mercury (Filtered)	mg/L	<0.000005 - 5.7E-7		<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	0.000035	<0.000005	0.0000078	<0.000005	<0.000005	<0.000005	<0.0001	<0.000005
Molybdenum (Filtered)	mg/L	0.001		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.0026	0.0019	<0.001	0.0018	<0.001	0.0015	<0.001	0.0012	<0.001	0.0011	<0.001	0.0011
Nickel (Filtered)	mg/L	0.001		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.0016	0.0026	0.0022	0.0021	0.0023	0.008	0.0019	0.0056	0.0018	0.0027	0.002	0.0187	0.0021
Phosphorus (filtered) (Filtered)	mg/l	0.3		<0.3	<0.3	<0.3	<0.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Potassium (Filtered)	mg/L	2		<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	2.1	<2	<2	<2	<2	<2	4.9	<2
Selenium (Filtered)	mg/L	0.00005		0.000272	0.000216	0.000257	0.000299	0.000267	0.000247	0.00035	0.00107	0.000839	0.000247	0.000756	0.000506	0.000821	0.000298	0.00065	0.000327	0.000608	0.000299	0.00059
Silicon (Filtered)	mg/L	0.05		2.19	2.2	2.22	2.13	2.18	2.2	2.27	1.92	1.92	1.87	1.91	14.4	1.82	2	1.69	2.24	1.66	6.96	1.64
Silver (Filtered)	mg/L	0.00002		<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	0.000033	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002
Sodium (Filtered)	mg/L	2		<2	5	<2	<2	<2	7.4	<2	<2	<2	<2	<2	<2	<2	5	<2	4	<2	7.4	2.1
Strontium (Filtered)	mg/L	0.005		0.0942	0.104	0.0929	0.0931	0.0983	0.0993	0.0968	0.161	0.126	0.07	0.119	0.0997	0.119	0.0578	0.106	0.135	0.102	0.155	0.101
Thallium (Filtered)	mg/L	0.0002		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Tin (Filtered)	mg/L	0.0005		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Titanium (Filtered)	mg/L	0.01		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.019	<0.01	<0.01	<0.01	<0.01	<0.01	0.035	<0.01
Uranium (Filtered)	mg/L	0.0002		0.00041	0.00045	0.00039	0.0004	0.00041	0.00042	0.00044	0.00056	0.00053	0.0003	0.00052	0.00071	0.00045	0.00027	0.00038	0.0005	0.00038	0.00125	0.0004
Vanadium (Filtered)	mg/L	0.0005		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.00053	<0.0005	<0.0005	<0.0005	0.0166	<0.0005	<0.0005	<0.0005	0.00055	<0.0005	0.0118	<0.0005
Zinc (Filtered)	mg/L	0.005		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.0233	0.0051	<0.005	<0.005	<0.005	<0.005	0.0413	<0.005

NOTES:

BC MOE 2017	British Columbia Ministry of Environment (BC MOE). 2017. British Columbia approved water quality guidelines: Aquatic life, wildlife & agriculture. Water Protection and Sustainability Branch. Victoria, British Columbia, Canada.
H	Hardness. Where hardness values exceed the range applied for guideline use, site specific assessment may be required.
#1	Dissolved Oxygen guideline protects all life stages other than buried embryo/alevin, based on instantaneous measurement.
#2	Guideline for ammonia nitrogen (NH_3) varies with pH and temperature, and is derived from Table 26D of the BC MOE, 2017 BCWQGs, ranging from 0.681 to 28.7 mg/L for pH 6.5-9.0 and temperature 0.0-20.0 degC.
#3	Guideline for fluoride varies with H. Guideline is 0.4 mg/L when H <10 mg/L. Calculated in mg/L and based on equation: [-51.73 + 92.57*log(Hardness)]x0.01 when H =10-385 mg/L.
#4	Guideline for nitrite varies with chloride concentrations.
#5	Guideline for copper varies with H and is calculated in mg/L and based on equation: [0.094(H)+2]/1000, when H =13-400 mg/L.
#6	Guideline for lead varies with H. Guideline is 0.003 mg/L when H<8 mg/L. Calculated in mg/L and based on equation: $[e^{(1.273*ln(H)-1.460)}]$/1000 when H=8-360 mg/L
#7	Guideline for manganese varies with H and is calculated in mg/L and based on equation: (0.01102*H)+0.54, when H =25-259 mg/L.
#8	Guideline for silver varies with H. Guideline is 0.0001 mg/L when H<100 mg/L or 0.003 mg/L when H>100 mg/L
#9	Guideline for zinc varies with H. Guideline is 0.033 mg/L when H is <90 mg/L. Calculated in mg/L and based on equation: [33+0.75*(H-90)]/1000, when H=90-500 mg/L.
#10	Guideline for aluminum varies with pH. Guideline is 0.1 mg/L if pH ≥ 6.5. Calculated in mg/L and based on equation: $e^{(1.209-2.426(pH)+0.286K)}$ where K=$(pH)^2$ and pH < 6.5.
#11	Guideline for cadmium varies with H and is calculated in mg/L and based on equation: $[e^{(1.03*ln(H)-5.274)}]$/1000, when H=7-455 mg/L.
-	No applicable guideline or analysis was not conducted.
<	Concentration is less than the laboratory detection limit indicated.
Bold	Bold and shaded indicates an exceedance of the applied guideline.
MPN	Most Probable Number
CFU	Colony Forming Units

Table 7: Summary of June 2017 Event Surface Water Quality Results

				Existing Reservoir Sites				Future Site C Reservoir						Downstream of Site C Reservoir								
Parameter	**Unit**	**Reported Detection Limit (RDL)**	**BC MOE 2017 (Approved Guidelines for freshwater aquatic life and short-term maximum)**	**WILLISTON (W1 - Deep)**	**WILLISTON (W1 - Shallow)**	**DINOSAUR (D1 - Deep)**	**DINOSAUR (D1 - Shallow)**	**PEACE CANYON (PC1)**	**UPPER SITE C RESERVOIR (PR1)**	**MIDDLE SITE C RESERVOIR (PR2)**	**HALFWAY RIVER DOWNSTREAM (HD)**	**LOWER SITE C RESERVOIR (PR3)**	**MOBERLY RIVER DOWNSTREAM (MD)**	**PEACE AT PINE (PD1)**	**PINE RIVER (PINE)**	**PEACE AT BEATTON (PD2)**	**BEATTON RIVER (BEATTON)**	**PEACE AT KISKATINAW (PD3)**	**KISKATINAW RIVER (KISKATINAW)**	**PEACE AT POUCE COUPE (PD4)**	**POUCE COUPE (POUCE)**	**MANY ISLANDS (PDS)**
Matrix				surface water	surface water	surface water	surface water	surface water	surface water	surface water	surface water	surface water	surface water	surface water	surface water	surface water	surface water	surface water	surface water	surface water	surface water	surface water
Sample Date				6/29/2017	6/29/2017	6/29/2017	6/29/2017	6/30/2017	6/30/2017	6/30/2017	6/30/2017	6/27/2017	6/27/2017	6/27/2017	6/27/2017	6/28/2017	6/28/2017	6/28/2017	6/28/2017	6/28/2017	6/28/2017	6/28/2017
Laboratory Identification Number				L1951349-2	L1951349-1	L1951349-4	L1951349-3	L1951924-3	L1951924-4	L1951924-2	L1951924-1	L1949651-2	L1949651-1	L1949651-3	L1949651-4	L1950526-1	L1950526-2	L1950526-3	L1950526-4	L1950526-5	L1950526-6	L1950526-7
Field Measurements																						
Sample Depth	m	-		5.0	0.2	5.0	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Total Depth	m	-		69.0	69.0	-	-	0.7	0.7	8.0	12.0	5.0	1.3	5.0	3.0	-	1.0	2.0	0.3	3.0	6.0	5.0
Temperature	°C	-	15	10.6	10.9	11.1	**15.6**	8.9	10.2	10.1	14.9	12.4	**15.6**	12.9	**15.3**	12.4	**16.9**	13.7	**16.5**	13.8	**16.9**	15.0
Dissolved Oxygen (DO)	mg/L	-	Minimum 5 #1	11.16	11.11	11.32	10.78	11.84	11.89	11.33	9.84	10.47	9.44	10.31	9.55	10.32	9.21	10.00	9.49	9.95	9.95	9.80
Specific Conductivity (SPC)	SPCµS/cm	-		185.7	185.5	188.8	19.4	188.7	189.4	193.3	384.8	257.5	172.4	254.8	261.8	254.0	148.3	231.3	352.9	243.5	561.0	248.4
Electrical Conductivity (EC)	SPCµS/cm	-		134.5	135.6	138.5	155.6	130.5	136.0	138.2	310.9	191.4	144.9	196.2	213.2	193.1	125.3	131.2	295.4	191.3	474.2	200.7
Salinity	parts per trillion	-		0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.19	0.12	0.08	0.12	-	0.12	0.07	0.11	0.17	0.12	0.27	0.12
pH	pH Units	-	6.5-9.0	8.18	8.17	8.19	8.21	8.19	8.29	8.17	8.37	7.29	8.24	8.35	8.35	8.31	7.91	8.24	8.62	8.29	8.65	8.33
Turbidity	nephelometric units	-		2.4	2.5	1.4	1.0	17.5	1.7	6.2	60.7	21.7	170.9	136.4	33.2	44.2	133.0	48.8	530.0	44.5	172.8	45.1
Total Dissolved Solids	mg/L	-		120.7	120.5	122.9	123.8	122.6	123.1	125.6	250.1	169.3	109.7	165.6	-	145.1	96.8	149.2	229.3	158.5	364.7	161.42
Physical Parameters																						
Colour	TCU	5		5.3	5.4	6.1	6.1	6.9	6.8	7.3	12.8	7.9	32.6	9.8	9.4	9.4	213	45	38.8	28.6	77.3	24.9
Electrical Conductivity (EC)	µS/cm	2		181	181	182	184	187	190	199	374	244	202	238	252	248	147	229	345	238	541	238
Hardness as CaCO3	mg/L	0.5		-	-	-	-	-	115	94.8	195	131	106	136	136	-	-	-	-	-	-	-
pH	pH Units	0.1	6.5-9.0	8.06	8.03	8.09	8.07	8.06	8.10	8.11	8.34	8.22	8.22	8.23	8.24	8.22	7.66	8.17	8.43	8.20	8.31	8.16
Total Suspended Solids (TSS)	mg/L	3		<3	3.7	<3	<3	<3	<3	8.6	75	28.6	74.6	32.4	42.6	63.3	111	67.1	801	53.9	121	65.5
Total Dissolved Solids (TDS)	mg/L	1		-	-	-	-	-	116	170	223	141	119	143	146	-	-	-	-	-	-	-
Turbidity	NTU	0.1		1.97	2.16	1.08	0.85	1.81	1.34	5.47	72.8	22.1	73.7	24.7	34.6	47.3	103	50.5	875	45.8	204	46.6
Anions and Nutrients																						
Alkalinity (Bicarbonate as CaCO3)	mg/L	1		79.2	81.7	83.9	82.9	84.2	84	84.4	161	111	104	110	123	111	41.6	100	169	110	155	116
Alkalinity (Carbonate as CaCO3)	mg/L	1		<1	<1	<1	<1	<1	<1	<1	5	<1	<1	<1	<1	<1	<1	<1	8.2	<1	2.8	<1
Alkalinity (Hydroxide) as CaCO3	mg/L	1		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Alkalinity (total as CaCO3)	mg/L	1		79.2	81.7	83.9	82.9	84.2	84	84.4	166	111	104	110	123	111	41.6	100	177	110	158	116
Ammonia as N	mg/L	0.005	See narrative #2	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.0076	<0.005	0.0067	0.0244	<0.005	0.0089	0.0141	0.0069	0.0501	0.0066	0.0207	<0.005
Bromide	mg/L	0.05		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Chloride	mg/L	0.5	600	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.62	0.53	0.64	<0.5	0.64	<0.5	9.46	<0.5
Fluoride	mg/L	0.02	See equation #3	0.036	0.036	0.042	0.039	0.041	0.039	0.041	0.097	0.056	0.07	0.057	0.061	0.059	0.077	0.063	0.09	0.063	0.172	0.063
Nitrate and Nitrite (as N)	mg/L	0.0051		0.0493	0.0494	0.0457	0.0446	0.052	0.0433	0.0471	<0.0051	0.03	0.0545	0.0308	0.0642	0.0456	<0.0051	0.0356	0.0505	0.0396	1.57	0.0425
Nitrate (as N)	mg/L	0.005	32.8	0.0493	0.0494	0.0457	0.0446	0.052	0.0433	0.0471	<0.005	0.03	0.0545	0.0308	0.0642	0.0456	<0.005	0.0356	0.0432	0.0396	1.56	0.0425
Nitrite (as N)	mg/L	0.001	0.06-0.60 #4	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.0073	<0.001	0.0095	<0.001
Total Kjeldahl Nitrogen (TKN)	mg/L	0.05		0.187	0.122	0.143	0.123	0.152	0.127	0.141	3.19	0.234	0.389	0.77	0.228	0.248	0.94	0.314	2.03	0.253	1.75	0.209
Nitrogen (Total)	mg/L	0.03		0.142	0.118	0.136	0.128	0.159	0.137	0.144	3.24	0.173	0.321	0.209	0.157	0.166	0.72	0.247	0.62	0.206	2.89	0.203
Orthophosphate (as P) (Filtered)	mg/L	0.001		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.0018	<0.001	<0.001	<0.001	<0.001	0.0011	0.0052	0.0018	0.0023	0.0016	0.0012	0.0015
Phosphorus (Total Dissolved)	mg/L	0.002		<0.002	<0.002	<0.002	<0.002	0.0029	<0.002	0.005	0.004	<0.002	0.0042	0.0025	0.0028	<0.002	0.0148	0.0045	0.0075	0.0035	0.0126	0.0027
Phosphorus	mg/L	0.002		0.014	0.0063	0.003	<0.002	<0.002	<0.002	0.0046	0.0925	0.0203	0.0634	0.22	0.0393	0.0372	0.184	0.074	0.512	0.0414	0.22	0.069
Sulphate	mg/L	0.3		14.7	14.8	15.1	15	14.7	14.8	15.4	46.7	24.1	9	22.8	16.3	22.6	28.4	23	20.8	22.1	125	22.2
Silica	mg/L	0.5		4.5	4.32	4.61	4.5	4.62	4.39	4.53	4.03	4.02	3.83	4.06	3.16	3.88	5.8	4.07	4.75	3.8	3.09	4.07
Organic and Inorganic Carbon																						
Dissolved Organic Carbon (DOC) (Filtered)	mg/L	0.5		3.61	3.01	3.78	4.34	4.09	3.92	2.94	4.5	3.86	10.6	3.83	3.93	3.51	32.1	8.94	14.1	6.87	25	6.96
Total Organic Carbon (TOC)	mg/L	0.5		3.02	2.71	3.26	2.91	2.89	2.55	2.99	5.48	4.16	10.4	6.66	4.42	3.89	36.4	8.96	13.2	8.14	29.9	7.85
Plant Pigments																						
Chlorophyll A	µg/L	0.01		0.719	0.742	0.702	0.795			-	-	-	-	-	-	-	-	-	-	-	-	-

NOTES:

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H	Hardness. Where hardness values exceed the range applied for guideline use, site specific assessment may be required.
#1	Dissolved Oxygen guideline protects all life stages other than buried embryo/alevin, based on instantaneous measurement.
#2	Guideline for ammonia nitrogen (NH_3) varies with pH and temperature, and is derived from Table 26D of the BC MOE, 2017 BCWQGs, ranging from 0.681 to 28.7 mg/L for pH 6.5-9.0 and temperature 0.0-20.0 degC.
#3	Guideline for fluoride varies with H. Guideline is 0.4 mg/L when H <10 mg/L. Calculated in mg/L and based on equation: [-51.73 + 92.57*log(Hardness)]x0.01 when H =10-385 mg/L.
#4	Guideline for nitrite varies with chloride concentrations.
-	No applicable guideline or analysis was not conducted.
<	Concentration is less than the laboratory detection limit indicated.
Bold	Bold and shaded indicates an exceedance of the applied guideline.
MPN	Most Probable Number
CFU	Colony Forming Units

Table 8: Summary of July 2017 Event Surface Water Quality Results

				Existing Reservoir Sites				Future Site C Reservoir						Downstream of Site C Reservoir								
Parameter	**Unit**	**Reported Detection Limit (RDL)**	**BC MOE 2017 (Approved Guidelines for freshwater aquatic life and short-term maximum)**	**WILLISTON (W1 - Deep)**	**WILLISTON (W1 - Shallow)**	**DINOSAUR (D1 - Deep)**	**DINOSAUR (D1 - Shallow)**	**PEACE CANYON (PC1)**	**UPPER SITE C RESERVOIR (PR1)**	**MIDDLE SITE C RESERVOIR (PR2)**	**HALFWAY RIVER DOWNSTREAM (HD)**	**LOWER SITE C RESERVOIR (PR3)**	**MOBERLY RIVER DOWNSTREAM (MD)**	**PEACE AT PINE (PD1)**	**PINE RIVER (PINE)**	**PEACE AT BEATTON (PD2)**	**BEATTON RIVER (BEATTON)**	**PEACE AT KISKATINAW (PD3)**	**KISKATINAW RIVER (KISKATINAW)**	**PEACE AT POUCE COUPE (PD4)**	**POUCE COUPE (POUCE)**	**MANY ISLANDS (PDS)**
Matrix				surface water	surface water	surface water	surface water	surface water	surface water	surface water	surface water	surface water	surface water	surface water	surface water	surface water	surface water	surface water	surface water	surface water	surface water	surface water
Sample Date				7/20/2017	7/20/2017	7/20/2017	7/20/2017	7/21/2017	7/21/2017	7/21/2017	7/21/2017	7/18/2017	7/18/2017	7/18/2017	7/18/2017	7/19/2017	7/19/2017	7/19/2017	7/19/2017	7/19/2017	7/19/2017	7/19/2017
Laboratory Identification Number				L1962155-2	L1962155-1	L1962155-4	L1962155-3	L1962772-3	L1962772-4	L1962772-2	L1962772-1	L1960524-2	L1960524-1	L1960524-3	L1960524-4	L1961413-1	L1961413-2	L1961413-3	L1961413-4	L1961413-5	L1961413-6	L1961413-7
Field Measurements																						
Sample Depth	m	-		5.0	0.2	5.0	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Total Depth	m	-		58.0	58.0	-	-	2.0	0.5	4.0	-	7.0	1.0	2.0	1.0	2.0	1.5	4.0	0.8	3.0	0.5	4.2
Temperature	°C	-	15	14.3	**15.7**	11.7	**17.9**	10.7	11.0	10.7	**17.0**	12.5	**16.0**	12.9	**15.8**	13.7	**19.8**	14.3	**17.9**	14.8	**20.0**	**15.8**
Dissolved Oxygen (DO)	mg/L	-	Minimum 5 [#1]	9.93	9.70	10.74	9.83	11.08	10.92	10.68	9.20	10.50	9.44	10.40	9.56	10.15	9.18	9.95	9.19	9.86	8.94	9.70
Specific Conductivity (SPC)	SPCµS/cm	-		179.5	180.4	182.6	187.9	184.5	184.5	186.0	414.1	235.6	233.3	236.6	299.6	239.5	192.1	239.6	388.6	247.7	606.0	255.0
Electrical Conductivity (EC)	SPCµS/cm	-		142.9	148.6	136.3	159.4	282.3	135.2	135.0	351.6	179.4	193.3	181.8	300.2	187.8	172.0	190.7	335.7	199.2	548.0	210.3
Salinity	parts per trillion	-		0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.20	0.11	0.11	0.11	0.14	0.11	0.09	0.11	0.19	0.12	0.29	0.12
pH	pH Units	-	6.5-9.0	8.14	8.19	8.07	8.21	8.03	8.10	8.12	8.36	8.19	8.21	8.27	8.32	8.26	8.01	8.22	8.49	8.27	8.29	8.38
Turbidity	nephelometric units	-		3.2	3.7	1.4	1.0	7.5	8.1	5.3	37.1	12.4	38.7	13.9	39.1	16.7	64.1	24.4	164.8	28.6	472.1	40.8
Total Dissolved Solids	mg/L	-		116.7	117.3	119.3	121.8	129.9	119.9	120.8	269.8	153.2	151.7	153.9	194.1	156.1	124.1	155.7	252.7	160.6	393.8	165.8
Physical Parameters																						
Colour	TCU	5		7.9	7.4	6.5	6.9	7.1	6.5	7.4	9.9	11.2	39	10.5	10.9	10.2	333	34.2	53.8	29.1	68.8	33.9
Electrical Conductivity (EC)	µS/cm	2		181	182	186	186	191	191	194	413	237	230	236	293	250	196	244	397	251	607	256
Hardness as CaCO3	mg/L	0.5																				
pH	pH Units	0.1	6.5-9.0	8.05	8.04	8.05	8.08	8.15	8.17	8.17	8.42	8.22	8.25	8.24	8.34	8.27	7.84	8.22	8.47	8.24	8.18	8.24
Total Suspended Solids (TSS)	mg/L	3		<3	<3	<3	<3	<3	<3	6.7	41.3	12.5	28.1	15.1	37.3	21.9	59.7	30.7	82.3	31.3	348	49.7
Total Dissolved Solids (TDS)	mg/L	1		113	117	116	115	117	129	122	279	148	158	146	216	159	221	166	310	163	558	188
Turbidity	NTU	0.1		3.48	2.86	1.18	1.01	1.37	1.43	3.5	38.8	13.2	34.2	13.3	40.6	17.3	65.9	24.3	195	28.8	542	42.1
Anions and Nutrients																						
Alkalinity (Bicarbonate as CaCO3)	mg/L	1		84.4	84.1	86	87.7	83.3	84.4	85.4	177	107	120	109	137	111	58.2	112	196	114	146	117
Alkalinity (Carbonate as CaCO3)	mg/L	1		<1	<1	<1	<1	<1	<1	<1	9.8	<1	<1	<1	5	<1	<1	<1	10.4	<1	<1	<1
Alkalinity (Hydroxide) as CaCO3	mg/L	1		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Alkalinity (total as CaCO3)	mg/L	1		84.4	84.1	86	87.7	83.3	84.4	85.4	187	107	120	109	142	111	58.2	112	206	114	146	117
Ammonia as N	mg/L	0.005	See narrative [#2]	<0.005	<0.005	<0.005	<0.005	0.0072	<0.005	<0.005	0.0174	<0.005	<0.005	<0.005	<0.005	<0.005	0.0163	<0.005	0.0142	<0.005	0.0648	<0.005
Bromide	mg/L	0.05		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.088	<0.05
Chloride	mg/L	0.5	600	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.59	<0.5	1.02	<0.5	0.68	<0.5	1.74	0.53	17.1	0.68
Fluoride	mg/L	0.02	See equation [#3]	0.034	0.034	0.036	0.037	0.036	0.035	0.037	0.101	0.052	0.077	0.053	0.073	0.053	0.09	0.057	0.096	0.059	0.218	0.063
Nitrate and Nitrite (as N)	mg/L	0.0051		0.0474	0.0473	0.0375	0.0327	0.0542	0.0515	0.0543	<0.0051	0.0289	<0.0051	0.0292	0.0159	0.0295	0.0161	0.0269	0.0843	0.0266	1.33	0.0409
Nitrate (as N)	mg/L	0.005	32.8	0.0474	0.0473	0.0375	0.0327	0.0542	0.0515	0.0543	<0.005	0.0289	<0.005	0.0292	0.0159	0.0295	0.0143	0.0269	0.0815	0.0266	1.29	0.0409
Nitrite (as N)	mg/L	0.001	0.06-0.60 [#4]	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.0018	<0.001	0.0029	<0.001	0.0411	<0.001
Total Kjeldahl Nitrogen (TKN)	mg/L	0.05		0.1	0.112	0.127	0.081	0.106	0.082	0.097	0.223	0.158	0.339	<0.25	0.228	0.182	1.12	0.246	0.79	0.275	2.28	0.286
Nitrogen (Total)	mg/L	0.03		0.166	0.12	0.13	0.115	0.165	0.122	0.134	0.157	0.147	0.301	0.141	0.156	0.153	0.952	0.161	0.664	0.206	2.76	0.252
Orthophosphate (as P) (Filtered)	mg/L	0.001		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.002	<0.001	<0.001	<0.001	<0.001	<0.001	0.0197	0.0014	0.0076	0.0017	0.0189	0.0017
Phosphorus (Total Dissolved)	mg/L	0.002		<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.0033	0.0033	<0.002	0.0027	<0.002	<0.002	0.0021	0.044	0.0044	0.0148	0.0035	0.0338	0.0045
Phosphorus	mg/L	0.002		0.0028	0.0034	<0.002	<0.002	0.0077	<0.002	0.0118	0.0585	<0.002	0.0294	0.0113	<0.002	0.0193	0.121	0.0281	0.166	0.0305	0.491	0.038
Sulphate	mg/L	0.3		13.3	13.3	14	14.2	13.8	13.8	14.2	51.5	22.9	10.1	22.4	21.8	21.2	34.7	22	21.1	22.6	148	24.5
Silica	mg/L	0.5		4.35	4.43	4.19	4.11	4.45	4.21	4.19	3.88	4.03	3.23	4.29	2.85	3.91	5.78	4.05	5.22	3.84	4.96	3.8
Organic and Inorganic Carbon																						
Dissolved Organic Carbon (DOC) (Filtered)	mg/L	0.5		5.18	4.98	4.69	4.23	3.74	3.83	5.43	4.73	3.9	9.65	3.57	4.01	4.04	40.7	7.31	16.6	8.13	25.2	8.91
Total Organic Carbon (TOC)	mg/L	0.5		2.78	2.92	2.78	2.73	3.32	2.84	3.43	4.33	3.27	9.19	3.29	4.46	3.73	43.2	6.3	16.7	5.58	28.9	7.67
Plant Pigments																						
Chlorophyll A	µg/L	0.01		0.644	0.759	1.32	0.799	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

NOTES:

BC MOE 2017	British Columbia Ministry of Environment (BC MOE). 2017. British Columbia approved water quality guidelines: Aquatic life, wildlife & agriculture. Water Protection and Sustainability Branch. Victoria, British Columbia, Canada.
H	Hardness. Where hardness values exceed the range applied for guideline use, site specific assessment may be required.
#1	Dissolved Oxygen guideline protects all life stages other than buried embryo/alevin, based on instantaneous measurement.
#2	Guideline for ammonia nitrogen (NH_3) varies with pH and temperature, and is derived from Table 26D of the BC MOE, 2017 BCWQGs, ranging from 0.681 to 28.7 mg/L for pH 6.5-9.0 and temperature 0.0-20.0 degC.
#3	Guideline for fluoride varies with H. Guideline is 0.4 mg/L when H <10 mg/L. Calculated in mg/L and based on equation: [-51.73 + 92.57*log(Hardness)]x0.01 when H =10-385 mg/L.
#4	Guideline for nitrite varies with chloride concentrations.
-	No applicable guideline or analysis was not conducted.
<	Concentration is less than the laboratory detection limit indicated.
Bold	Bold and shaded indicates an exceedance of the applied guideline.
MPN	Most Probable Number
CFU	Colony Forming Units

Table 9: Summary of August 2017 Event Surface Water Quality Results

				Existing Reservoir Sites				Future Site C Reservoir						Downstream of Site C Reservoir								
Parameter	**Unit**	**Reported Detection Limit (RDL)**	**BC MOE 2017 (Approved Guidelines for freshwater aquatic life and short-term maximum)**	**WILLISTON (W1 - Deep)**	**WILLISTON (W1 - Shallow)**	**DINOSAUR (D1 - Deep)**	**DINOSAUR (D1 - Shallow)**	**PEACE CANYON (PC1)**	**UPPER SITE C RESERVOIR (PR1)**	**MIDDLE SITE C RESERVOIR (PR2)**	**HALFWAY RIVER DOWNSTREAM (HD)**	**LOWER SITE C RESERVOIR (PR3)**	**MOBERLY RIVER DOWNSTREAM (MD)**	**PEACE AT PINE (PD1)**	**PINE RIVER (PINE)**	**PEACE AT BEATTON (PD2)**	**BEATTON RIVER (BEATTON)**	**PEACE AT KISKATINAW (PD3)**	**KISKATINAW RIVER (KISKATINAW)**	**PEACE AT POUCE COUPE (PD4)**	**POUCE COUPE (POUCE)**	**MANY ISLANDS (PDS)**
Matrix				surface water	surface water	surface water	surface water	surface water	surface water	surface water	surface water	surface water	surface water	surface water	surface water	surface water	surface water	surface water	surface water	surface water	surface water	surface water
Sample Date				8/11/2017	8/11/2017	8/11/2017	8/11/2017	8/12/2017	8/12/2017	8/12/2017	8/12/2017	8/9/2017	8/9/2017	8/9/2017	8/9/2017	8/10/2017	8/10/2017	8/10/2017	8/10/2017	8/10/2017	8/10/2017	8/10/2017
Laboratory Identification Number				L1974039-2	L1974039-1	L1974039-4	L1974039-3	L1974040-3	L1974040-4	L1974040-2	L1974040-1	L1972424-2	L1972424-1	L1972424-3	L1972424-4	L1973238-2	L1973238-1	L1973238-5	L1973238-4	L1973238-6	L1973238-7	L1973238-8
Field Measurements																						
Sample Depth	m	-		5.0	0.2	5.0	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Total Depth	m	-		59.0	59.0	21.7	21.7	17.3	2.1	3.0	3.0	2.5	2.4	4.3	4.6	4.0	1.0	4.0	3.2	4.0	0.4	5.0
Temperature	°C	-	15	**16.8**	**19.1**	9.4	11.7	9.8	9.8	10.6	**19.8**	10.8	**23.8**	11.2	**23.7**	11.4	**21.6**	12.2	**20.8**	12.8	**20.0**	14.1
Dissolved Oxygen (DO)	mg/L	-	Minimum 5 [#1]	9.23	9.06	10.56	10.47	10.62	10.67	10.17	8.72	10.78	8.11	10.69	8.37	10.54	8.15	10.44	8.77	10.34	9.00	10.05
Specific Conductivity (SPC)	SPCµS/cm	-		176.2	176.9	182.7	183.2	182.1	118.9	186.6	444.7	197.6	289.3	196.7	326.4	198.2	201.5	202.1	487.9	204.9	934.0	206.3
Electrical Conductivity (EC)	SPCµS/cm	-		148.8	156.9	128.1	138.9	129.1	129.1	134.7	400.6	143.7	283.7	144.8	318.1	146.9	188.6	152.7	449.3	157.1	859.0	163.5
Salinity	parts per trillion	-		0.08	0.08	0.09	0.09	0.09	0.09	0.09	0.21	0.09	0.14	0.09	0.16	0.09	0.09	0.10	0.24	0.10	0.46	0.10
pH	pH Units	-	6.5-9.0	8.23	8.29	8.00	8.01	8.03	8.09	8.27	8.44	8.04	8.40	8.14	8.47	8.21	8.06	8.23	8.57	8.26	8.53	8.26
Turbidity	nephelometric units	-		8.0	7.0	6.6	6.3	6.9	6.5	8.0	21.0	27.1	12.4	17.2	10.0	20.4	35.0	22.2	11.4	21.1	16.1	26.4
Total Dissolved Solids	mg/L	-		114.5	114.9	118.7	119.4	118.4	118.1	121.5	289.0	128.4	188.1	127.7	212.2	129.0	131.2	131.6	317.5	133.2	613.3	134.1
Physical Parameters																						
Colour	TCU	5		8.5	8	7.3	7.2	6.7	6	7.9	5.9	6.8	17.1	7.5	6.3	353	7	18.8	8.5	18.1	36.6	19.5
Electrical Conductivity (EC)	µS/cm	2		170	170	176	176	176	178	183	424	194	277	195	320	191	193	469	195	201	922	196
Hardness as CaCO3	mg/L	0.5																				
pH	pH Units	0.1	6.5-9.0	8.14	8.13	8.13	8.12	8.13	8.14	8.16	8.45	8.12	8.31	8.16	8.44	7.91	8.12	8.54	8.13	8.13	8.51	8.12
Total Suspended Solids (TSS)	mg/L	3		<3	3.7	3.3	<3	<3	<3	<3	23.7	34.1	9.5	51.5	6.7	20.3	73.1	5.3	99.3	86.3	7.1	75.5
Total Dissolved Solids (TDS)	mg/L	1		117	116	120	117	109	111	111	269	128	171	117	180	227	132	294	132	128	652	128
Turbidity	NTU	0.1		1.7	1.92	1.13	0.79	1.16	1.06	2.39	12.8	7.2	7.95	9.56	4.92	32.8	15.4	6.77	15.4	15.2	13.5	18.2
Anions and Nutrients																						
Alkalinity (Bicarbonate as CaCO3)	mg/L	1		80.2	81.2	82.8	83.3	84	84.1	86.2	180	88.3	138	88.2	140	64.6	86.4	215	87.2	89.9	232	89.5
Alkalinity (Carbonate as CaCO3)	mg/L	1		<1	<1	<1	<1	<1	<1	<1	12.2	<1	2.2	<1	8	<1	<1	17.4	<1	<1	17.2	<1
Alkalinity (Hydroxide) as CaCO3	mg/L	1		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Alkalinity (total as CaCO3)	mg/L	1		80.2	81.2	82.8	83.3	84	84.1	86.2	193	88.3	141	88.2	148	64.6	86.4	232	87.2	89.9	249	89.5
Ammonia as N	mg/L	0.005	See narrative [#2]	<0.005	<0.005	0.0087	0.0072	0.0079	<0.005	<0.005	<0.005	<0.005	0.0053	<0.005	<0.005	0.0088	<0.005	<0.005	<0.005	<0.005	0.0106	<0.005
Bromide	mg/L	0.05		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.25	<0.05
Chloride	mg/L	0.5	600	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.5	<0.5	0.53	<0.5	1.26	0.65	<0.5	1.11	<0.5	<0.5	12.9	<0.5
Fluoride	mg/L	0.02	See equation [#3]	0.036	0.034	0.037	0.037	0.034	0.037	0.037	0.108	0.04	0.087	0.04	0.074	0.087	0.037	0.102	0.04	0.042	0.22	0.04
Nitrate and Nitrite (as N)	mg/L	0.0051		0.0439	0.0433	0.062	0.0601	0.0619	0.0606	0.0558	<0.0051	0.0542	<0.0051	0.0553	<0.0051	0.0075	0.0508	<0.0051	0.0472	0.0458	<0.025	0.0462
Nitrate (as N)	mg/L	0.005	32.8	0.0439	0.0433	0.0609	0.0601	0.0608	0.0595	0.0558	<0.005	0.0542	<0.005	0.0553	<0.005	0.0061	0.0508	<0.005	0.0472	0.0458	<0.025	0.0462
Nitrite (as N)	mg/L	0.001	0.06-0.60 [#4]	<0.001	<0.001	0.0011	<0.001	0.0011	0.0011	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.0013	<0.001	<0.001	<0.001	<0.001	<0.005	<0.001
Total Kjeldahl Nitrogen (TKN)	mg/L	0.05		0.087	0.086	0.09	0.077	0.07	0.065	0.096	0.125	0.061	0.124	0.092	0.067	1.09	0.152	0.382	0.178	0.175	0.875	0.163
Nitrogen (Total)	mg/L	0.03		0.177	0.178	0.157	0.13	0.148	0.13	0.16	0.109	0.148	0.188	0.137	0.083	0.948	0.138	0.346	0.156	0.17	0.856	0.161
Orthophosphate (as P) (Filtered)	mg/L	0.001		<0.001	<0.001	<0.001	0.0014	<0.001	<0.001	<0.001	<0.001	<0.001	0.0013	<0.001	<0.001	0.0136	0.0019	<0.001	0.001	0.002	<0.001	0.0016
Phosphorus (Total Dissolved)	mg/L	0.002		<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.0024	<0.002	0.0037	0.0026	<0.002	0.0322	<0.002	0.0027	0.0022	0.0025	0.0077	0.0024
Phosphorus	mg/L	0.002		0.0021	0.0025	<0.002	<0.002	0.0028	0.0021	0.0056	0.0164	0.0302	0.0102	0.0194	0.0053	0.071	0.0236	0.0084	0.115	0.0364	0.0198	0.0289
Sulphate	mg/L	0.3		12.7	12.8	13.9	13.9	13.8	13.8	14.5	56.8	16.4	14	16.3	25.6	32.3	16	36.8	16.4	17.2	262	17.3
Silica	mg/L	0.5		4.1	4.12	4.42	4.25	4.29	4.31	4.28	3.72	4.48	3.42	4.34	2.47	6.27	4.04	4.48	4.05	4.25	0.72	3.99
Organic and Inorganic Carbon																						
Dissolved Organic Carbon (DOC) (Filtered)	mg/L	0.5		3.28	3.46	3	3.52	2.71	2.79	3.09	3.19	2.95	6.2	2.65	3.78	41.8	2.98	10.4	3.16	4.08	19	4.29
Total Organic Carbon (TOC)	mg/L	0.5		3.15	2.9	2.87	2.93	2.61	2.73	2.81	2.88	3.15	5.93	3.01	2.15	41.5	2.71	9.81	4.18	5.56	19.1	4.23
Plant Pigments																						
Chlorophyll A	µg/L	0.01		0.925	1.01	0.17	0.109	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

NOTES:

BC MOE 2017	British Columbia Ministry of Environment (BC MOE). 2017. British Columbia approved water quality guidelines: Aquatic life, wildlife & agriculture. Water Protection and Sustainability Branch. Victoria, British Columbia, Canada.
H	Hardness. Where hardness values exceed the range applied for guideline use, site specific assessment may be required.
#1	Dissolved Oxygen guideline protects all life stages other than buried embryo/alevin, based on instantaneous measurement.
#2	Guideline for ammonia nitrogen (NH_3) varies with pH and temperature, and is derived from Table 26D of the BC MOE, 2017 BCWQGs, ranging from 0.681 to 28.7 mg/L for pH 6.5-9.0 and temperature 0.0-20.0 degC.
#3	Guideline for fluoride varies with H. Guideline is 0.4 mg/L when H <10 mg/L. Calculated in mg/L and based on equation: [-51.73 + 92.57*log(Hardness)]x0.01 when H =10-385 mg/L.
#4	Guideline for nitrite varies with chloride concentrations.
-	No applicable guideline or analysis was not conducted.
<	Concentration is less than the laboratory detection limit indicated.
Bold	Bold and shaded indicates an exceedance of the applied guideline.
MPN	Most Probable Number
CFU	Colony Forming Units

Table 10: Summary of September 2017 Event Surface Water Quality Results

				Existing Reservoir Sites				Future Site C Reservoir						Downstream of Site C Reservoir							
Parameter	**Unit**	**Reported Detection Limit (RDL)**	**BC MOE 2017 (Approved Guidelines for freshwater aquatic life and short-term maximum)**	**WILLISTON (W1 - Deep)**	**WILLISTON (W1 - Shallow)**	**DINOSAUR (D1 - Deep)**	**DINOSAUR (D1 - Shallow)**	**PEACE CANYON (PC1)**	**UPPER SITE C RESERVOIR (PR1)**	**MIDDLE SITE C RESERVOIR (PR2)**	**HALFWAY RIVER DOWNSTREAM (HD)**	**LOWER SITE C RESERVOIR (PR3)**	**MOBERLY RIVER DOWNSTREAM (MD)**	**PEACE AT PINE (PD1)**	**PINE RIVER (PINE)**	**PEACE AT BEATTON (PD2)**	**BEATTON RIVER (BEATTON)**	**PEACE AT KISKATINAW (PD3)**	**KISKATINAW RIVER (KISKATINAW)**	**PEACE AT POUCE COUPE (PD4)**	**POUCE COUPE (POUCE)**	**MANY ISLANDS (PDS)**
Matrix				surface water	surface water	surface water	surface water	surface water	surface water	surface water	surface water	surface water	surface water	surface water	surface water	surface water	surface water	surface water	surface water	surface water	surface water
Sample Date				9/17/2017	9/17/2017	9/17/2017	9/17/2017	9/18/2017	9/18/2017	9/18/2017	9/18/2017	9/20/2017	9/20/2017	9/20/2017	9/20/2017	9/19/2017	9/19/2017	9/19/2017	9/19/2017	9/19/2017	9/19/2017
Laboratory Identification Number				L1992751-2	L1992751-1	L1992751-4	L1992751-3	L1993110-3	L1993110-4	L1993110-2	L1993110-1	L1994687-2	L1994687-1	L1994687-3	L1994687-4	L1994216-1	L1994216-2	L1994216-3	L1994216-4	L1994216-5	L1994216-6	L1994216-7
Field Measurements																						
Sample Depth	m	-		5.0	0.2	5.0	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Total Depth	m	-		57.0	57.0	46.0	46.0	18.0	13.3	-	1.0	5.0	1.0	1.5	1.5	4.0	1.0	4.0	14.0	3.5	1.0	5.0
Temperature	°C	-	15	14.3	14.4	12.1	12.2	12.1	12.3	13.1	12.4	11.1	11.1	11.4	10.4	11.7	12.3	11.8	11.5	12.1	12.3	12.2
Dissolved Oxygen (DO)	mg/L	-	Minimum 5 [#1]	9.40	9.42	9.99	10.03	8.39	8.36	4.36	8.46	7.11	10.32	9.41	10.15	9.80	8.87	9.84	9.74	7.67	7.00	7.33
Specific Conductivity (SPC)	SPCµS/cm	-		166.2	166.2	169.9	169.9	170.3	170.1	170.2	432.6	179.0	359.5	179.7	283.7	132.9	427.0	182.1	463.4	182.1	483.6	180.8
Electrical Conductivity (EC)	SPCµS/cm	-		132.2	132.5	128.0	128.5	128.1	128.8	130.0	329.6	131.6	264.3	132.9	204.8	133.5	232.1	136.2	343.8	137.3	311.5	136.7
Salinity	parts per trillion	-		0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.21	0.09	0.17	0.09	0.14	0.08	0.21	0.09	0.23	0.09	0.24	0.09
pH	pH Units	-	6.5-9.0	8.28	8.26	8.17	8.18	8.16	8.20	8.34	8.47	8.27	8.33	8.26	8.51	8.35	8.41	8.38	8.68	8.41	8.52	8.36
Turbidity	nephelometric units	-		3.3	3.3	3.5	3.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Dissolved Solids	mg/L	-		108.1	108.1	110.5	110.4	110.6	110.5	110.5	281.9	116.1	233.6	116.7	184.6	115.9	277.3	118.2	299.9	118.4	320.1	117.6
Physical Parameters																						
Colour	TCU	5		7.8	7.5	7.3	7.7	8.4	8.2	8.6	<5	7.9	8.6	8.3	7.2	7.5	244	8	10.5	8.2	14.7	8.2
Electrical Conductivity (EC)	µS/cm	2		169	167	170	170	175	175	177	442	187	369	185	286	186	438	189	480	190	852	193
Hardness as CaCO3	mg/L	0.5		86.6	84.5	89.5	87.9	88.5	89.1	84.9	228	104	205	103	164	89.4	158	89	213	92.7	255	92.5
pH	pH Units	0.1	6.5-9.0	8	7.98	7.98	7.98	8.09	8.07	8.1	8.38	8.03	8.25	8.03	8.27	8.11	8.26	8.11	8.48	8.19	8.37	8.17
Total Suspended Solids (TSS)	mg/L	3		<3	<3	<3	<3	<3	<3	4.8	7.8	7.9	17.3	15.5	8.7	7.5	<3	6.3	3.1	11.7	39.5	15.7
Total Dissolved Solids (TDS)	mg/L	1		94.5	92.2	95.7	95.1	96.2	95.4	94.2	260	105	219	105	170	100	303	101	286	104	549	104
Turbidity	NTU	0.1		1.03	1.03	1.33	1.26	2.22	2.16	2.04	4.7	4.02	10.9	6.12	6.7	3.74	10.7	4.35	3.3	6.7	20.6	6.52
Anions and Nutrients																						
Alkalinity (Bicarbonate as CaCO3)	mg/L	1		79.9	77.6	79.7	79.8	80.8	79.2	80.2	185	83	181	84	135	84.8	146	86	206	88.6	165	89.3
Alkalinity (Carbonate as CaCO3)	mg/L	1		<1	<1	<1	<1	<1	<1	<1	7.6	<1	<1	<1	<1	<1	<1	<1	13.2	<1	7.2	<1
Alkalinity (Hydroxide) as CaCO3	mg/L	1		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Alkalinity (total as CaCO3)	mg/L	1		79.9	77.6	79.7	79.8	80.8	79.2	80.2	192	83	181	84	135	84.8	146	86	220	88.6	172	89.3
Ammonia as N	mg/L	0.005	See narrative [#2]	<0.005	0.0053	<0.005	<0.005	<0.005	0.0079	<0.005	<0.005	<0.005	<0.005	0.007	<0.005	<0.005	0.0075	<0.005	<0.005	<0.005	0.0051	<0.005
Bromide	mg/L	0.05		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.25	<0.05
Chloride	mg/L	0.5	600	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.57	<0.5	0.61	<0.5	1.02	<0.5	5.29	<0.5	1.32	<0.5	9.4	<0.5
Fluoride	mg/L	0.02	See equation [#3]	0.034	0.035	0.035	0.035	0.034	0.034	0.034	0.101	0.038	0.098	0.039	0.064	0.037	0.153	0.039	0.101	0.038	0.14	0.039
Nitrate and Nitrite (as N)	mg/L	0.0051		0.0488	0.0503	0.0572	0.0574	0.056	0.0535	0.049	<0.0051	0.0584	<0.0051	0.0592	0.03	0.0489	<0.0051	0.0472	<0.0051	0.0456	<0.025	0.0429
Nitrate (as N)	mg/L	0.005	32.8	0.0446	0.0463	0.0543	0.0546	0.0535	0.051	0.0469	<0.005	0.0572	<0.005	0.0592	0.03	0.0473	<0.005	0.0454	<0.005	0.0434	<0.025	0.0415
Nitrite (as N)	mg/L	0.001	0.06-0.60 [#4]	0.0043	0.004	0.0028	0.0028	0.0025	0.0026	0.0021	<0.001	0.0012	<0.001	<0.001	<0.001	0.0015	<0.001	0.0017	<0.001	0.0021	<0.005	0.0014
Total Kjeldahl Nitrogen (TKN)	mg/L	0.05		0.118	0.117	0.112	0.113	0.074	0.073	0.076	0.07	0.119	0.139	0.139	0.073	0.087	0.811	0.071	0.275	0.134	0.428	0.108
Nitrogen (Total)	mg/L	0.03		0.139	0.15	0.135	0.142	0.142	0.138	0.13	0.076	0.144	0.116	0.154	0.101	0.133	0.834	0.127	0.265	0.131	0.44	0.131
Orthophosphate (as P) (Filtered)	mg/L	0.001		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.0015	<0.001	<0.001	<0.001	0.008	<0.001	<0.001	<0.001	<0.001	<0.001
Phosphorus (Total Dissolved)	mg/L	0.002		<0.002	<0.002	<0.002	<0.002	<0.002	0.0028	<0.002	<0.002	<0.002	0.0022	0.0021	<0.002	<0.002	0.024	<0.002	0.0031	0.0021	0.0045	<0.002
Phosphorus	mg/L	0.002		0.0035	0.0036	0.0036	0.0036	0.0037	0.0044	0.0069	0.0086	0.0069	0.0202	0.0062	0.0102	0.011	0.0381	0.009	0.0069	0.0128	0.0214	0.0133
Sulphate	mg/L	0.3		12.4	12.5	13	13	13	13	13.1	59.6	14.4	27.1	14.7	24.6	14.2	82.7	14.5	50.5	14.7	279	14.7
Silica	mg/L	0.5		4.3	4.35	4.38	4.65	4.26	4.27	4.23	3.47	4.21	4.07	4.14	2.11	4.18	4.24	4.07	1.67	4.13	2.09	4.1
Anions Total	meq/L			1.86	1.82	1.87	1.87	1.89	1.86	1.88	5.1	1.96	4.2	1.99	3.25	2	4.8	2.03	5.48	2.08	9.52	2.1
Cations Total	meq/L			1.73	1.69	1.79	1.76	1.77	1.78	1.7	4.69	2.08	4.39	2.06	3.42	1.79	4.84	1.78	5.28	1.85	7.61	1.85
Ionic Balance	N/A			-3.6	-3.6	-2.2	-3.2	-3.4	-2.1	-5	-4.2	2.8	2.2	1.7	2.5	-5.5	0.4	-6.5	-1.9	-5.8	-11.1	-6.2
Organic and Inorganic Carbon																						
Dissolved Organic Carbon (DOC) (Filtered)	mg/L	0.5		2.89	2.93	2.47	2.9	2.54	2.52	2.6	1.75	2.57	3.2	2.49	1.41	2.37	30.3	2.94	6.25	2.48	6.84	2.46
Total Organic Carbon (TOC)	mg/L	0.5		3.05	2.88	2.67	2.61	2.62	2.63	2.61	1.78	2.99	3.35	2.97	1.67	2.89	32.5	2.87	6.69	2.65	10.2	2.73
Plant Pigments																						
Chlorophyll A	µg/L	0.01		0.965	0.914	0.628	0.614	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Metals																						
Methylmercury (as MeHg)-Total	ug/L	<5.0E-8		<5.0E-8	<5.0E-8	<5.0E-8	<5.0E-8	<5.0E-8	<5.0E-8	<5.0E-8	<5.0E-8	<5.0E-8	<5.0E-8	<5.0E-8	<5.0E-8	<5.0E-8	4.88E-7	<5.0E-8	<5.0E-8	<5.0E-8	<5.0E-8	<5.0E-8
Methylmercury (as MeHg)-Dissolved (Filtered)	ug/L	<0.00005		<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	0.000396	<0.00005	<0.00005	<0.00005	0.000057	<0.00005
Mercury	mg/L	<0.000005 - 5.7E-7		<5.0E-7	<0.000005 - 6.2E-7	<5.0E-7	<5.0E-7	<5.0E-7	<5.0E-7	<5.0E-7	<0.000005 - 6.8E-7	5.6E-7	0.00000118	8.3E-7	8.9E-7	<0.000005 - 7.1E-7	0.00005 - 0.000002	<0.000005 - 5.7E-7	<5.0E-7	<0.000005 - 8.6E-7	<0.000005 - 6.4E-7	<0.000005 - 7.4E-7
Mercury (Filtered)	mg/L	<0.000005 - 5.7E-7		<5.0E-7	<5.0E-7	<5.0E-7	<5.0E-7	<5.0E-7	<5.0E-7	<5.0E-7	<5.0E-7	<5.0E-7	<5.0E-7	<5.0E-7	<5.0E-7	<5.0E-7	.000005 - 0.000002	<5.0E-7	<5.0E-7	<5.0E-7	<0.000005 - 5.1E-7	<5.0E-7

NOTES:

BC MOE 2017	British Columbia Ministry of Environment (BC MOE). 2017. British Columbia approved water quality guidelines: Aquatic life, wildlife & agriculture. Water Protection and Sustainability Branch. Victoria, British Columbia, Canada.
H	Hardness. Where hardness values exceed the range applied for guideline use, site specific assessment may be required.
#1	Dissolved Oxygen guideline protects all life stages other than buried embryo/alevin, based on instantaneous measurement.
#2	Guideline for ammonia nitrogen (NH_3) varies with pH and temperature, and is derived from Table 26D of the BC MOE, 2017 BCWQGs, ranging from 0.681 to 28.7 mg/L for pH 6.5-9.0 and temperature 0.0-20.0 degC.
#3	Guideline for fluoride varies with H. Guideline is 0.4 mg/L when H <10 mg/L. Calculated in mg/L and based on equation: [-51.73 + 92.57*log(Hardness)]x0.01 when H =10-385 mg/L.
#4	Guideline for nitrite varies with chloride concentrations.
#5	Guideline for copper varies with H and is calculated in mg/L and based on equation: [0.094(H)+2]/1000, when H =13-400 mg/L.
#6	Guideline for lead varies with H. Guideline is 0.003 mg/L when H<8 mg/L. Calculated in mg/L and based on equation: $[e^{(1.273*ln(H)-1.460)}]/1000$ when H=8-360 mg/L
#7	Guideline for manganese varies with H and is calculated in mg/L and based on equation: (0.01102*H)+0.54, when H =25-259 mg/L.
#8	Guideline for silver varies with H. Guideline is 0.0001 mg/L when H<100 mg/L or 0.003 mg/L when H>100 mg/L
#9	Guideline for zinc varies with H. Guideline is 0.033 mg/L when H is <90 mg/L. Calculated in mg/L and based on equation: [33+0.75*(H-90)]/1000, when H=90-500 mg/L.
#10	Guideline for aluminum varies with pH. Guideline is 0.1 mg/L if pH ≥ 6.5. Calculated in mg/L and based on equation: $e^{(1.209-2.426(pH)+0.286K)}$ where $K=(pH)^2$ and pH < 6.5.
#11	Guideline for cadmium varies with H and is calculated in mg/L and based on equation: $[e^{(1.03*ln(H)-5.274)}]/1000$, when H=7-455 mg/L.
-	No applicable guideline or analysis was not conducted.
<	Concentration is less than the laboratory detection limit indicated.
Bold	Bold and shaded indicates an exceedance of the applied guideline.
MPN	Most Probable Number
CFU	Colony Forming Units

Table 11: Summary of October 2017 Event Surface Water Quality Results

				Existing Reservoir Sites				Future Site C Reservoir						Downstream of Site C Reservoir								
Parameter	**Unit**	**Reported Detection Limit (RDL)**	**BC MOE 2017 (Approved Guidelines for freshwater aquatic life and short-term maximum)**	**WILLISTON (W1 - Deep)**	**WILLISTON (W1 - Shallow)**	**DINOSAUR (D1 - Deep)**	**DINOSAUR (D1 - Shallow)**	**PEACE CANYON (PC1)**	**UPPER SITE C RESERVOIR (PR1)**	**MIDDLE SITE C RESERVOIR (PR2)**	**HALFWAY RIVER DOWNSTREAM (HD)**	**LOWER SITE C RESERVOIR (PR3)**	**MOBERLY RIVER DOWNSTREAM (MD)**	**PEACE AT PINE (PD1)**	**PINE RIVER (PINE)**	**PEACE AT BEATTON (PD2)**	**BEATTON RIVER (BEATTON)**	**PEACE AT KISKATINAW (PD3)**	**KISKATINAW RIVER (KISKATINAW)**	**PEACE AT POUCE COUPE (PD4)**	**POUCE COUPE (POUCE)**	**MANY ISLANDS (PDS)**
Matrix				surface water	surface water	surface water	surface water	surface water	surface water	surface water	surface water	surface water	surface water	surface water	surface water	surface water	surface water	surface water	surface water	surface water	surface water	surface water
Sample Date				10/20/2017	10/20/2017	10/20/2017	10/20/2017	10/18/2017	10/18/2017	10/18/2017	10/18/2017	10/17/2017	10/17/2017	10/17/2017	10/17/2017	10/19/2017	10/19/2017	10/19/2017	10/19/2017	10/19/2017	10/19/2017	10/19/2017
Laboratory Identification Number				L2011209-2	L2011209-1	L2011209-4	L2011209-3	L2009935-3	L2009935-4	L2009935-2	L2009935-1	L2009107-2	L2009107-1	L2009107-3	L2009107-4	L2010676-1	L2010676-2	L2010676-4	L2010676-5	L2010676-6	L2010676-7	L2010676-8
Field Measurements																						
Sample Depth	m	-		5.0	0.2	5.0	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Total Depth	m	-		45.5	45.5	14.9	14.9	1.5	3.0	6.8	3.9	4.7	0.7	1.0	2.3	3.7	0.9	3.3	1.7	3.4	1.3	6.9
Temperature	°C	-	15	10.7	10.7	10.2	10.2	10.7	10.7	10.5	2.8	10.4	5.8	10.2	5.2	8.1	3.8	8.1	5.3	8.4	3.2	7.9
Dissolved Oxygen (DO)	mg/L	-	Minimum 5 [#1]	9.80	9.83	9.99	10.02	10.09	10.24	10.36	12.54	10.12	11.23	10.27	11.59	10.79	12.28	10.75	11.75	10.61	11.87	10.67
Specific Conductivity (SPC)	SPCµS/cm	-		174.9	174.9	176.0	176.2	175.4	175.4	175.9	477.3	178.8	292.9	184.9	308.1	188.9	547.0	187.7	338.7	187.5	1104.0	198.8
Electrical Conductivity (EC)	SPCµS/cm	-		127.2	127.2	126.4	126.6	127.4	127.4	124.2	274.9	127.8	185.8	132.7	191.8	127.7	325.0	127.1	210.5	128.5	645.0	133.3
Salinity	parts per trillion	-		0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.23	0.08	0.14	0.09	0.15	0.09	0.26	0.09	0.17	0.09	0.54	0.09
pH	pH Units	-	6.5-9.0	8.19	8.35	8.19	8.29	8.09	8.17	8.36	8.40	8.28	8.17	8.20	8.33	8.31	8.38	8.28	8.46	8.27	8.20	8.48
Turbidity	nephelometric units	-		4.9	4.9	5.3	5.2	4.7	4.9	5.2	7.8	6.3	11.6	9.2	35.8	51.9	12.6	61.1	41.1	61.4	10.7	79.7
Total Dissolved Solids	mg/L	-		113.6	113.6	114.4	114.6	114.0	114.0	114.3	310.6	116.1	190.3	120.1	200.3	122.4	355.5	121.1	221.1	121.9	717.8	129.0
Physical Parameters																						n
Colour	TCU	5		7.5	6.6	9	6.8	7.6	7.9	8.9	<5	<5	14.9	7	5.2	13.4	145	12.9	16.8	11.6	11.6	9.8
Electrical Conductivity (EC)	µS/cm	2		165	169	165	167	166	165	172	452	172	274	179	286	182	516	180	346	173	329	182
Hardness as CaCO3	mg/L	0.5		85.1	79	86.9	87.7	87.5	86.9	86.5	255	85	141	87.1	152	94.6	197	87.3	164	85.8	152	108
pH	pH Units	0.1	6.5-9.0	8.11	8.14	8.14	8.14	8.05	8.06	8.04	8.34	8.13	8.34	8.15	8.37	8.03	8.27	7.95	8.36	8.03	8.14	8.06
Total Suspended Solids (TSS)	mg/L	3		<3	<3	<3	<3	3.8	5.3	5.5	6.3	6.1	7.7	15.5	50.7	106	3.5	123	148	151	21.9	161
Total Dissolved Solids (TDS)	mg/L	1		93	90.9	93.3	94.2	93.7	93	92.4	276	95	160	97.4	169	104	360	100	210	100	216	113
Turbidity	NTU	0.1		0.83	0.73	1.2	1.25	1.5	1.48	1.35	3.24	1.7	8.78	3.05	20.4	65.2	9.28	77.2	48.1	67.1	28.7	80.6
Anions and Nutrients																						
Alkalinity (Bicarbonate as CaCO3)	mg/L	1		79.6	80.1	79.1	79.9	77.9	76.8	76.7	190	80.9	138	82.1	140	86.5	186	85	179	84.7	111	89
Alkalinity (Carbonate as CaCO3)	mg/L	1		<1	<1	<1	<1	<1	<1	<1	5.4	<1	4.6	<1	5	<1	<1	<1	9.2	<1	<1	<1
Alkalinity (Hydroxide) as CaCO3	mg/L	1		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Alkalinity (total as CaCO3)	mg/L	1		79.6	80.1	79.1	79.9	77.9	76.8	76.7	195	80.9	142	82.1	145	86.5	186	85	188	84.7	111	89
Ammonia as N	mg/L	0.005	See narrative [#2]	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.0051	<0.005	<0.005	0.0088	<0.005	<0.005	<0.005	<0.005	<0.005
Bromide	mg/L	0.05		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Chloride	mg/L	0.5	600	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.61	<0.5	0.61	<0.5	0.97	<0.5	4.51	<0.5	0.75	<0.5	4.24	<0.5
Fluoride	mg/L	0.02	See equation [#3]	0.046	0.047	0.044	0.046	0.036	0.036	0.035	0.103	0.036	0.081	0.037	0.067	0.039	0.148	0.034	0.072	0.039	0.069	0.042
Nitrate and Nitrite (as N)	mg/L	0.0051		0.0464	0.0464	0.0513	0.0506	0.049	0.0482	0.0465	<0.0051	0.0468	<0.0051	0.0457	0.063	0.0595	0.0509	0.0602	0.026	0.058	0.0746	0.0625
Nitrate (as N)	mg/L	0.005	32.8	0.0464	0.0464	0.0513	0.0506	0.049	0.0482	0.0465	<0.005	0.0468	<0.005	0.0457	0.063	0.0595	0.0509	0.0602	0.026	0.058	0.0746	0.0625
Nitrite (as N)	mg/L	0.001	0.06-0.60 [#4]	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Total Kjeldahl Nitrogen (TKN)	mg/L	0.05		0.062	0.068	0.062	0.061	0.118	0.088	0.1	0.086	0.096	0.159	0.097	0.155	0.311	0.782	0.334	0.306	0.304	0.236	0.342
Nitrogen (Total)	mg/L	0.03		0.12	0.118	0.125	0.13	0.138	0.132	0.129	0.066	0.129	0.155	0.142	0.175	0.234	0.683	0.269	0.296	0.244	0.252	0.244
Orthophosphate (as P) (Filtered)	mg/L	0.001		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	0.001	0.0016	0.0012	<0.001	0.0011	0.0027	0.0013	0.0011	0.0015	<0.001	0.0011
Phosphorus (Total Dissolved)	mg/L	0.002		0.0021	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.0026	<0.002	<0.002	0.0036	0.0135	0.0034	0.0048	0.0034	0.0035	0.0033
Phosphorus	mg/L	0.002		0.0029	0.0031	0.0036	0.0036	0.0225	0.0049	0.0043	0.007	0.0075	0.0125	0.0159	0.049	0.0997	0.0281	0.134	0.055	0.133	0.0308	0.158
Sulphate	mg/L	0.3		11.8	11.7	11.8	11.9	12.6	12.5	12.6	63.3	13	15.2	13.8	20.5	12.9	99.8	12.8	22.6	13.6	70.7	15
Silica	mg/L	0.5		4.13	4.06	4.18	4.4	4.48	4.4	4.2	3.57	4.11	3.41	4.23	2.43	3.75	2.56	3.91	2.84	3.86	3.22	4.02
Anions Total	meq/L			1.84	1.85	1.83	1.85	1.82	1.8	1.8	5.23	1.89	3.18	1.93	3.36	2	5.93	1.97	4.25	1.98	3.82	2.1
Cations Total	meq/L			1.7	1.58	1.74	1.75	1.75	1.74	1.73	5.26	1.7	3	1.74	3.17	1.89	6.01	1.74	3.65	1.72	3.77	2.23
Ionic Balance	N/A			-4	-7.9	-2.7	-2.7	-2.1	-1.7	-2	0.2	-5.4	-2.9	-5.3	-3	-2.9	0.7	-6.1	-7.5	-7.2	-0.6	3.1
Organic and Inorganic Carbon																						
Dissolved Organic Carbon (DOC) (Filtered)	mg/L	0.5		2.62	2.57	2.5	2.55	2.49	2.88	2.66	1.36	2.67	4.57	2.59	1.88	3.43	26.3	3.8	7.47	3.07	3.64	2.76
Total Organic Carbon (TOC)	mg/L	0.5		2.71	2.85	2.62	2.6	2.81	3.04	2.73	1.57	2.85	4.94	2.96	2.78	5.52	27.6	5.94	8.23	5.53	4.8	5.22
Plant Pigments																						
Chlorophyll A	µg/L	0.01		1.86	0.556	1.55	1.15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Speciated Metals																						
Methylmercury (as MeHg)-Total	µg/L			<5.0E-8	<5.0E-8	<5.0E-8	<5.0E-8	<5.0E-8	<5.0E-8	<5.0E-8	<5.0E-8	<5.0E-8	2.56E-7	<5.0E-8	<5.0E-8	6.7E-8	3.15E-7	<5.0E-8	<5.0E-8	9.7E-8	<5.0E-8	1.36E-7
Methylmercury (as MeHg)-Dissolved (Filtered)	µg/L	0.00005		<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	0.000273	<0.00005	<0.00005	0.000057	<0.00005	<0.00005
Total Metals																						
Aluminum	mg/L	0.005		0.019	0.0185	0.0309	0.0324	0.0456	0.0409	0.0377	0.0767	0.0875	0.17	0.115	0.668	1.57	0.132	1.86	1.81	1.63	0.475	2.04
Antimony	mg/L	0.0005		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Arsenic	µg/L	0.0005	0.005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.00061	0.00114	0.00101	0.00144	0.00136	0.00145	0.00059	0.00183
Barium	mg/L	0.02		0.03	0.03	0.03	0.03	0.029	0.03	0.031	0.101	0.032	0.155	0.038	0.128	0.084	0.085	0.099	0.207	0.113	0.064	0.125
Beryllium	mg/L	0.001		<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.00011	0.00012	0.00011	<0.0001	0.00014
Bismuth	mg/L	0.2		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Boron - soluble	mg/L	0.1		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Cadmium	mg/L	0.000005		0.000014	0.0000123	0.0000152	0.0000174	0.0000223	0.0000138	0.0000131	0.0000178	0.0000167	0.0000195	0.0000328	0.0000661	0.000101	0.000042	0.000122	0.0000986	0.000136	0.0000374	0.000173
Calcium	mg/L	0.1		24.5	24.3	25.2	25.1	26.2	25.9	26.1	68.8	24.4	39.3	25.7	44.6	29.7	51.5	31	55	30.3	42.1	33.4
Chromium	mg/L	0.001		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.0011	0.0025	<0.001	0.0031	0.0033	0.0028	<0.001	0.0034
Cobalt	mg/L	0.0003	0.11	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	0.00062	0.0011	0.00048	0.00146	0.00121	0.00136	0.00044	0.00184
Copper	mg/L	0.001	See equation [#5]	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.0011	<0.001	0.0016	0.0032	0.0018	0.0038	0.0117	0.0037	0.0018	0.0047
Iron	mg/L	0.03	1	<0.03	<0.03	0.046	0.048	0.065	0.053	0.049	0.126	0.104	0.369	0.22	**1.34**	**2.7**	**2.27**	**3.1**	**2.17**	**3.26**	0.829	**3.9**
Lead	mg/L	0.0005	See equation [#6]	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.00073	0.00134	<0.0005	0.00167	0.00139	0.00161	0.00051	0.00224
Lithium	mg/L	0.001		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.0085	0.0016	0.0041	0.0014	0.0071	0.0039	0.0095	0.0043	0.0059	0.0039	0.0059	0.0051
Magnesium	mg/L	0.1		5.67	5.66	5.63	5.66	5.95	5.82	5.96	19.7	5.85	10.8	6.25	11.2	8.16	15.9	8.76	18	7.49	14	9.44
Manganese	mg/L	0.0001	See equation [#7]	**0.00151**	**0.00154**	**0.00209**	**0.00229**	**0.00278**	**0.00226**	**0.0022**	**0.009**	**0.00276**	**0.0256**	**0.0068**	**0.0313**	**0.0493**	**0.0759**	**0.0626**	**0.037**	**0.0607**	**0.026**	**0.076**
Mercury	mg/L	<0.000005 - 5.7E-7		<5.0E-7	<5.0E-7	5.4E-7	<5.0E-7	<5.0E-7	5.1E-7	6.7E-7	5.7E-7	6.7E-7	0.0000147	9.9E-7	0.000004	0.000007	0.0000035	0.0000077	0.00000165	0.0000081	0.00000214	0.0000098
Molybdenum	mg/L	0.001	2	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.0037	<0.001	<0.001	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Nickel	mg/L	0.001		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.0013	<0.001	0.0016	<0.001	0.0022	0.0039	0.0046	0.0046	0.0059	0.0048	0.0021	0.0054
Phosphorus	mg/L	0.3		<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Potassium	mg/L	2		<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Selenium	mg/L	0.00005	0.002	0.000233	0.000246	0.000267	0.000249	0.000239	0.000241	0.000206	0.00146	0.00025	0.000181	0.000262	0.000531	0.000304	0.00029	0.000392	0.000305	0.000395	0.00044	0.000415
Silicon	mg/L	0.05		2.05	2.07	2.1	2.11	2.21	2.23	2.2	1.88	2.13	1.89	2.21	2.02	4.43	1.48	4.46	4.22	4.09	2.34	4.89
Silver	mg/L	0.00002	0.0001 or 0.003 [#8]	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	0.000024	<0.00002	0.00003	0.000034	0.000032	<0.00002	0.000043
Sodium	mg/L	2		<2	<2	<2	<2	<2	<2	<2	3.4	<2	4	<2	3	<2	43.4	<2	13.4	<2	16.9	<2
Strontium	mg/L	0.005		0.0937	0.0921	0.0952	0.0956	0.093	0.0968	0.095	0.346	0.102	0.103	0.105	0.166	0.106	0.203	0.111	0.229	0.107	0.158	0.122
Thallium	mg/L	0.0002		<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	0.000023	0.000047	0.000011	0.00005	0.000056	0.000047	0.000017	0.000071
Tin	mg/L	0.0005		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Titanium	mg/L	0.01		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.011	<0.01	0.011	<0.01	0.014	<0.01	0.013
Uranium	mg/L	0.0002		0.00046	0.00041	0.00047	0.00048	0.00041	0.00042	0.00041	0.00091	0.0004	0.00042	0.00048	0.00045	0.00045	0.00163	0.00047	0.0008	0.00062	0.00073	0.00058
Vanadium	mg/L	0.0005		<0.0005	<0.0005	<0.0005	<0.0005	0.00056	0.00054	0.00058	0.00072	0.0006	0.00076	0.00082	0.00257	0.00613	0.00086	0.00725	0.00721	0.00661	0.00197	0.00791
Zinc	mg/L	0.005	See equation [#9]	<0.005	<0.005	<0.005	<0.005	0.0054	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.0092	0.0138	0.0068	0.0175	0.0162	0.0168	0.0056	0.0222

Table 11: Summary of October 2017 Event Surface Water Quality Results

				Existing Reservoir Sites				Future Site C Reservoir						Downstream of Site C Reservoir								
Parameter	**Unit**	**Reported Detection Limit (RDL)**	**BC MOE 2017 (Approved Guidelines for freshwater aquatic life and short-term maximum)**	**WILLISTON (W1 - Deep)**	**WILLISTON (W1 - Shallow)**	**DINOSAUR (D1 - Deep)**	**DINOSAUR (D1 - Shallow)**	**PEACE CANYON (PC1)**	**UPPER SITE C RESERVOIR (PR1)**	**MIDDLE SITE C RESERVOIR (PR2)**	**HALFWAY RIVER DOWNSTREAM (HD)**	**LOWER SITE C RESERVOIR (PR3)**	**MOBERLY RIVER DOWNSTREAM (MD)**	**PEACE AT PINE (PD1)**	**PINE RIVER (PINE)**	**PEACE AT BEATTON (PD2)**	**BEATTON RIVER (BEATTON)**	**PEACE AT KISKATINAW (PD3)**	**KISKATINAW RIVER (KISKATINAW)**	**PEACE AT POUCE COUPE (PD4)**	**POUCE COUPE (POUCE)**	**MANY ISLANDS (PDS)**
Dissolved Metals																						
Aluminum (Filtered)	mg/L	0.005	0.1 [#10]	0.0076	0.0053	0.0074	0.0057	<0.005	0.0184	<0.005	**0.142**	0.0116	0.034	<0.005	0.0058	0.0066	0.0385	0.0083	**0.16**	0.0057	0.0664	0.277
Antimony (Filtered)	mg/L	0.0005		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Arsenic (Filtered)	mg/L	0.0005		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.00066	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Barium (Filtered)	mg/L	0.02		0.029	0.03	0.03	0.029	0.028	0.03	0.029	0.097	0.032	0.135	0.032	0.104	0.042	0.089	0.044	0.123	0.041	0.054	0.081
Beryllium (Filtered)	mg/L	0.001		<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0002	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Bismuth (Filtered)	mg/L	0.2		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Boron - soluble (Filtered)	mg/L	0.1		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Cadmium (Filtered)	mg/L	0.000005	See equation [#11]	0.0000099	0.0000079	0.0000079	0.0000084	0.0000076	0.0000122	0.0000077	0.0000126	0.0000099	0.0000187	0.0000066	0.0000095	0.000012	0.0000187	0.0000149	0.0000479	0.0000196	0.0000215	0.0000793
Calcium (Filtered)	mg/L	0.1		24.8	22.5	25.5	26	25.6	25.3	25.1	70.5	24.5	39.5	25.2	43.4	27.1	50.3	23.3	43.5	23.8	38.9	29.9
Chromium (Filtered)	mg/L	0.001		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cobalt (Filtered)	mg/L	0.0003		<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	0.00036	<0.0003	0.00039	<0.0003	<0.0003	0.00059
Copper (Filtered)	mg/L	0.001		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.0016	<0.001	0.0027	<0.001	0.001	0.0018
Iron (Filtered)	mg/L	0.03	0.35	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	0.07	<0.03	<0.03	<0.03	**0.673**	<0.03	0.351	<0.03	0.117	**0.676**
Lead (Filtered)	mg/L	0.0005		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.00073
Lithium (Filtered)	mg/L	0.001		0.001	0.0011	0.0011	0.001	<0.001	<0.001	<0.001	0.0088	0.0013	0.0042	0.0014	0.0066	<0.002	0.01	0.0018	0.0033	0.0012	0.0051	0.0026
Magnesium (Filtered)	mg/L	0.1		5.66	5.52	5.62	5.56	5.73	5.76	5.79	19.2	5.79	10.4	5.89	10.6	6.54	17.3	7.08	13.4	6.43	13.3	8.16
Manganese (Filtered)	mg/L	0.0001		0.0006	0.00035	0.00063	0.00058	0.00035	0.00148	0.00039	0.00584	0.00101	0.0503	0.0007	0.00336	0.00256	0.0171	0.00261	0.0191	0.00459	0.0145	0.0342
Mercury (Filtered)	mg/L	<0.000005 - 5.7E-7		<5.0E-7	<5.0E-7	<5.0E-7	<5.0E-7	<5.0E-7	<5.0E-7	<5.0E-7	<5.0E-7	<5.0E-7	<5.0E-7	<5.0E-7	<5.0E-7	0.000001	0.0000024	8.0E-7	0.00000419	<5.0E-7	0.00000135	0.00000209
Molybdenum (Filtered)	mg/L	0.001		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.0036	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Nickel (Filtered)	mg/L	0.001		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.0013	<0.001	<0.001	<0.001	0.0045	<0.001	0.0017	<0.001	0.0011	0.0016
Phosphorus (filtered) (Filtered)	mg/l	0.3																				
Potassium (Filtered)	mg/L	2		<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	2.3	<2	<2	<2	<2	<2
Selenium (Filtered)	mg/L	0.00005		0.000216	0.000246	0.000224	0.000242	0.0002	0.000202	0.000225	0.00121	0.000231	0.00019	0.000229	0.000467	0.00027	0.000229	0.000253	0.000242	0.000293	0.000375	0.000362
Silicon (Filtered)	mg/L	0.05		2	1.99	2.03	1.99	2.06	2.14	2.1	1.68	2.04	1.64	2	1.1	1.86	1.17	1.72	1.59	1.89	1.68	2.2
Silver (Filtered)	mg/L	0.00002		<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002
Sodium (Filtered)	mg/L	2		<2	<2	<2	<2	<2	<2	<2	3.3	<2	3.8	<2	2.8	<2	45.5	<2	7.9	<2	16.6	<2
Strontium (Filtered)	mg/L	0.005		0.0936	0.0856	0.0961	0.096	0.0926	0.0903	0.0922	0.346	0.0955	0.0996	0.102	0.16	0.0944	0.189	0.082	0.174	0.0907	0.156	0.117
Thallium (Filtered)	mg/L	0.0002		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Tin (Filtered)	mg/L	0.0005		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Titanium (Filtered)	mg/L	0.01		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Uranium (Filtered)	mg/L	0.0002		0.00042	0.00039	0.00043	0.00043	0.00037	0.00035	0.00036	0.00084	0.00044	0.00041	0.00044	0.00038	0.00038	0.00151	0.00029	0.00051	0.00037	0.00065	0.00044
Vanadium (Filtered)	mg/L	0.0005		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.001	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.0012
Zinc (Filtered)	mg/L	0.005		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.0054

NOTES:

BC MOE 2017	British Columbia Ministry of Environment (BC MOE). 2017. British Columbia approved water quality guidelines: Aquatic life, wildlife & agriculture. Water Protection and Sustainability Branch. Victoria, British Columbia, Canada.
H	Hardness. Where hardness values exceed the range applied for guideline use, site specific assessment may be required.
#1	Dissolved Oxygen guideline protects all life stages other than buried embryo/alevin, based on instantaneous measurement.
#2	Guideline for ammonia nitrogen (NH_3) varies with pH and temperature, and is derived from Table 26D of the BC MOE, 2017 BCWQGs, ranging from 0.681 to 28.7 mg/L for pH 6.5-9.0 and temperature 0.0-20.0 degC.
#3	Guideline for fluoride varies with H. Guideline is 0.4 mg/L when H <10 mg/L. Calculated in mg/L and based on equation: [-51.73 + 92.57*log(Hardness)]x0.01 when H =10-385 mg/L.
#4	Guideline for nitrite varies with chloride concentrations.
#5	Guideline for copper varies with H and is calculated in mg/L and based on equation: [0.094(H)+2]/1000, when H =13-400 mg/L.
#6	Guideline for lead varies with H. Guideline is 0.003 mg/L when H<8 mg/L. Calculated in mg/L and based on equation: $[e^{(1.273*ln(H)-1.460)}]/1000$ when H=8-360 mg/L
#7	Guideline for manganese varies with H and is calculated in mg/L and based on equation: (0.01102*H)+0.54, when H =25-259 mg/L.
#8	Guideline for silver varies with H. Guideline is 0.0001 mg/L when H<100 mg/L or 0.003 mg/L when H>100 mg/L
#9	Guideline for zinc varies with H. Guideline is 0.033 mg/L when H is <90 mg/L. Calculated in mg/L and based on equation: [33+0.75*(H-90)]/1000, when H=90-500 mg/L.
#10	Guideline for aluminum varies with pH. Guideline is 0.1 mg/L if pH ≥ 6.5. Calculated in mg/L and based on equation: $e^{(1.209-2.426(pH)+0.286K)}$ where $K=(pH)^2$ and pH < 6.5.
#11	Guideline for cadmium varies with H and is calculated in mg/L and based on equation: $[e^{(1.03*ln(H)-5.274)}]/1000$, when H=7-455 mg/L.
-	No applicable guideline or analysis was not conducted.
<	Concentration is less than the laboratory detection limit indicated.
Bold	Bold and shaded indicates an exceedance of the applied guideline.
MPN	Most Probable Number
CFU	Colony Forming Units

Table 12: Summary of 2017 QAQC Duplicate Surface Water Quality Results

Parameter	Unit	Reported Detection Limit (RDL)	May Event: D1-SHALLOW	DUP1	RPD Analysis	UPPER SITE C RESERVOIR (PR1)	DUPLICATE 2 (DUP2)	RPD Analysis	June Event: DINOSAUR SHALLOW (D1-SHALLOW)	DUPLICATE 1 (DUP 1)	RPD Analysis	UPPER SITE C RESERVOIR (PR1)	DUP 2	RPD Analysis	July Event: DINOSAUR SHALLOW (D1 - SHALLOW)	DUPLICATE 1 (DUP 1)	RPD Analysis	MIDDLE SITE C RESERVOIR (PR2)	DUP 2	RPD Analysis
Sample Date			5/26/2017	5/26/2017		5/24/2017	5/24/2017		6/29/2017	6/29/2017		6/30/2017	6/30/2017		7/20/2017	7/20/2017		7/21/2017	7/21/2017	
Laboratory Identification Number			L1932382-4	L1932382-6		L1931659-4	L1931659-5		L1951349-3	L1951349-5		L1951924-4	L1951924-5		L1962155-3	L1962155-5		L1962772-2	L1962772-5	
Physical Parameters																				
Colour	Col. Unit	5	21.7	21.6		24.8	28.6	14	6.1	6.6		6.8	7.2		6.9	<5		7.4	7.6	3
Electrical Conductivity (EC)	µS/cm	2	185	179	3	182	182	0	184	185	1	190	184	3	186	190	2	194	193	1
Hardness as $CaCO_3$	µg/L	0.5	86.4	87.1	1	89.2	91.3	2	-	-		115	94.8	19						
pH	pH Units	0.1	8.1	8.08	0	8.13	8.15	0	8.07	8.08	0	8.1	8.12	0	8.08	8.09	0	8.17	8.16	0
Total Suspended Solids (TSS)	µg/L	3	16.4	18	9	30.8	29	6	<3	<3		<3	<3		<3	<3		6.7	9.7	**37**
Total Dissolved Solids (TDS)	µg/L	1	101	100	1	104	103	1	-	-		116	103	12	115	118	3	122	123	1
Turbidity	NTU	0.1	38.6	40	4	63.8	63.5	0	0.85	1.01	17	1.34	1.35	1	1.01	1.02	1	3.5	3.35	4
Anions and Nutrients																				
Alkalinity (Bicarbonate as CaCO3)	mg/L	1	84.7	83.4	2	87	85.1	2	82.9	84.9	2	84	85.5	2	87.7	86.2	2	85.4	84.4	1
Alkalinity (Carbonate as CaCO3)	mg/L	1	<1	<1		<1	<1		<1	<1		<1	<1		<1	<1		<1	<1	
Alkalinity (Hydroxide) as CaCO3	mg/L	1	<1	<1		<1	<1		<1	<1		<1	<1		<1	<1		<1	<1	
Alkalinity (total as CaCO3)	mg/L	1	84.7	83.4	2	87	85.1	2	82.9	84.9	2	84	85.5	2	87.7	86.2	2	85.4	84.4	1
Ammonia as N	mg/L	0.005	-	-		<0.005	<0.005		<0.005	<0.005		<0.005	<0.005		<0.005	<0.005		<0.005	<0.005	
Bromide	mg/L	0.05	<0.05	<0.05		<0.05	<0.05		<0.05	<0.05		<0.05	<0.05		<0.05	<0.05		<0.05	<0.05	
Chloride	mg/L	0.5	<0.5	<0.5		<0.5	<0.5		<0.5	<0.5		<0.5	<0.5		<0.5	<0.5		<0.5	<0.5	
Fluoride	mg/L	0.02	0.044	0.044		0.045	0.046		0.039	0.04	3	0.039	0.04		0.037	0.037		0.037	0.037	
Nitrate and Nitrite (as N)	mg/L	0.0051	0.0986	0.0988	0	0.109	0.109	0	0.0446	0.0454	2	0.0433	0.0439	1	0.0327	0.0327	0	0.0543	0.053	2
Nitrate (as NO3-N)	mg/L	0.005	0.0986	0.0988	0	0.109	0.109	0	0.0446	0.0454	2	0.0433	0.0439	1	0.0327	0.0327		0.0543	0.053	2
Nitrite (as NO2-N)	mg/L	0.001	<0.001	<0.001		<0.001	<0.001		<0.001	<0.001		<0.001	<0.001		<0.001	<0.001		<0.001	<0.001	
Total Kjeldahl Nitrogen (TKN)	mg/L	0.05	-	-		0.237	0.226	5	0.123	0.145	16	0.127	0.126	1	0.081	0.089		0.097	0.098	
Nitrogen (Total)	mg/L	0.03	-	-		0.262	0.249	5	0.128	0.119	7	0.137	0.136	1	0.115	0.112	3	0.134	0.13	3
Orthophosphate (as P) (Filtered)	mg/L	0.001	0.0013	0.0015		0.002	0.0017		<0.001	<0.001		<0.001	<0.001		<0.001	<0.001		<0.001	<0.001	
Phosphorus (Filtered)	mg/L	0.002	-	-		0.0042	0.0039		<0.002	<0.002		<0.002	<0.002		<0.002	<0.002		0.0033	0.0029	
Phosphorus	mg/L	0.002	-	-		0.0608	0.0593	2	<0.002	<0.002		<0.002	0.0023		<0.002	<0.002		0.0118	0.0057	**70**
Sulphate	mg/L	0.3	13.2	13.3	1	13.2	13.3	1	15	14.8	1	14.8	14.8	0	14.2	14.2	0	14.2	14.2	0
Silica	mg/L	0.5	4.32	4.55	5	4.39	4.21	4	4.5	4.36	3	4.39	4.15	6	4.11	3.92	5	4.19	4.4	5
Anions Total	meq/L		1.98	1.95	2	2.02	1.99	1	-	-		1.99	2.02							
Cations Total	meq/L		1.73	1.74	1	1.78	1.83	3	-	-		2.73	1.89							
Ionic Balance	N/A		-6.7	-5.7	16	-6.3	-4.2		-	-		15.7	-3.2							
Organic and Inorganic Carbon																				
Dissolved Organic Carbon (DOC)	mg/L	0.5	4.56	4.59	1	4.9	5.13	5	4.34	3.31	27	3.92	3.2	20	4.23	4.08	4	5.43	4.23	25
Total Organic Carbon (TOC)	mg/L	0.5	5.38	5.25	2	6.19	6.2	0	2.91	3.48	18	2.55	2.87	12	2.73	2.96	8	3.43	2.76	22
Plant Pigments																				
Chlorophyll A	µg/L	0.01	0.481	0.597	22	-	-		0.795	0.764	4	-	-		0.799	0.989	21	-	-	
Speciated Metals																				
Methylmercury (as MeHg)-total																				
Methylmercury (as MeHg)-Dissolved (Filtered)	ug/L	0.00005	<0.00005	<0.00005		<0.00005	<0.00005		-	-		-	-							
Total Metals																				
Aluminum	mg/L	0.005	1.08	1.39	25	1.01	0.986	2	-	-		0.0344	0.0307	11						
Antimony	mg/L	0.0005	<0.0005	<0.0005		<0.0005	<0.0005		-	-		<0.0005	<0.0005							
Arsenic	mg/L	0.0005	0.00064	0.00064		0.0008	0.00084		-	-		<0.0005	<0.0005							
Barium	mg/L	0.02	0.075	0.079		0.086	0.086		-	-		0.035	0.035							
Beryllium	mg/L	0.001	<0.001	<0.001		<0.001	<0.001		-	-		<0.0001	<0.0001							
Bismuth	mg/L	0.2	<0.2	<0.2		<0.2	<0.2		-	-		<0.2	<0.2							
Boron - soluble	mg/L	0.1	<0.1	<0.1		<0.1	<0.1		-	-		<0.1	<0.1							
Cadmium	mg/L	0.000005	0.0000561	0.0000615	9	0.0000802	0.0000806	0	-	-		0.0000186	0.0000194	4						
Calcium	mg/L	0.1	26.5	27.7	4	27.4	27.8	1	-	-		27.6	28	1						
Chromium	mg/L	0.001	0.0019	0.0025		0.0019	0.0019		-	-		<0.001	<0.001							
Cobalt	mg/L	0.0003	0.00047	0.00047		0.00067	0.0007		-	-		<0.0003	<0.0003							
Copper	mg/L	0.001	0.002	0.002		0.0026	0.0027		-	-		<0.001	<0.001							
Iron	mg/L	0.03	1.21	1.27	5	1.75	1.79	2	-	-		0.045	0.038							
Lead	mg/L	0.0005	0.00061	0.00064		0.00088	0.00091		-	-		<0.0005	<0.0005							
Lithium	mg/L	0.001	0.0025	0.0027		0.0021	0.0021		-	-		<0.001	<0.001							
Magnesium	mg/L	0.1	6.78	6.97	3	6.58	6.51	1	-	-		6.88	6.98	1						
Manganese	mg/L	0.0001	0.0168	0.0167	1	0.023	0.0236	3	-	-		0.00252	0.00241	4						
Mercury	mg/L	0.000005	0.0000061	0.0000059	3	<0.0001	<0.0001		-	-		<0.000005	<0.000005							
Molybdenum	mg/L	0.001	<0.001	<0.001		<0.001	<0.001		-	-		<0.001	<0.001							
Nickel	mg/L	0.001	0.0026	0.0026	0	0.0033	0.0034		-	-		<0.001	<0.001							
Phosphorus	mg/L	0.3	<0.3	<0.3		<0.3	<0.3		-	-		<0.3	<0.3							
Potassium	mg/L	2	<2	<2		<2	<2		-	-		<2	<2							
Selenium	mg/L	0.00005	0.000319	0.000319	0	0.000328	0.000343	4	-	-		0.000289	0.000281	3						
Silicon	mg/L	0.1	4.49	5.14	13	3.63	3.6	1	-	-		2.09	2.1	0						
Silver	mg/L	0.00002	<0.00002	<0.00002		0.000024	0.000024		-	-		<0.00002	<0.00002							
Sodium	mg/L	2	<2	<2		<2	<2		-	-		<2	<2							
Strontium	mg/L	0.005	0.103	0.1	3	0.0996	0.0986	1	-	-		0.111	0.109	2						
Thallium	mg/L	0.0002	<0.0002	<0.0002		<0.0002	<0.0002		-	-		<0.0002	<0.0002							
Tin	mg/L	0.0005	<0.0005	<0.0005		<0.0005	<0.0005		-	-		<0.0005	<0.0005							
Titanium	mg/L	0.01	<0.024	0.035		0.01	<0.01		-	-		<0.01	<0.01							
Uranium	mg/L	0.0002	0.00049	0.00051	4	0.00046	0.00047	2	-	-		0.00052	0.0005							
Vanadium	mg/L	0.0005	0.00435	0.0053	20	0.00442	0.00448	1	-	-		<0.0005	<0.0005							
Zinc	mg/L	0.005	0.0068	0.0071	4	0.0094	0.0112	17	-	-		<0.005	<0.005							
Dissolved Metals																				
Aluminum (Filtered)	mg/L	0.005	0.0105	0.0102	3	0.0086	0.0095		-	-		<0.005	<0.005							
Antimony (Filtered)	mg/L	0.0005	<0.0005	<0.0005		<0.0005	<0.0005		-	-		<0.0005	<0.0005							
Arsenic (Filtered)	mg/L	0.0005	<0.0005	<0.0005		<0.0005	<0.0005		-	-		<0.0005	<0.0005							
Barium (Filtered)	mg/L	0.02	0.047	0.073		0.048	0.048		-	-		0.032	0.058							
Beryllium (Filtered)	mg/L	0.001	<0.001	<0.001		<0.001	<0.001		-	-		<0.0001	<0.001							
Bismuth (Filtered)	mg/L	0.2	<0.2	<0.2		<0.2	<0.2		-	-		<0.2	<0.2							
Boron - soluble (Filtered)	mg/L	0.1	<0.1	<0.1		<0.1	<0.1		-	-		<0.1	<0.1							
Cadmium (Filtered)	mg/L	0.000005	0.0000184	0.0000172	7	0.0000163	0.0000164	1	-	-		0.000007	0.0000118	**51**						
Calcium (Filtered)	mg/L	0.1	25.8	25.9	0	25.2	25.6	2	-	-		26.4	27.3	3						
Chromium (Filtered)	mg/L	0.001	<0.001	<0.001		<0.001	<0.001		-	-		<0.001	<0.001							
Cobalt (Filtered)	mg/L	0.0003	<0.0003	<0.0003		<0.0003	<0.0003		-	-		<0.0003	<0.0003							
Copper (Filtered)	mg/L	0.001	<0.001	0.0011		<0.001	<0.001		-	-		<0.001	0.0012							
Iron (Filtered)	mg/L	0.03	<0.03	<0.03		<0.03	<0.03		-	-		<0.03	<0.03							
Lead (Filtered)	mg/L	0.0005	<0.0005	<0.0005		<0.0005	<0.0005		-	-		<0.0005	<0.0005							
Lithium (Filtered)	mg/L	0.001	0.0012	0.0012		0.0016	0.0017		-	-		0.0052	<0.001							
Magnesium (Filtered)	mg/L	0.1	5.33	5.45	2	6.39	6.64	4	-	-		11.9	6.46	**59**						
Manganese (Filtered)	mg/L	0.0001	0.00355	0.00345	3	0.00381	0.00393	3	-	-		0.00062	0.00058	7						
Mercury (Filtered)	mg/L	0.000005	<0.000005	<0.000005		<0.000005	<0.000005		-	-		<0.000005	<0.000005							
Molybdenum (Filtered)	mg/L	0.001	<0.001	<0.001		<0.001	<0.001		-	-		0.0014	<0.001							
Nickel (Filtered)	mg/L	0.001	<0.001	<0.001		<0.001	<0.001		-	-		<0.001	<0.001							
Phosphorus (Filtered)	mg/L	0.3	<0.3	<0.3		-	-													
Potassium (Filtered)	mg/L	2	<2	<2		<2	<2		-	-		<2	<2							
Selenium (Filtered)	mg/L	0.00005	0.000299	0.000269	11	0.000247	0.000264	7	-	-		0.000267	0.000264	1						
Silicon (Filtered)	mg/L	0.05	2.13	2.11	1	2.2	2.19	0	-	-		2.62	2.03	25						
Silver (Filtered)	mg/L	0.00002	<0.00002	<0.00002		<0.00002	<0.00002		-	-		<0.00002	<0.00002							
Sodium (Filtered)	mg/L	2	<2	<2		<2	<2		-	-		10	<2							
Strontium (Filtered)	mg/L	0.005	0.0931	0.0937	1	0.0993	0.0995	0	-	-		0.102	0.103	1						
Thallium (Filtered)	mg/L	0.0002	<0.0002	<0.0002		<0.0002	<0.0002		-	-		<0.0002	<0.0002							
Tin (Filtered)	mg/L	0.0005	<0.0005	<0.0005		<0.0005	<0.0005		-	-		<0.0005	<0.0005							
Titanium (Filtered)	mg/L	0.01	<0.01	<0.01		<0.01	<0.01		-	-		<0.01	<0.01							
Uranium (Filtered)	mg/L	0.0002	0.0004	0.00039		0.00042	0.00042		-	-		0.00079	0.00049	**47**						
Vanadium (Filtered)	mg/L	0.0005	<0.0005	<0.0005		<0.0005	<0.0005		-	-		<0.0005	<0.0005							
Zinc (Filtered)	mg/L	0.005	<0.005	<0.005		<0.005	<0.005		-	-		<0.005	<0.005							

Parameter	August Event: DINOSAUR SHALLOW (D1 - SHALLOW)	DUPLICATE (DUP 1)	RPD Analysis	PEACE AT KISKATINAW (PD3)	DUPLICATE 2 (DUP 2)	RPD Analysis	September Event: DINOSAUR SHALLOW (D1-SHALLOW)	DUPLICATE 1 (DUP 1)	RPD Analysis	MIDDLE SITE C RESERVOIR (PR2)	DUPLICATE 2 (DUP 2)	RPD Analysis	October Event: DINOSAUR SHALLOW (D1 - SHALLOW)	DUPLICATE 1 (DUP 1)	RPD Analysis	POUCE COUPE (POUCE)	DUPLICATE 2 (DUP 2)	RPD Analysis
Sample Date	8/11/2017	8/11/2017		8/10/2017	8/10/2017		9/17/2017	9/17/2017		9/18/2017	9/18/2017		10/20/2017	10/20/2017		10/19/2017	10/19/2017	
Laboratory Identification Number	L1974039-3	L1974039-5		L1973238-4	L1973238-3		L1992751-3	L1992751-5		L1993110-2	L1993110-5		L2011209-3	L2011209-5		L2010676-7	L2010676-3	
Physical Parameters																		
Colour	7.2	7.7	7	8.5	19.1	**77**	7.7	7.4	4	8.6	7.4	15	6.8	<5		11.6	9.7	18
Electrical Conductivity (EC)	176	178	1	195	195	0	170	174	2	177	178	1	167	161	4	329	319	3
Hardness as $CaCO_3$							87.9	89.3	2	84.9	89.7	5	87.7	89	1	152	149	2
pH	8.12	8.14	0	8.13	8.15	0	7.98	8.09	1	8.1	8.11	0	8.14	7.88	3	8.14	8.16	0
Total Suspended Solids (TSS)	<3	3.3		99.3	77.3	25	<3	<3		4.8	4.8	0	<3	<3		21.9	21.1	4
Total Dissolved Solids (TDS)	117	117	0	132	127	4	95.1	96.2	1	94.2	96.9	3	94.2	93.9	0	216	214	1
Turbidity	0.79	0.74	7	15.4	15.1	2	1.26	1.4	11	2.04	2.57	23	1.25	1.24	1	28.7	23.9	18
Anions and Nutrients																		
Alkalinity (Bicarbonate as CaCO3)	83.3	83.8	1	87.2	88.9	2	79.8	80.9	1	80.2	81	1	79.9	78.7	2	111	110	1
Alkalinity (Carbonate as CaCO3)	<1	<1		<1	<1		<1	<1		<1	<1		<1	<1		<1	<1	
Alkalinity (Hydroxide) as CaCO3	<1	<1		<1	<1		<1	<1		<1	<1		<1	<1		<1	<1	
Alkalinity (total as CaCO3)	83.3	83.8	1	87.2	88.9	2	79.8	80.9	1	80.2	81	1	79.9	78.7	2	111	110	1
Ammonia as N	0.0072	0.0097		<0.005	<0.005		<0.005	<0.005		<0.005	<0.005		<0.005	<0.005		<0.005	<0.005	
Bromide	<0.05	<0.05		<0.05	<0.05		<0.05	<0.05		<0.05	<0.05		<0.05	<0.05		<0.05	<0.05	
Chloride	<0.5	<0.5		<0.5	<0.5		<0.5	<0.5		<0.5	<0.5		<0.5	<0.5		4.24	4.23	0
Fluoride	0.037	0.037		0.04	0.041	2	0.035	0.035		0.034	0.035		0.046	0.044		0.069	0.069	
Nitrate and Nitrite (as N)	0.0601	0.0604	0	0.0472	0.0466	1	0.0574	0.0565	2	0.049	0.0511	4	0.0506	0.0484	4	0.0746	0.0733	2
Nitrate (as NO3-N)	0.0601	0.0604	0	0.0472	0.0466	1	0.0546	0.0539	1	0.0469	0.0486	4	0.0506	0.0484	4	0.0746	0.0733	2
Nitrite (as NO2-N)	<0.001	<0.001		<0.001	<0.001		0.0028	0.0026		0.0021	0.0025		<0.001	<0.001		<0.001	<0.001	
Total Kjeldahl Nitrogen (TKN)	0.077	0.089		0.178	0.17	5	0.113	0.101	11	0.076	0.079		0.061	0.098		0.236	0.209	12
Nitrogen (Total)	0.13	0.133	2	0.156	0.15	4	0.142	0.139	2	0.13	0.132	2	0.13	0.111	16	0.252	0.243	4
Orthophosphate (as P) (Filtered)	0.0014	<0.001		0.001	0.0021		<0.001	<0.001		<0.001	<0.001		<0.001	<0.001		<0.001	0.001	
Phosphorus (Filtered)	<0.002	<0.002		0.0022	0.0023		<0.002	<0.002		<0.002	<0.002		<0.002	<0.002		0.0035	0.0037	
Phosphorus	<0.002	<0.01		0.115	0.0517	**76**	0.0036	0.0041		0.0069	0.0061		0.0036	0.0041		0.0308	0.0239	25
Sulphate	13.9	13.9	0	16.4	16.4	0	13	13	0	13.1	13.2	1	11.9	11.8	1	70.7	70.5	0
Silica	4.25	4.18	2	4.05	3.93	3	4.65	4.58	2	4.23	4.15	2	4.4	4.19	5	3.22	3.2	1
Anions Total							1.87	1.89		1.88	1.9		1.85	1.82		3.82	3.8	
Cations Total							1.76	1.79		1.7	1.79		1.75	1.78		3.77	3.74	
Ionic Balance							-3.2	-2.9		-5	-2.8		-2.7	-1.2		-0.6	-0.7	
Organic and Inorganic Carbon																		
Dissolved Organic Carbon (DOC)	3.52	4.96	**34**	3.16	4.37	**32**	2.9	2.46	16	2.6	2.71	4	2.55	2.6	2	3.64	3.59	1
Total Organic Carbon (TOC)	2.93	2.95	1	4.18	3.33	23	2.61	2.53	3	2.61	2.74	5	2.6	2.63	1	4.8	4.62	4
Plant Pigments																		
Chlorophyll A	0.109	0.094	15	-	-		0.614	0.752	20	-	-		1.15	0.906	24	-	-	
Speciated Metals																		
Methylmercury (as MeHg)-total							<5.0E-8	<5.0E-8		<5.0E-8	<5.0E-8		<5.0E-8	<5.0E-8		<5.0E-8	<5.0E-8	
Methylmercury (as MeHg)-Dissolved (Filtered)							<0.00005	<0.00005		<0.00005	<0.00005		<0.00005	<0.00005		<0.00005	<0.00005	
Total Metals																		
Aluminum										0.056	0.0534	5	0.0324	0.0296		0.475	0.42	12
Antimony										<0.0005	<0.0005		<0.0005	<0.0005		<0.0005	<0.0005	
Arsenic										<0.0005	<0.0005		<0.0005	<0.0005		0.00059	0.00051	
Barium										0.031	0.032		0.03	0.03		0.064	0.06	
Beryllium										<0.0001	<0.0001		<0.0001	<0.0001		<0.0001	<0.0001	
Bismuth										<0.2	<0.2		<0.2	<0.2		<0.2	<0.2	
Boron - soluble										<0.1	<0.1		<0.1	<0.1		<0.1	<0.1	
Cadmium										0.0000182	0.0000193	6	0.0000174	0.0000131	28	0.0000374	0.000038	2
Calcium										25.3	25.7	2	25.1	25.6	2	42.1	40	5
Chromium										<0.001	<0.001		<0.001	<0.001		<0.001	<0.001	
Cobalt										<0.0003	<0.0003		<0.0003	<0.0003		0.00044	0.00037	
Copper										<0.001	<0.001		<0.001	<0.001		0.0018	0.0016	
Iron										0.055	0.072		0.048	0.038		0.829	0.691	18
Lead										<0.0005	<0.0005		<0.0005	<0.0005		0.00051	<0.0005	
Lithium										0.0011	<0.001		<0.001	<0.001		0.0059	0.0057	3
Magnesium										5.89	5.8	2	5.66	5.72	1	14	12.7	10
Manganese										0.00254	0.00259	2	0.00229	0.00205	11	0.026	0.0237	9
Mercury							<5.0E-7	<5.0E-7		<5.0E-7	<0.000005 - 5.7E-7		<5.0E-7	<5.0E-7		0.00000214	0.00000217	
Molybdenum										<0.001	<0.001		<0.001	<0.001		<0.001	<0.001	
Nickel										<0.001	<0.001		<0.001	<0.001		0.0021	0.0017	
Phosphorus										<0.3	<0.3		<0.3	<0.3		<0.3	<0.3	
Potassium										<2	<2		<2	<2		<2	<2	
Selenium										0.000226	0.000234	3	0.000249	0.00024	4	0.00044	0.000391	12
Silicon										2.1	2.06	2	2.11	2.11	0	2.34	2.27	3
Silver										<0.00002	<0.00002		<0.00002	<0.00002		<0.00002	<0.00002	
Sodium										<2	<2		<2	<2		16.9	16	5
Strontium										0.0962	0.0972	1	0.0956	0.0972	2	0.158	0.158	0
Thallium										<0.00001	<0.00001		<0.00001	<0.00001		0.000017	0.000014	
Tin										<0.0005	<0.0005		<0.0005	<0.0005		<0.0005	<0.0005	
Titanium										<0.01	<0.01		<0.01	<0.01		<0.01	<0.01	
Uranium										0.00046	0.00047		0.00048	0.00048		0.00073	0.00071	
Vanadium										0.00051	0.00053		<0.0005	<0.0005		0.00197	0.00173	13
Zinc										<0.005	<0.005		<0.005	<0.005		0.0056	<0.005	
Dissolved Metals																		
Aluminum (Filtered)										0.0589	0.0069		0.0057	0.0056		0.0664	0.0587	12
Antimony (Filtered)										<0.0005	<0.0005		<0.0005	<0.0005		<0.0005	<0.0005	
Arsenic (Filtered)										<0.0005	<0.0005		<0.0005	<0.0005		<0.0005	<0.0005	
Barium (Filtered)										0.032	0.031		0.029	0.03		0.054	0.056	
Beryllium (Filtered)										<0.0001	<0.0001		<0.0001	<0.0001		<0.0001	<0.0001	
Bismuth (Filtered)										<0.2	<0.2		<0.2	<0.2		<0.2	<0.2	
Boron - soluble (Filtered)										<0.1	<0.1		<0.1	<0.1		<0.1	<0.1	
Cadmium (Filtered)										0.0000088	0.0000085		0.0000084	0.0000072		0.0000215	0.0000216	0
Calcium (Filtered)										24.1	26.4	9	26	26.3	1	38.9	37.6	3
Chromium (Filtered)										<0.001	<0.001		<0.001	<0.001		<0.001	<0.001	
Cobalt (Filtered)										<0.0003	<0.0003		<0.0003	<0.0003		<0.0003	<0.0003	
Copper (Filtered)										<0.001	<0.001		<0.001	<0.001		0.001	0.001	
Iron (Filtered)										<0.03	<0.03		<0.03	<0.03		0.117	0.117	0
Lead (Filtered)										<0.0005	<0.0005		<0.0005	<0.0005		<0.0005	<0.0005	
Lithium (Filtered)										0.0011	<0.001		0.001	0.0012		0.0051	0.005	2
Magnesium (Filtered)										6	5.8	3	5.56	5.68	2	13.3	13.3	0
Manganese (Filtered)										0.00057	0.00043	28	0.00058	0.00055	5	0.0145	0.0151	4
Mercury (Filtered)							<5.0E-7	<5.0E-7		<5.0E-7	<5.0E-7		<5.0E-7	<5.0E-7		0.00000135	0.0000014	
Molybdenum (Filtered)										<0.001	<0.001		<0.001	<0.001		<0.001	<0.001	
Nickel (Filtered)										<0.001	<0.001		<0.001	<0.001		0.0011	0.0012	
Phosphorus (Filtered)																		
Potassium (Filtered)										<2	<2		<2	<2		<2	<2	
Selenium (Filtered)										0.000233	0.00026	11	0.000242	0.000209	15	0.000375	0.000338	10
Silicon (Filtered)										2.01	2.1	4	1.99	2.03	2	1.68	1.65	2
Silver (Filtered)										<0.00002	<0.00002		<0.00002	<0.00002		<0.00002	<0.00002	
Sodium (Filtered)										<2	<2		<2	<2		16.6	17.5	5
Strontium (Filtered)										0.0962	0.0986	2	0.096	0.097	1	0.156	0.156	0
Thallium (Filtered)										<0.0002	<0.0002		<0.0002	<0.0002		<0.0002	<0.0002	
Tin (Filtered)										<0.0005	<0.0005		<0.0005	<0.0005		<0.0005	<0.0005	
Titanium (Filtered)										<0.01	<0.01		<0.01	<0.01		<0.01	<0.01	
Uranium (Filtered)										0.00044	0.0004		0.00043	0.00043		0.00065	0.00064	2
Vanadium (Filtered)										<0.0005	<0.0005		<0.0005	<0.0005		<0.0005	<0.0005	
Zinc (Filtered)										<0.005	<0.005		<0.005	<0.005		<0.005	<0.005	

NOTES:

-	Analysis was not conducted.
<	Concentration is less than the laboratory detection limit indicated.
RPD	RPD is Relative Percentage Difference calculated as RPD=[C2-C1]/[(C1+C2)/2] where C1,C2 = concentrations of parameters in 1st and 2nd sample respectively.
	RPDs have only been considered where a concentration is 5 times greater than the RDL
BOLD	RPDs greater than 30% are shaded in grey and bolded
MPN	Most Probable Number
CFU	Colony Forming Units

Table 13: Summary of 2017 QAQC Duplicate Surface Water Quality Results

Parameter	Unit	Reported Detection Limit (RDL)	BC MOE 2017 (mg/kg in dry weight) Lower SWQG	BC MOE 2017 (mg/kg in dry weight) Upper SWQG	DINOSAUR (D1)	DUPLICATE 1 (DUP 1)	RPD Analysis	POUCE COUPE (POUCE)	DUPLICATE 2 (DUP 2)	RPD Analysis
Matrix					soil	soil		soil	soil	
Sample Date					10/20/2017	10/20/2017		10/19/2017	10/19/2017	
Laboratory Identification Number					L2011210-2	L2011210-3		L2010677-6	L2010677-8	
Particle Size (Soil)										
% Sand (0.125mm - 0.063mm)	%	1.0	-	-	23.9	24.3	2	30.4	25.5	18
% Sand (0.25mm - 0.125mm)	%	1.0	-	-	23.8	19.7	19	41.7	36.7	13
% Sand (0.50mm - 0.25mm)	%	1.0	-	-	7.2	1.7	**124**	<1	<1	
% Clay (<4um)	%	1.0	-	-	5.6	5.6	0	5.3	9.2	54
% Gravel (>2mm)	%	1.0	-	-	1.5	<1		<1	<1	
% Sand (1.00mm - 0.50mm)	%	1.0	-	-	1.1	<1		<1	<1	
% Silt (0.0312mm - 0.004mm)	%	1.0	-	-	17.8	24	**30**	9.4	15.9	51
% Silt (0.063mm - 0.0312mm)	%	1.0	-	-	18.3	23.3	24	12.4	11.7	6
% Sand (2.00mm - 1.00mm)	%	1.0	-	-	<1	<1		<1	<1	
Carbon										
Total Organic Carbon (TOC)	%	0.05			1.47	0.989	**39**	0.443	0.672	41
Physical Tests (Soil)										
pH	pH Units	0.1	-	-	8	8.16	2	8.38	8.18	2
Anions and Nutrients (Soil)										
Nitrogen (Total)	%	0.02	-	-	0.132	0.112	16	0.05	0.069	**32**
Plant Available Nutrients (Soil)										
Ammonium	mg/kg	1	-	-	2.5	3.5	**33**	1.4	1.9	**30**
Nitrate (as NO3-N)	mg/kg	2	-	-	<2	<2		<2	<2	
Nitrate and Nitrite (as N)	mg/kg	2	-	-	<2	<2		<2	<2	
Phosphate	mg/kg	2	-	-	4	6.4	**46**	<2	2.1	
Metals (Soil)										
Aluminum	mg/kg	50	-	-	7220	6350	13	4180	6800	**48**
Antimony	mg/kg	0.1	-	-	0.73	0.67	9	0.38	0.63	**50**
Arsenic	mg/kg	0.1	5.9[#1]	17[#2]	6.47	6.22	4	9.2	12.5	**30**
Barium	mg/kg	0.5	-	-	284	291	2	326	297	9
Beryllium	mg/kg	0.1	-	-	0.37	0.33	11	0.33	0.52	**45**
Bismuth	mg/kg	0.2	-	-	<0.2	<0.2		<0.2	<0.2	
Boron - soluble	mg/kg	5	-	-	5.4	5.3		<5	7.2	
Cadmium	mg/kg	0.02	0.6[#1]	3.5[#2]	1.07	0.761	**34**	0.179	0.445	**85**
Calcium	mg/kg	50	-	-	19,500	15,900	20	6140	9810	**46**
Chromium	mg/kg	0.5	37.3[#1]	90[#2]	18.3	18.8	3	9.84	14.6	**39**
Cobalt	mg/kg	0.1	-	-	6.92	6.15	12	6.67	10.3	**43**
Copper	mg/kg	0.5	35.7[#1]	197[#2]	15.4	13.2	15	6.91	15.4	**76**
Iron	mg/kg	50	21,200 (about 2%)[#3]	43,766 (about 4%)[#3]	18,000	17,700	2	15,300	20,200	28
Lead	mg/kg	0.5	35[#1]	91.3[#2]	9.04	7.92	13	5.71	9.17	**47**
Lithium	mg/kg	2	-	-	9	7.6	17	6.4	10.7	**50**
Magnesium	mg/kg	20	-	-	7490	6090	21	2510	3540	**34**
Manganese	mg/kg	1	460[#3]	1100[#3]	313	284	10	214	336	**44**
Mercury	mg/kg	0.005	0.17[#1]	0.486[#2]	0.0344	0.0298	14	0.0272	0.0547	**67**
Molybdenum	mg/kg	0.1	-	-	1.05	0.95	10	0.63	1.07	**52**
Nickel	mg/kg	0.5	16[#3]	75[#3]	22.3	19.9	11	17	26.6	**44**
Phosphorus	mg/kg	50	-	-	825	794	4	521	622	18
Potassium	mg/kg	100	-	-	1260	1240	2	740	1230	**50**
Selenium	mg/kg	0.2	-	-	0.36	0.33		0.29	0.56	
Silver	mg/kg	0.1	0.5[#4]	N/A[#4]	0.19	0.15		<0.1	0.14	
Sodium	mg/kg	50	-	-	75	71		76	103	
Titanium	mg/kg	1.0	-	-	<110	126		<46	46	
Tungsten	mg/kg	0.5			<0.5	<0.5		<0.5	<0.5	
Uranium	mg/kg	0.05	-	-	0.651	0.628	4	0.542	1.04	**63**
Vanadium	mg/kg	0.2	-	-	40.8	41.3	1	23.3	31.6	**30**
Zinc	mg/kg	2	123[#1]	315[#2]	78.7	66	18	50.9	79.3	**44**
Zirconium	mg/kg	1	-	-	1.3	1.2	8	2.2	2.8	24

NOTES:

BC MOE 2017	BC MOE. 2017. Working Water Quality Guidelines and Working Sediment Quality Guidelines for British Columbia. Water Protection and Sustainability Branch. British Columbia Ministry of Environment.
Lower SWQG	A concentration
Upper SWQG	A concentration that if exceeded will likely cause severe effects on aquatic life (equivalent to CCME's Probably Effect Level (PEL; CCME (2001)).
CCME 2001	Canadian Council
AET	Apparent Effects Threshold
BA	Background Approach
CoA	Co-Occurrence analysis
EqP	Equilibrium Partitioning
ISQG	Interim Sediment Quality Guideline
NSTPA	National Status and Trends Program Approach
PEL	Probable Effect Level
SLC	Screening Level Concentration
#1	Lower SWQG is based on ISQG
#2	Upper SWQG is based on PEL
#3	Effect levels based on SLC
#4	Based on Ontario sediment guideline
<	Concentration is less than the laboratory detection limit indicated.
-	No applicable standard or guideline
RPD	RPD is Relative Percentage Difference calculated as RPD=[C2-C1]/[(C1+C2)/2] where C1,C2 = concentrations of parameters in 1st and 2nd sample respectively.
	RPDs have only been considered where a concentration is greater than the RDL
BOLD	RPDs greater than 30% are in bold
	RPD is calculated for parameters that are more than 5 times the detection limit

Table 14: Summary of 2017 QAQC Duplicate Surface Water Quality Results

Parameter	Unit	Reported Detection Limit (RDL)	BC MOE 2016 (Approved Guidelines for freshwater aquatic life and short-term maximum)	TRIP BLANK	TRIP BLANK	TRIP BLANK	TRIP BLANK	TRIP BLANK	TRIP BLANK	FIELD BLANK	FIELD BLANK	FIELD BLANK	FIELD BLANK	FIELD BLANK	FIELD BLANK
				surface water	surface water	surface water	surface water	surface water	surface water	surface water	surface water	surface water	surface water	surface water	surface water
Sample Date				5/26/2017	6/29/2017	7/20/2017	8/12/2017		10/20/2017	5/26/2017	6/29/2017	7/20/2017	8/11/2017	9/18/2017	10/20/2017
Laboratory Identification Number				L1932382-5	L1951349-7	L1962155-7	L1974040-5	L1994687-5	L2011209-7	L1932382-7	L1951349-6	L1962155-6	L1974039-6	L1993110-6	L2011209-6
Physical Parameters															
Colour	Col. Unit	5		<5	<5	-	<5	<5	<5	<5	<5	<5	<5	<5	<5
Electrical Conductivity (EC)	µS/cm	2		<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Hardness as $CaCO_3$	µg/L	0.5		<0.5	-			<0.5	<0.5	<0.5				**0.56**	<0.5
pH	pH Units	0.1	6.5-9.0	**5.21**	**5.25**	**5.15**	**5.34**	**5.42**	**5.46**	**5.25**	**5.28**	**5.12**	**5.34**	**5.44**	**5.52**
Total Suspended Solids (TSS)	µg/L	3		<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3
Total Dissolved Solids (TDS)	µg/L	1		<1	-	<10	<10	<1	<1	<1	-	<10	<10	<1	<1
Turbidity	NTU	0.1		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Anions and Nutrients															
Alkalinity (Bicarbonate as CaCO3)	mg/L	1		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Alkalinity (Carbonate as CaCO3)	mg/L	1		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Alkalinity (Hydroxide) as CaCO3	mg/L	1		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Alkalinity (total as CaCO3)	mg/L	1		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Ammonia as N	mg/L	0.005	See narrative [#2]	-	**0.0129**	<0.023	<0.005	<0.025	<0.011	-	<0.005	<0.005	<0.005	<0.005	<0.005
Bromide	mg/L	0.05		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Chloride	mg/L	0.5	600	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Fluoride	mg/L	0.02	See equation [#3]	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Nitrate and Nitrite (as N)	mg/L	0.0051		<0.0051	<0.0051	<0.0051	<0.0051	<0.0051	<0.0051	<0.0051	<0.0051	<0.0051	<0.0051	0.0166	<0.0051
Nitrate (as NO3-N)	mg/L	0.005	32.8	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.0166	<0.005
Nitrite (as NO2-N)	mg/L	0.001	0.06-0.60 [#4]	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Total Kjeldahl Nitrogen (TKN)	mg/L	0.05		-	**0.05**	<0.05	<0.05	<0.05	<0.05	-	<0.05	<0.05	<0.05	<0.05	<0.05
Nitrogen (Total)	mg/L	0.03		-	<0.03	<0.03	<0.03	<0.03	<0.03	-	<0.03	<0.03	<0.03	0.048	<0.03
Orthophosphate (as P) (Filtered)	mg/L	0.001		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Phosphorus (Filtered)	mg/L	0.002		-	<0.002	<0.002	<0.002	<0.002	<0.002	-	<0.002	<0.002	<0.002	<0.002	<0.002
Phosphorus	mg/L	0.002		-	<0.002	<0.002	<0.002	<0.002	<0.002	-	<0.002	<0.002	<0.002	<0.002	<0.002
Sulphate	mg/L	0.3		<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Silica	mg/L	0.5		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Anions Total	meq/L			<0.1	-			<0.1	<0.1	<0.1	-			<0.1	<0.1
Cations Total	meq/L			<0.1	-			<0.1	<0.1	<0.1	-			<0.1	<0.1
Ionic Balance	N/A			0	-			0	0	0	-			90.7	0
Organic and Inorganic Carbon															
Dissolved Organic Carbon (DOC)	0.5	µg/L		<0.5	-	-	-	-	-	0.76	0.69	2.39	1.37	<0.5	<0.5
Total Organic Carbon (TOC)	0.5	µg/L		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Plant Pigments															
Chlorophyll A	µg/L	0.01			-	-	-	-		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Speciated Metals															
total								<5.0E-8	<5.0E-8					<5.0E-8	<5.0E-8
Methylmercury (as MeHg)-Dissolved	ug/L	0.00005		<0.00005	-			-	-	<0.00005	-			<0.00005	<0.00005
Total Metals															
Aluminum	mg/L	0.005		<0.005	-			<0.005	<0.005	<0.005	-			<0.005	<0.005
Antimony	mg/L	0.0005	5	<0.0005	-			<0.0005	<0.0005	<0.0005	-			<0.0005	<0.0005
Arsenic	mg/L	0.0005		<0.0005	-			<0.0005	<0.0005	<0.0005	-			<0.0005	<0.0005
Barium	mg/L	0.02		<0.02	-			<0.02	<0.02	<0.02	-			<0.02	<0.02
Beryllium	mg/L	0.001		<0.001	-			<0.0001	<0.0001	<0.001	-			<0.0001	<0.0001
Bismuth	mg/L	0.2		<0.2	-			<0.2	<0.2	<0.2	-			<0.2	<0.2
Boron - soluble	mg/L	0.1		<0.1	-			<0.1	<0.1	<0.1	-			<0.1	<0.1
Cadmium	mg/L	0.000005		<0.000005	-			<0.000005	<0.000005	<0.000005	-			<0.000005	<0.000005
Calcium	mg/L	0.1		<0.1	-			<0.1	<0.1	<0.1	-			<0.1	<0.1
Chromium	mg/L	0.001	0.11	<0.001	-			<0.001	<0.001	<0.001	-			**0.003**	<0.001
Cobalt	mg/L	0.0003	See equation [#5]	<0.0003	-			<0.0003	<0.0003	<0.0003	-			<0.0003	<0.0003
Copper	mg/L	0.001	1	<0.001	-			<0.001	<0.001	<0.001	-			<0.001	<0.001
Iron	mg/L	0.03	See equation [#6]	<0.03	-			<0.03	<0.03	<0.03	-			<0.03	<0.03
Lead	mg/L	0.0005		<0.0005	-			<0.0005	<0.0005	<0.0005	-			<0.0005	<0.0005
Lithium	mg/L	0.001		<0.001	-			<0.001	<0.001	<0.001	-			<0.001	<0.001
Magnesium	mg/L	0.1	See equation [#7]	<0.1	-			<0.1	<0.1	<0.1	-			<0.1	<0.1
Manganese	mg/L	0.0001		<0.0001	-			<0.0001	<0.0001	<0.0001	-			**0.00025**	**0.00014**
Mercury	mg/L	0.000005	2	<0.000005	-			-	-	<0.000005	-			<5.0E-7	<5.0E-7
Molybdenum	mg/L	0.001		<0.001	-			<0.001	<0.001	<0.001	-			<0.001	<0.001
Nickel	mg/L	0.001		<0.001	-			<0.001	<0.001	<0.001	-			<0.001	<0.001
Phosphorus	mg/L	0.3		<0.3	-			<0.3	<0.3	<0.3	-			<0.3	<0.3
Potassium	mg/L	2	0.002	<2	-			<2	<2	<2	-			<2	<2
Selenium	mg/L	0.00005		<0.00005	-			<0.00005	<0.00005	<0.00005	-			<0.00005	<0.00005
Silicon	mg/L	0.1	0.0001 or 0.003 [#8]	<0.1	-			<0.1	<0.1	<0.1	-			<0.1	<0.1
Silver	mg/L	0.00002		<0.00002	-			<0.00002	<0.00002	<0.00002	-			<0.00002	<0.00002
Sodium	mg/L	2		<2	-			<2	<2	<2	-			<2	<2
Strontium	mg/L	0.005		<0.005	-			<0.005	<0.005	<0.005	-			<0.005	<0.005
Thallium	mg/L	0.0002		<0.0002	-			<0.00001	<0.00001	<0.0002	-			<0.00001	<0.00001
Tin	mg/L	0.0005		<0.0005	-			<0.0005	<0.0005	<0.0005	-			<0.0005	<0.0005
Titanium	mg/L	0.01		<0.01	-			<0.01	<0.01	<0.01	-			<0.01	<0.01
Uranium	mg/L	0.0002		<0.0002	-			<0.0002	<0.0002	<0.0002	-			<0.0002	<0.0002
Vanadium	mg/L	0.0005	See equation [#9]	<0.0005	-			<0.0005	<0.0005	<0.0005	-			<0.0005	<0.0005
Zinc	mg/L	0.005		<0.005	-			<0.005	<0.005	<0.005	-			<0.005	<0.005
Dissolved Metals			0.1 [#10]												
Aluminum (Filtered)	mg/L	0.005		<0.005	-			-	-	<0.005	-			**0.0868**	<0.005
Antimony (Filtered)	mg/L	0.0005		<0.0005	-			-	-	<0.0005	-			<0.0005	<0.0005
Arsenic (Filtered)	mg/L	0.0005		<0.0005	-			-	-	<0.0005	-			<0.0005	<0.0005
Barium (Filtered)	mg/L	0.02		<0.02	-			-	-	<0.02	-			<0.02	<0.02
Beryllium (Filtered)	mg/L	0.001		<0.001	-			-	-	<0.001	-			<0.0001	<0.0001
Bismuth (Filtered)	mg/L	0.2		<0.2	-			-	-	<0.2	-			<0.2	<0.2
Boron - soluble (Filtered)	mg/L	0.1	See equation [#11]	<0.1	-			-	-	<0.1	-			<0.1	<0.1
Cadmium (Filtered)	mg/L	0.000005		<0.000005	-			-	-	<0.000005	-			<0.000005	<0.000005
Calcium (Filtered)	mg/L	0.1		<0.1	-			-	-	<0.1	-			**0.22**	<0.1
Chromium (Filtered)	mg/L	0.001		<0.001	-			-	-	<0.001	-			<0.001	<0.001
Cobalt (Filtered)	mg/L	0.0003		<0.0003	-			-	-	<0.0003	-			<0.0003	<0.0003
Copper (Filtered)	mg/L	0.001	0.35	<0.001	-			-	-	<0.001	-			<0.001	<0.001
Iron (Filtered)	mg/L	0.03		<0.03	-			-	-	<0.03	-			<0.03	<0.03
Lead (Filtered)	mg/L	0.0005		<0.0005	-			-	-	<0.0005	-			<0.0005	<0.0005
Lithium (Filtered)	mg/L	0.001		<0.001	-			-	-	<0.001	-			<0.001	<0.001
Magnesium (Filtered)	mg/L	0.1		<0.1	-			-	-	<0.1	-			<0.1	<0.1
Manganese (Filtered)	mg/L	0.0001		<0.0001	-			-	-	<0.0001	-			**0.00015**	**0.0001**
Mercury (Filtered)	mg/L	0.000005		<0.000005	-			-	-	<0.000005	-			<5.0E-7	<5.0E-7
Molybdenum (Filtered)	mg/L	0.001		<0.001	-			-	-	<0.001	-			<0.001	<0.001
Nickel (Filtered)	mg/L	0.001		<0.001	-			-	-	<0.001	-			<0.001	<0.001
Phosphorus (Filtered)	mg/L	0.3		<0.3						<0.3					
Potassium (Filtered)	mg/L	2		<2	-			-	-	<2	-			<2	<2
Selenium (Filtered)	mg/L	0.00005		<0.00005	-			-	-	<0.00005	-			<0.00005	<0.00005
Silicon (Filtered)	mg/L	0.05		<0.05	-			-	-	<0.05	-			**0.054**	<0.05
Silver (Filtered)	mg/L	0.00002		<0.00002	-			-	-	<0.00002	-			<0.00002	<0.00002
Sodium (Filtered)	mg/L	2		<2	-			-	-	<2	-			<2	<2
Strontium (Filtered)	mg/L	0.005		<0.005	-			-	-	<0.005	-			<0.005	<0.005
Thallium (Filtered)	mg/L	0.0002		<0.0002	-			-	-	<0.0002	-			<0.0002	<0.0002
Tin (Filtered)	mg/L	0.0005		<0.0005	-			-	-	<0.0005	-			<0.0005	<0.0005
Titanium (Filtered)	mg/L	0.01		<0.01	-			-	-	<0.01	-			<0.01	<0.01
Uranium (Filtered)	mg/L	0.0002		<0.0002	-			-	-	<0.0002	-			<0.0002	<0.0002
Vanadium (Filtered)	mg/L	0.0005		<0.0005	-			-	-	<0.0005	-			<0.0005	<0.0005

NOTES:

BC MOE 2017	British Columbia Ministry of Environment (BC MOE). 2017. British Columbia approved water quality guidelines: Aquatic life, wildlife & agriculture. Water Protection and Sustainability Branch. Victoria, British Columbia, Canada.
H	Hardness. Where hardness values exceed the range applied for guideline use, site specific assessment may be required.
#1	Dissolved Oxygen guideline protects all life stages other than buried embryo/alevin, based on instantaneous measurement.
#2	Guideline for ammonia nitrogen (NH_3) varies with pH and temperature, and is derived from Table 26D of the BC MOE, 2017 BCWQGs, ranging from 0.681 to 28.7 mg/L for pH 6.5-9.0 and temperature 0.0-20.0 degC.
#3	Guideline for fluoride varies with H. Guideline is 0.4 mg/L when H <10 mg/L. Calculated in mg/L and based on equation: [-51.73 + 92.57*log(Hardness)]x0.01 when H <10-385 mg/L.
#4	Guideline for nitrite varies with chloride concentrations.
#5	Guideline for copper varies with H and is calculated in mg/L and based on equation: [0.094(H)+2]/1000, when H =13-400 mg/L.
#6	Guideline for lead varies with H. Guideline is 0.003 mg/L when H<8 mg/L. Calculated in mg/L and based on equation: $[e^{(1.273*ln(H)-1.460)}]$/1000 when H=8-360 mg/L
#7	Guideline for manganese varies with H and is calculated in mg/L and based on equation: (0.01102*H)+0.54, when H =25-259 mg/L.
#8	Guideline for silver varies with H. Guideline is 0.0001 mg/L when H<100 mg/L or 0.003 mg/L when H>100 mg/L
#9	Guideline for zinc varies with H. Guideline is 0.033 mg/L when H is <90 mg/L. Calculated in mg/L and based on equation: [33+0.75*(H-90)]/1000, when H=90-500 mg/L.
#10	Guideline for aluminum varies with pH. Guideline is 0.1 mg/L if pH ≥ 6.5. Calculated in mg/L and based on equation: $e^{(1.209-2.426(pH)+0.286K)}$ where K=$(pH)^2$ and pH < 6.5.
#11	Guideline for cadmium varies with H and is calculated in mg/L and based on equation: $[e^{(1.017*ln(H)-5.274)}]$/1000, when H=7-455 mg/L.
-	No applicable guideline or analysis was not conducted.
<	Concentration is less than the laboratory detection limit indicated.
MPN	Most Probable Number
CFU	Colony Forming Units
Bold	Bold and shaded indicates an exceedance of the RDL.

PHOTOS

Photos 1 to 17

Photo 1: Dinosaur Reservoir (D1) Sampling Location on May 26, 2017

Photo 2: Williston Reservoir (W1) Sampling Location on May 26, 2017

Photo 3: Peace Canyon (PC1) Sampling Location on May 24, 2017

Photo 4: Upper Site C Reservoir (PR1) Sampling Location on May 24, 2017

Photo 5: Middle Site C Reservoir (PR2) Sampling Location on May 24, 2017

Photo 6: Halfway River - Downstream (HD) Sampling Location on May 24, 2017

Photo 7: Lower Site C Reservoir (PR3) Sampling Location on May 25, 2017

Photo 8: Moberly River - Downstream (MD) Sampling Location on May 25, 2017

Photo 9: Peace at Pine (PD1) Sampling Location on May 25, 2017

Photo 10: Pine River (PINE) Sampling Location on May 25, 2017

Photo 11: Peace at Beatton River (PD2) Sampling Location on May 27, 2017

Photo 12: Beatton River (BEATTON) Sampling Location on May 27, 2017

Photo 13: Peace at Kiskatinaw River (PD3) Sampling Location on May 27, 2017

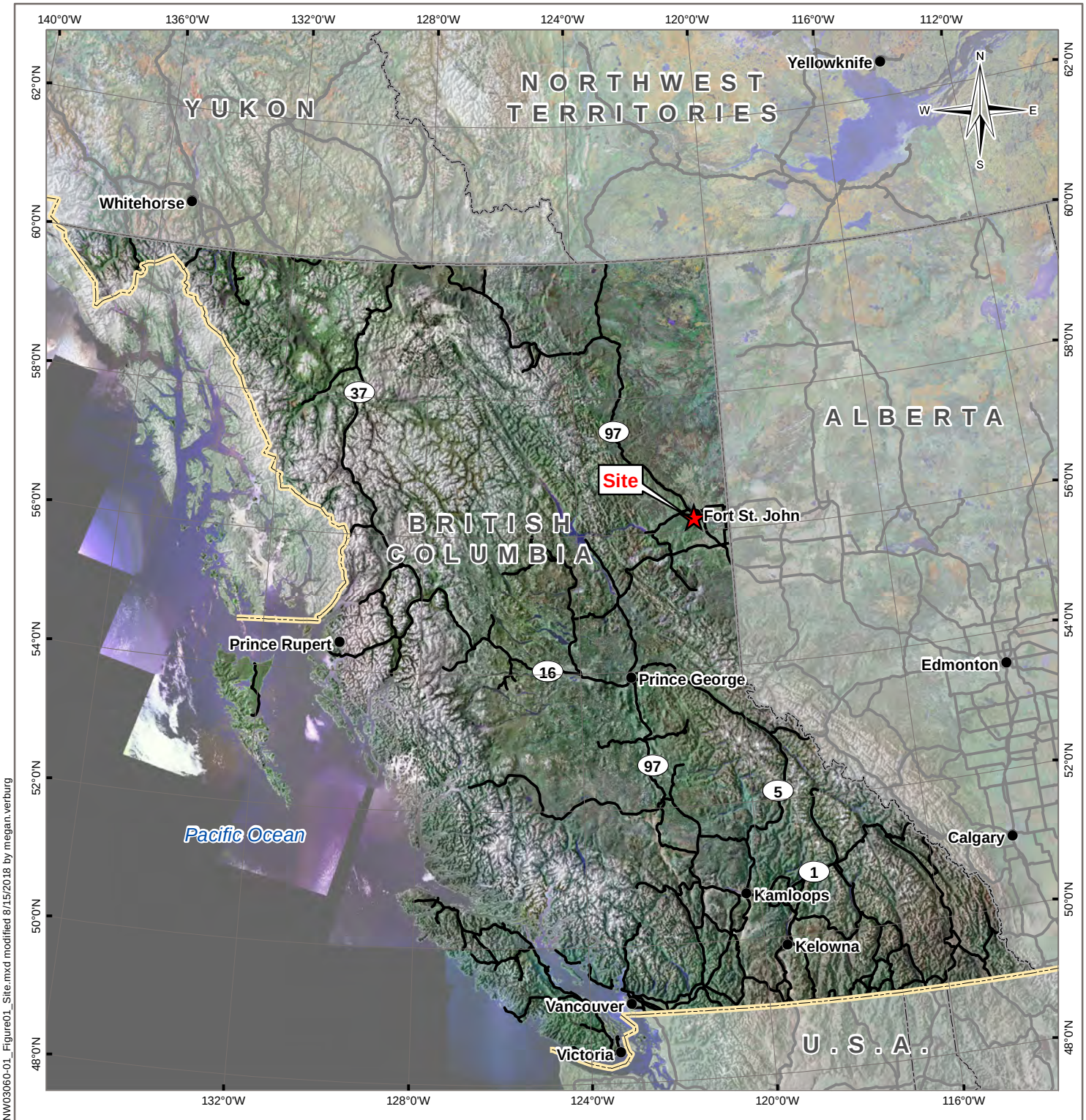
Photo 14: Kiskatinaw River (KR) Sampling Location on May 27, 2017

Photo 15: Peace at Pouce Coupe (PD4) Sampling Location on May 27, 2017

Photo 16: Pouce Coupe River (Pouce) Sampling Location on May 27, 2017

Photo 17: Peace at Many Islands (PD5) Sampling Location on May 27, 2017

FIGURES



LEGEND

- Site Location
- Populated Place
- Major Road
- Provincial / Territorial / State Boundary
- International Border

NOTES
Base data source:
ESRI Data & Maps

STATUS
ISSUED FOR USE

PEACE RIVER AND SITE C RESERVOIR WATER AND SEDIMENT QUALITY MONITORING PROGRAMS

Site Location

PROJECTION	DATUM	CLIENT
BC Albers	NAD83	BC hydro

Scale: 1:9,000,000
100 50 0 100
Kilometres

FILE NO. VENW03060-01_Figure01_Site.mxd

OFFICE	DWN	CKD	APVD	REV
Tt-VANC	SL	MEZ	DM	0

DATE	PROJECT NO.
August 15, 2018	ENW.VENW03060-01

TETRA TECH

Figure 1

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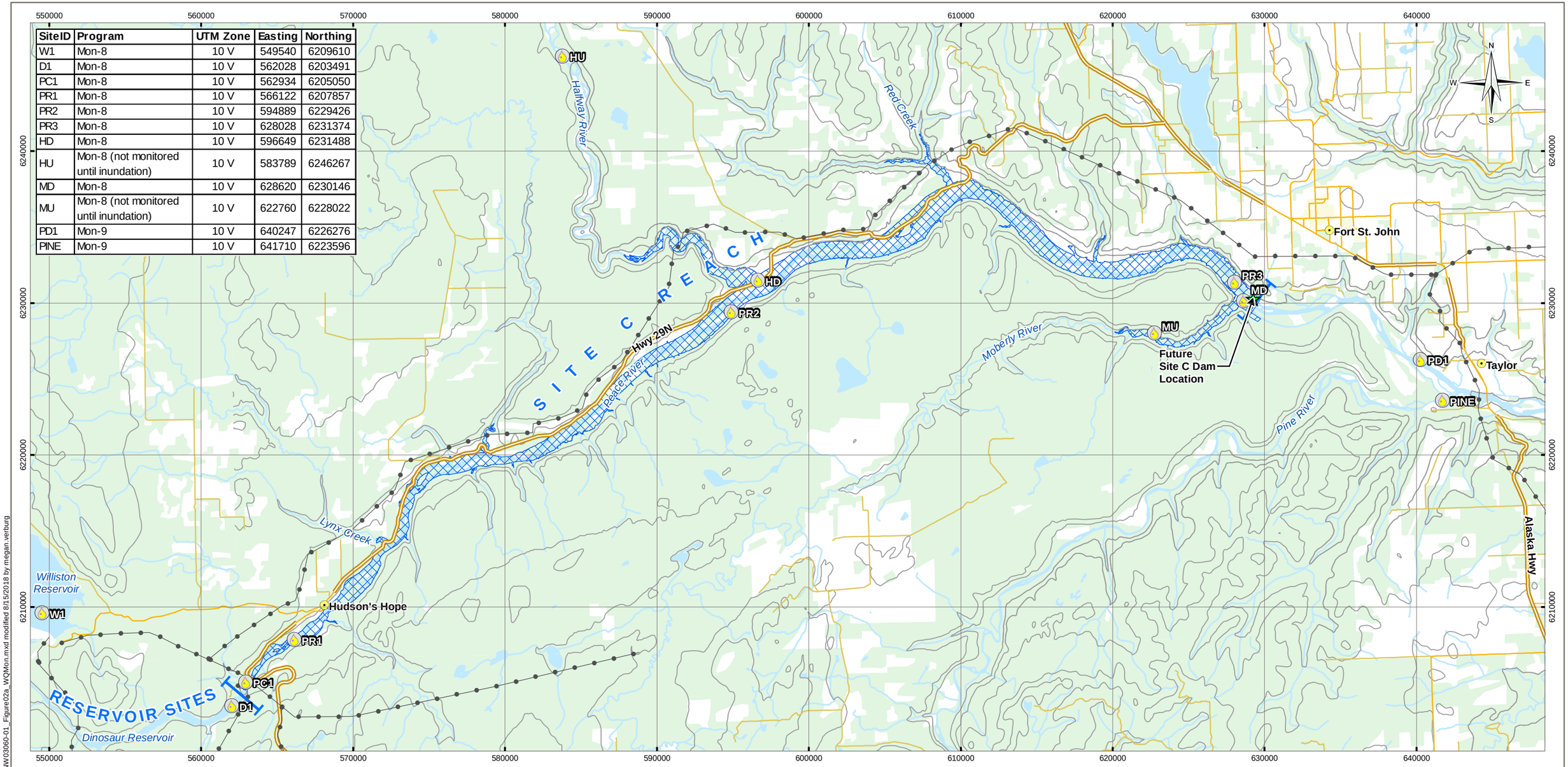
SiteID	Program	UTM Zone	Easting	Northing
W1	Mon-8	10 V	549540	6209610
D1	Mon-8	10 V	562028	6203491
PC1	Mon-8	10 V	562934	6205050
PR1	Mon-8	10 V	566122	6207857
PR2	Mon-8	10 V	594889	6229426
PR3	Mon-8	10 V	628028	6231374
HD	Mon-8	10 V	596649	6231488
HU	Mon-8 (not monitored until inundation)	10 V	583789	6246267
MD	Mon-8	10 V	628620	6230146
MU	Mon-8 (not monitored until inundation)	10 V	622760	6228022
PD1	Mon-9	10 V	640247	6226276
PINE	Mon-9	10 V	641710	6223596



LEGEND

- Surface Water Monitoring Station / Sediment Sample Location
- Reach Break
- Future Site C Dam Location
- Proposed Site C Reservoir
- Power Line
- Highway
- Main Road
- Local Road
- Contour (100 m)
- Watercourse
- Waterbody
- Residential Area
- Wooded Area
- BC-Alberta Border

NOTES
Base data source:
CanVec 1:250K

STATUS
ISSUED FOR USE

PEACE RIVER AND SITE C RESERVOIR WATER AND SEDIMENT QUALITY MONITORING PROGRAMS

Water Quality Monitoring Station Location Plan

PROJECTION	DATUM	CLIENT
UTM Zone 10	NAD83	BC hydro

Scale: 1:250,000
5 2.5 0 5
Kilometres

FILE NO.
VENW03060-01_Figure02a_WQMon.mxd

OFFICE	DWN	CKD	APVD	REV
Tt-VANC	SL	MEZ	DM	0

DATE	PROJECT NO.
August 15, 2018	ENW.VENW03060-01

TETRA TECH

Figure 2a

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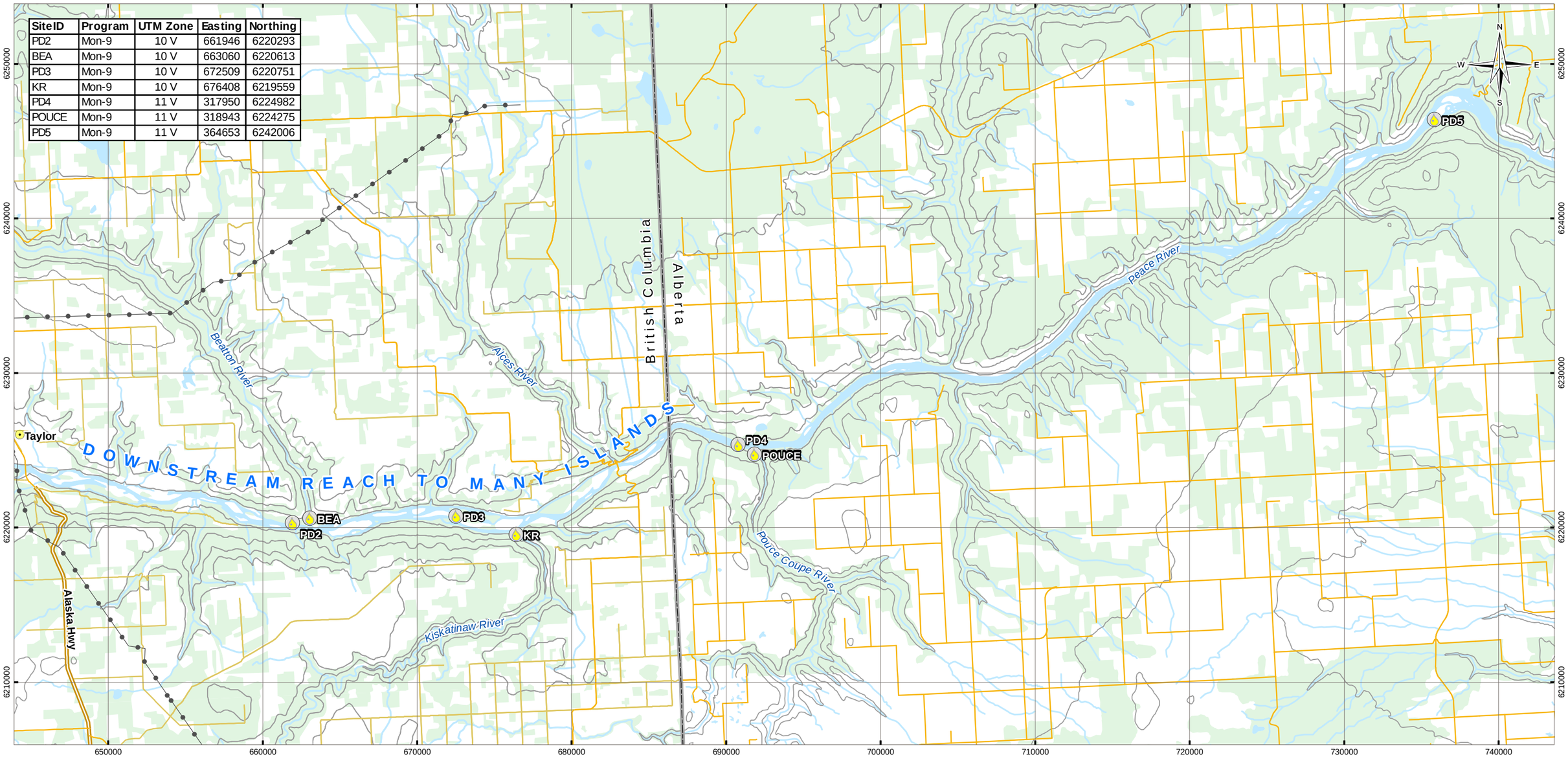
SiteID	Program	UTM Zone	Easting	Northing
PD2	Mon-9	10 V	661946	6220293
BEA	Mon-9	10 V	663060	6220613
PD3	Mon-9	10 V	672509	6220751
KR	Mon-9	10 V	676408	6219559
PD4	Mon-9	11 V	317950	6224982
POUCE	Mon-9	11 V	318943	6224275
PD5	Mon-9	11 V	364653	6242006



LEGEND

- Surface Water Monitoring Station / Sediment Sample Location
- Power Line
- Highway
- Main Road
- Local Road
- Contour (100 m)
- Watercourse
- Waterbody
- Residential Area
- Wooded Area
- BC-Alberta Border

NOTES
Base data source:
CanVec 1:250K

STATUS
ISSUED FOR USE

PEACE RIVER AND SITE C RESERVOIR WATER AND SEDIMENT QUALITY MONITORING PROGRAMS

Water Quality Monitoring Station Location Plan

PROJECTION UTM Zone 10		**DATUM** NAD83		**CLIENT** BC hydro
Scale: 1:250,000 5 2.5 0 5 Kilometres				TETRA TECH
FILE NO. VENW03060-01_Figure02b_WQMon.mxd				
OFFICE Tt-VANC	**DWN** SL	**CKD** MEZ	**APVD** DM	**REV** 0
DATE August 15, 2018	**PROJECT NO.** ENW.VENW03060-01			**Figure 2b**

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APPENDIX A
LABORATORY REPORTS

Tetra Tech Canada Inc.
ATTN: Danielle MacDonald
14940-123 Ave., NW
Edmonton AB T5V 1B4

Date Received: 25-MAY-17
Report Date: 07-JUN-17 11:21 (MT)
Version: FINAL

Client Phone: 780-886-3055

Certificate of Analysis

Lab Work Order #: L1931659

Project P.O. #: NOT SUBMITTED
Job Reference: VENV03060
C of C Numbers: 14-
Legal Site Desc:

Brent Mack, B.Sc.
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1931659-1 Water 24-MAY-17 15:30 HALFWAY RIVER - DOWNSTREAM (HD)	L1931659-2 Water 24-MAY-17 16:10 MIDDLE SITE C RESERVOIR (PR2)	L1931659-3 Water 24-MAY-17 17:40 PEACE CANYON (PC1)	L1931659-4 Water 24-MAY-17 18:20 UPPER SITE C RESERVOIR (PR1)	L1931659-5 Water 24-MAY-17 15:30 DUPLICATE 2 (DUP2)
WATER						
Physical Tests	Colour, True (CU)	50.3	28.2	25.1	24.8	28.6
	Conductivity (uS/cm)	256	190	182	182	182
	Hardness (as CaCO3) (ug/L)	131000	93500	89100	89200	91300
	pH (pH)	8.12	8.12	8.12	8.13	8.15
	Total Suspended Solids (ug/L)	2450000	163000	30000	30800	29000
	TDS (Calculated) (ug/L)	214000	119000	103000	104000	103000
	Turbidity (NTU)	1610	220	60.1	63.8	63.5
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (ug/L)	163000	104000	85800	87000	85100
	Alkalinity, Carbonate (as CaCO3) (ug/L)	<1000	<1000	<1000	<1000	<1000
	Alkalinity, Hydroxide (as CaCO3) (ug/L)	<1000	<1000	<1000	<1000	<1000
	Alkalinity, Phenolphthalein (as CaCO3) (ug/L)	<2000	<2000	<2000	<2000	<2000
	Alkalinity, Total (as CaCO3) (ug/L)	163000	104000	85800	87000	85100
	Ammonia, Total (as N) (ug/L)	34.9	<5.0	<5.0	<5.0	<5.0
	Bromide (Br) (ug/L)	<50	<50	<50	<50	<50
	Chloride (Cl) (ug/L)	<500	<500	<500	<500	<500
	Fluoride (F) (ug/L)	92	50	45	45	46
	Nitrate and Nitrite (as N) (ug/L)	73.5	114	110	109	109
	Nitrate (as N) (ug/L)	73.5	114	110	109	109
	Nitrite (as N) (ug/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Total Kjeldahl Nitrogen (ug/L)	3190 RRV	423	241	237	226
	Total Nitrogen (ug/L)	1160 DLM	340 DLM	252	262	249
	Orthophosphate-Dissolved (as P) (ug/L)	9.8	2.7	2.0	2.0	1.7
	Phosphorus (P)-Total Dissolved (ug/L)	14.2	5.4	4.1	4.2	3.9
	Phosphorus (P)-Total (ug/L)	2270	212	60.8	60.8	59.3
	Silicate (as SiO2) (ug/L)	3630	4160	4130	4390	4210
	Sulfate (SO4) (ug/L)	23900	14500	13200	13200	13300
	Anion Sum (meq/L)	3.77	2.38	2.00	2.02	1.99
	Cation Sum (meq/L)	2.64	1.87	1.78	1.78	1.83
	Cation - Anion Balance (%)	-17.7	-12.1	-5.7	-6.3	-4.2
Organic / Inorganic Carbon	Dissolved Organic Carbon (ug/L)	11000	6470	5220	4900	5130
	Total Organic Carbon (ug/L)	45300	9180	6460	6190	6200
Total Metals	Aluminum (Al)-Total (ug/L)	15300	3370	1020	1010	986
	Antimony (Sb)-Total (ug/L)	0.80	<0.50	<0.50	<0.50	<0.50
	Arsenic (As)-Total (ug/L)	14.8	2.44	0.87	0.80	0.84
	Barium (Ba)-Total (ug/L)	1010	150	86	86	86
	Beryllium (Be)-Total (ug/L)	1.3	<1.0	<1.0	<1.0	<1.0

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1931659-1 Water 24-MAY-17 15:30 HALFWAY RIVER - DOWNSTREAM (HD)	L1931659-2 Water 24-MAY-17 16:10 MIDDLE SITE C RESERVOIR (PR2)	L1931659-3 Water 24-MAY-17 17:40 PEACE CANYON (PC1)	L1931659-4 Water 24-MAY-17 18:20 UPPER SITE C RESERVOIR (PR1)	L1931659-5 Water 24-MAY-17 15:30 DUPLICATE 2 (DUP2)
WATER						
Total Metals	Bismuth (Bi)-Total (ug/L)	<200	<200	<200	<200	<200
	Boron (B)-Total (ug/L)	<100	<100	<100	<100	<100
	Cadmium (Cd)-Total (ug/L)	3.12	0.383	0.0839	0.0802	0.0806
	Calcium (Ca)-Total (ug/L)	137000	37100	27500	27400	27800
	Chromium (Cr)-Total (ug/L)	31.0	6.4	1.9	1.9	1.9
	Cobalt (Co)-Total (ug/L)	17.5	2.55	0.68	0.67	0.70
	Copper (Cu)-Total (ug/L)	44.3	8.2	2.6	2.6	2.7
	Iron (Fe)-Total (ug/L)	37000	6280	1800	1750	1790
	Lead (Pb)-Total (ug/L)	20.5	2.98	0.89	0.88	0.91
	Lithium (Li)-Total (ug/L)	28.8	5.8	2.2	2.1	2.1
	Magnesium (Mg)-Total (ug/L)	31400	9760	6690	6580	6510
	Manganese (Mn)-Total (ug/L)	664 DLM	101 DLM	23.6 DLM	23.0 DLM	23.6 DLM
	Mercury (Hg)-Total (ug/L)	0.13	<0.10	<0.10	<0.10	<0.10
	Molybdenum (Mo)-Total (ug/L)	3.3	1.0	<1.0	<1.0	<1.0
	Nickel (Ni)-Total (ug/L)	61.9	9.9	3.4	3.3	3.4
	Phosphorus (P)-Total (ug/L)	2970	<300	<300	<300	<300
	Potassium (K)-Total (ug/L)	4400	<2000	<2000	<2000	<2000
	Selenium (Se)-Total (ug/L)	2.55	0.484	0.345	0.328	0.343
	Silicon (Si)-Total (ug/L)	23400	7500	3690	3630	3600
	Silver (Ag)-Total (ug/L)	0.502	0.062	0.030	0.024	0.024
	Sodium (Na)-Total (ug/L)	2400	<2000	<2000	<2000	<2000
	Strontium (Sr)-Total (ug/L)	387	124	100	99.6	98.6
	Thallium (Tl)-Total (ug/L)	0.58	<0.20	<0.20	<0.20	<0.20
	Tin (Sn)-Total (ug/L)	<0.50	<0.50	<0.50	<0.50	<0.50
	Titanium (Ti)-Total (ug/L)	47	55	10	10	<10
	Uranium (U)-Total (ug/L)	2.91	0.64	0.45	0.46	0.47
	Vanadium (V)-Total (ug/L)	78.4	14.5	4.57	4.42	4.48
	Zinc (Zn)-Total (ug/L)	231	30.0	10.2	9.4	11.2
Dissolved Metals	Dissolved MeHg Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (ug/L)	25.6	8.3	13.8	8.6	9.5
	Antimony (Sb)-Dissolved (ug/L)	<0.50	<0.50	<0.50	<0.50	<0.50
	Arsenic (As)-Dissolved (ug/L)	<0.50	<0.50	<0.50	<0.50	<0.50
	Barium (Ba)-Dissolved (ug/L)	60	44	48	48	48
	Beryllium (Be)-Dissolved (ug/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Bismuth (Bi)-Dissolved (ug/L)	<200	<200	<200	<200	<200

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1931659-1 Water 24-MAY-17 15:30 HALFWAY RIVER - DOWNSTREAM (HD)	L1931659-2 Water 24-MAY-17 16:10 MIDDLE SITE C RESERVOIR (PR2)	L1931659-3 Water 24-MAY-17 17:40 PEACE CANYON (PC1)	L1931659-4 Water 24-MAY-17 18:20 UPPER SITE C RESERVOIR (PR1)	L1931659-5 Water 24-MAY-17 15:30 DUPLICATE 2 (DUP2)
WATER						
Dissolved Metals	Boron (B)-Dissolved (ug/L)	<100	<100	<100	<100	<100
	Cadmium (Cd)-Dissolved (ug/L)	0.0263	0.0269	0.0159	0.0163	0.0164
	Calcium (Ca)-Dissolved (ug/L)	36100	26100	25100	25200	25600
	Chromium (Cr)-Dissolved (ug/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Cobalt (Co)-Dissolved (ug/L)	<0.30	<0.30	<0.30	<0.30	<0.30
	Copper (Cu)-Dissolved (ug/L)	1.7	1.0	<1.0	<1.0	<1.0
	Iron (Fe)-Dissolved (ug/L)	96	<30	33	<30	<30
	Lead (Pb)-Dissolved (ug/L)	<0.50	<0.50	<0.50	<0.50	<0.50
	Lithium (Li)-Dissolved (ug/L)	3.8	2.4	1.8	1.6	1.7
	Magnesium (Mg)-Dissolved (ug/L)	10000	6850	6400	6390	6640
	Manganese (Mn)-Dissolved (ug/L)	7.85	5.62	4.06	3.81	3.93
	Mercury (Hg)-Dissolved (ug/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Molybdenum (Mo)-Dissolved (ug/L)	2.6	<1.0	<1.0	<1.0	<1.0
	Nickel (Ni)-Dissolved (ug/L)	2.6	1.6	<1.0	<1.0	<1.0
	Phosphorus (P)-Dissolved (ug/L)	<300	<300	<300	<300	<300
	Potassium (K)-Dissolved (ug/L)	<2000	<2000	<2000	<2000	<2000
	Selenium (Se)-Dissolved (ug/L)	1.07	0.350	0.267	0.247	0.264
	Silicon (Si)-Dissolved (ug/L)	1920	2270	2180	2200	2190
	Silver (Ag)-Dissolved (ug/L)	<0.020	<0.020	<0.020	<0.020	<0.020
	Sodium (Na)-Dissolved (ug/L)	<2000	<2000	<2000	<2000	<2000
	Strontium (Sr)-Dissolved (ug/L)	161	96.8	98.3	99.3	99.5
	Thallium (Tl)-Dissolved (ug/L)	<0.20	<0.20	<0.20	<0.20	<0.20
	Tin (Sn)-Dissolved (ug/L)	<0.50	<0.50	<0.50	<0.50	<0.50
	Titanium (Ti)-Dissolved (ug/L)	<10	<10	<10	<10	<10
	Uranium (U)-Dissolved (ug/L)	0.56	0.44	0.41	0.42	0.42
	Vanadium (V)-Dissolved (ug/L)	0.53	<0.50	<0.50	<0.50	<0.50
	Zinc (Zn)-Dissolved (ug/L)	<5.0	<5.0	<5.0	<5.0	<5.0
Speciated Metals	Methylmercury (as MeHg)-Dissolved (ug/L)	0.000090	<0.000050	<0.000050	<0.000050	<0.000050

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

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Dissolved Organic Carbon	MS-B	L1931659-1, -2, -3, -4, -5
Matrix Spike	Dissolved Organic Carbon	MS-B	L1931659-1, -2, -3, -4, -5
Matrix Spike	Total Organic Carbon	MS-B	L1931659-2, -3, -4, -5
Matrix Spike	Total Organic Carbon	MS-B	L1931659-2, -3, -4, -5
Matrix Spike	Total Organic Carbon	MS-B	L1931659-2, -3, -4, -5
Matrix Spike	Total Organic Carbon	MS-B	L1931659-1
Matrix Spike	Total Organic Carbon	MS-B	L1931659-1
Matrix Spike	Total Organic Carbon	MS-B	L1931659-1
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L1931659-1, -2, -3, -4, -5
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1931659-1, -2, -3, -4, -5
Matrix Spike	Boron (B)-Total	MS-B	L1931659-1, -2, -3, -4, -5
Matrix Spike	Calcium (Ca)-Total	MS-B	L1931659-1, -2, -3, -4, -5
Matrix Spike	Magnesium (Mg)-Total	MS-B	L1931659-1, -2, -3, -4, -5
Matrix Spike	Molybdenum (Mo)-Total	MS-B	L1931659-1, -2, -3, -4, -5
Matrix Spike	Potassium (K)-Total	MS-B	L1931659-1, -2, -3, -4, -5
Matrix Spike	Sodium (Na)-Total	MS-B	L1931659-1, -2, -3, -4, -5
Matrix Spike	Strontium (Sr)-Total	MS-B	L1931659-1, -2, -3, -4, -5
Matrix Spike	Total Nitrogen	MS-B	L1931659-1, -2
Matrix Spike	Phosphorus (P)-Total	MS-B	L1931659-1, -2, -3, -4, -5

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.
RRV	Reported Result Verified By Repeat Analysis

Test Method References:

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

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

ANIONS-N+N-CALC-VA	Water	Nitrite & Nitrate in Water (Calculation)	EPA 300.0

Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).

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

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

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

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

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

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

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

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

COLOUR-TRUE-VA	Water	Colour (True) by Spectrometer	BCMOE Colour Single Wavelength

This analysis is carried out using procedures adapted from British Columbia Environmental Manual "Colour- Single Wavelength." Colour (True Colour) is determined by filtering a sample through a 0.45 micron membrane filter followed by analysis of the filtrate using the platinum-cobalt colourimetric method.
Colour measurements can be highly pH dependent, and apply to the pH of the sample as received (at time of testing), without pH adjustment. Concurrent measurement of sample pH is recommended.

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

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

Reference Information

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

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

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

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

HARDNESS-CALC-VA Water Hardness APHA 2340B

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

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

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

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

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

IONBALANCE-VA Water Ion Balance Calculation APHA 1030E

Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:

Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum]

MEHG-D-GCAF-VA Water Diss. Methylmercury in Water by GCAFS EPA 1630

This method follows Method 1630 of the US EPA. Samples are distilled under an inert gas flow to isolate methylmercury and minimize matrix interferences. The distillate is analyzed by aqueous phase ethylation, purge and trap, desorption and GC separation. The separated species are the pyrolized to elemental Hg and quantified by cold vapour atomic flourescence spectroscopy. Results are reported "as MeHg".

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

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

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

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

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

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

N-T-COL-VA Water Total Nitrogen in water by Colour APHA4500-P(J)/NEMI9171/USGS03-4174

This analysis is carried out using procedures adapted from APHA Method 4500-P (J) "Persulphate Method for Simultaneous Determination of Total Nitrogen and Total Phosphorus" and National Environmental Methods Index - Nemi method 5735.

NH3-F-VA Water Ammonia in Water by Fluorescence APHA 4500 NH3-NITROGEN (AMMONIA)

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

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

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

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

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

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

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

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

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

Reference Information

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

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

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

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

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

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

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

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

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

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

SILICATE-COL-VA	Water	Silicate by Colourimetric analysis	APHA 4500-SiO2 E.

This analysis is carried out using procedures adapted from APHA Method 4500-SiO2 E. "Silica". Silicate (molybdate-reactive silica) is determined by the molybdosilicate-heteropoly blue colourimetric method.

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

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

TDS-CALC-VA	Water	TDS (Calculated)	APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".
The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

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

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

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

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

TURBIDITY-VA	Water	Turbidity by Meter	APHA 2130 Turbidity

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

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

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

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

Chain of Custody Numbers:

14-

Reference Information

GLOSSARY OF REPORT TERMS

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

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

Tetra Tech Canada Inc.
ATTN: Danielle MacDonald
14940-123 Ave., NW
Edmonton AB T5V 1B4

Date Received: 26-MAY-17
Report Date: 07-JUN-17 13:43 (MT)
Version: FINAL

Client Phone: 780-886-3055

Certificate of Analysis

Lab Work Order #: L1931960

Project P.O. #: NOT SUBMITTED
Job Reference: VENV03060
C of C Numbers: 14-
Legal Site Desc:

Comments: RRR= The observed discrepancy between Total Kjeldahl Nitrogen (TKN) and Total Nitrogen (TN) - TKN>TN in samples L1931960(1-4) has been confirmed through review of current analytical and/or historical data for the site. The two methods of analysis utilize different digestion and measurement techniques and, for select matrix types, will exhibit a bias in measured results. This is inherent to the combination of sample matrix and analytical techniques.

Brent Mack, B.Sc.
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1931960-1	L1931960-2	L1931960-3	L1931960-4	
	Description	Water	Water	Water	Water	
	Sampled Date	25-MAY-17	25-MAY-17	25-MAY-17	25-MAY-17	
	Sampled Time	17:45	17:20	16:30	16:00	
	Client ID	MOBERLY RIVER - DOWNSTREAM (MD)	LOWER SITE C RESERVOIR (PR3)	PEACE AT PINE (PD1)	PINE RIVER (PINE)	
Grouping	**Analyte**					
WATER						
Physical Tests	Colour, True (CU)	197	49.0	49.5	81.8	
	Conductivity (uS/cm)	206	234	231	186	
	Hardness (as CaCO3) (ug/L)	105000	119000	116000	131000	
	pH (pH)	8.05	8.09	8.04	8.01	
	Total Suspended Solids (ug/L)	1280000	1060000	1460000	2230000	
	TDS (Calculated) (ug/L)	143000	170000	173000	170000	
	Turbidity (NTU)	904	922	1120	1300	
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (ug/L)	110000	122000	132000	108000	
	Alkalinity, Carbonate (as CaCO3) (ug/L)	<1000	<1000	<1000	<1000	
	Alkalinity, Hydroxide (as CaCO3) (ug/L)	<1000	<1000	<1000	<1000	
	Alkalinity, Phenolphthalein (as CaCO3) (ug/L)	<2000	<2000	<2000	<2000	
	Alkalinity, Total (as CaCO3) (ug/L)	110000	122000	132000	108000	
	Ammonia, Total (as N) (ug/L)	22.1	24.9	25.4	26.3	
	Bromide (Br) (ug/L)	<50	<50	<50	<50	
	Chloride (Cl) (ug/L)	<500	<500	<500	<500	
	Fluoride (F) (ug/L)	73	74	76	58	
	Nitrate and Nitrite (as N) (ug/L)	134	90.8	93.0	124	
	Nitrate (as N) (ug/L)	133	90.8	93.0	123	
	Nitrite (as N) (ug/L)	1.2	<1.0	<1.0	1.5	
	Total Kjeldahl Nitrogen (ug/L)	2020	1510	1740	2160	
	Total Nitrogen (ug/L)	1000 RRR	930 RRR	1190 RRR	740 RRR	
	Orthophosphate-Dissolved (as P) (ug/L)	5.5	7.1	6.8	5.2	
	Phosphorus (P)-Total Dissolved (ug/L)	11.5	12.0	11.9	8.7	
	Phosphorus (P)-Total (ug/L)	1330	1380	1590	1380	
	Silicate (as SiO2) (ug/L)	3620	3970	3770	2850	
	Sulfate (SO4) (ug/L)	9340	19800	19400	9610	
	Anion Sum (meq/L)	2.41	2.87	3.04	2.38	
	Cation Sum (meq/L)	2.10	2.38	2.33	3.42	
	Cation - Anion Balance (%)	-6.7	-9.4	-13.2	18.0	
Organic / Inorganic Carbon	Dissolved Organic Carbon (ug/L)	11500	10000	10600	11200	
	Total Organic Carbon (ug/L)	30200	34700	33100	37200	
Total Metals	Aluminum (Al)-Total (ug/L)	12200	10900	11900	13400	
	Antimony (Sb)-Total (ug/L)	0.52	0.70	0.70	0.67	
	Arsenic (As)-Total (ug/L)	9.23	9.78	10.9	11.9	
	Barium (Ba)-Total (ug/L)	634	615	706	786	
	Beryllium (Be)-Total (ug/L)	<1.0	<1.0	<1.0	1.1	

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1931960-1	L1931960-2	L1931960-3	L1931960-4	
	Description	Water	Water	Water	Water	
	Sampled Date	25-MAY-17	25-MAY-17	25-MAY-17	25-MAY-17	
	Sampled Time	17:45	17:20	16:30	16:00	
	Client ID	MOBERLY RIVER - DOWNSTREAM (MD)	LOWER SITE C RESERVOIR (PR3)	PEACE AT PINE (PD1)	PINE RIVER (PINE)	
Grouping	**Analyte**					
WATER						
Total Metals	Bismuth (Bi)-Total (ug/L)	<200	<200	<200	<200	
	Boron (B)-Total (ug/L)	<100	<100	<100	<100	
	Cadmium (Cd)-Total (ug/L)	1.03	1.70	1.94	1.55	
	Calcium (Ca)-Total (ug/L)	54400	83700	87500	81400	
	Chromium (Cr)-Total (ug/L)	20.7	20.5	22.4	23.5	
	Cobalt (Co)-Total (ug/L)	12.1	9.88	11.4	15.6	
	Copper (Cu)-Total (ug/L)	31.4	26.1	30.7	34.8	
	Iron (Fe)-Total (ug/L)	25400	23900	26600	37200	
	Lead (Pb)-Total (ug/L)	15.1	13.4	15.0	20.3	
	Lithium (Li)-Total (ug/L)	19.6	17.8	19.5	25.1	
	Magnesium (Mg)-Total (ug/L)	16800	19800	21200	20700	
	Manganese (Mn)-Total (ug/L)	463	353	425	662	
	Mercury (Hg)-Total (ug/L)	0.095 DLM	0.081 DLM	0.085 DLM	0.071 DLM	
	Molybdenum (Mo)-Total (ug/L)	1.1	2.9	2.7	1.3	
	Nickel (Ni)-Total (ug/L)	39.6	36.9	42.0	49.6	
	Phosphorus (P)-Total (ug/L)	1130	1370	1530	1860	
	Potassium (K)-Total (ug/L)	3700	3500	3700	3700	
	Selenium (Se)-Total (ug/L)	0.932	1.77	1.78	1.32	
	Silicon (Si)-Total (ug/L)	18300	16600	17900	18500	
	Silver (Ag)-Total (ug/L)	0.408	0.414	0.464	0.540	
	Sodium (Na)-Total (ug/L)	2200	2000	2200	<2000	
	Strontium (Sr)-Total (ug/L)	137	247	252	184	
	Thallium (Tl)-Total (ug/L)	0.29	0.41	0.44	0.38	
	Tin (Sn)-Total (ug/L)	<0.50	<0.50	<0.50	<0.50	
	Titanium (Ti)-Total (ug/L)	59	50	43	34	
	Uranium (U)-Total (ug/L)	1.58	2.02	2.22	2.07	
	Vanadium (V)-Total (ug/L)	41.0	51.6	55.4	48.2	
	Zinc (Zn)-Total (ug/L)	123	140	159	171	
Dissolved Metals	Dissolved MeHg Filtration Location	FIELD	FIELD	FIELD	FIELD	
	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	
	Aluminum (Al)-Dissolved (ug/L)	13.8	11.0	11.1	4580	
	Antimony (Sb)-Dissolved (ug/L)	<0.50	<0.50	<0.50	<0.50	
	Arsenic (As)-Dissolved (ug/L)	<0.50	<0.50	<0.50	1.76	
	Barium (Ba)-Dissolved (ug/L)	95	54	56	260	
	Beryllium (Be)-Dissolved (ug/L)	<1.0	<1.0	<1.0	<1.0	
	Bismuth (Bi)-Dissolved (ug/L)	<200	<200	<200	<200	

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1931960-1 Water 25-MAY-17 17:45 MOBERLY RIVER - DOWNSTREAM (MD)	L1931960-2 Water 25-MAY-17 17:20 LOWER SITE C RESERVOIR (PR3)	L1931960-3 Water 25-MAY-17 16:30 PEACE AT PINE (PD1)	L1931960-4 Water 25-MAY-17 16:00 PINE RIVER (PINE)	
WATER						
Dissolved Metals	Boron (B)-Dissolved (ug/L)	<100	<100	<100	<100	
	Cadmium (Cd)-Dissolved (ug/L)	0.0152	0.0197	0.0166	0.338	
	Calcium (Ca)-Dissolved (ug/L)	28700	33000	32500	37700	
	Chromium (Cr)-Dissolved (ug/L)	<1.0	<1.0	<1.0	7.1	
	Cobalt (Co)-Dissolved (ug/L)	<0.30	<0.30	<0.30	2.58	
	Copper (Cu)-Dissolved (ug/L)	1.7	1.4	1.4	7.3	
	Iron (Fe)-Dissolved (ug/L)	91	53	53	4360	
	Lead (Pb)-Dissolved (ug/L)	<0.50	<0.50	<0.50	3.69	
	Lithium (Li)-Dissolved (ug/L)	3.3	3.1	3.0	6.8	
	Magnesium (Mg)-Dissolved (ug/L)	8100	8800	8600	8930	
	Manganese (Mn)-Dissolved (ug/L)	7.13	5.35	4.49	136	
	Mercury (Hg)-Dissolved (ug/L)	<0.0050	<0.0050	<0.0050	0.035 DLM	
	Molybdenum (Mo)-Dissolved (ug/L)	<1.0	1.9	1.8	<1.0	
	Nickel (Ni)-Dissolved (ug/L)	2.1	2.2	2.3	8.0	
	Phosphorus (P)-Dissolved (ug/L)	<300	<300	<300	370	
	Potassium (K)-Dissolved (ug/L)	<2000	<2000	<2000	2100	
	Selenium (Se)-Dissolved (ug/L)	0.247	0.839	0.756	0.506	
	Silicon (Si)-Dissolved (ug/L)	1870	1920	1910	14400	
	Silver (Ag)-Dissolved (ug/L)	<0.020	<0.020	<0.020	0.033	
	Sodium (Na)-Dissolved (ug/L)	<2000	<2000	<2000	<2000	
	Strontium (Sr)-Dissolved (ug/L)	70.0	126	119	99.7	
	Thallium (Tl)-Dissolved (ug/L)	<0.20	<0.20	<0.20	<0.20	
	Tin (Sn)-Dissolved (ug/L)	<0.50	<0.50	<0.50	<0.50	
	Titanium (Ti)-Dissolved (ug/L)	<10	<10	<10	19	
	Uranium (U)-Dissolved (ug/L)	0.30	0.53	0.52	0.71	
	Vanadium (V)-Dissolved (ug/L)	<0.50	<0.50	<0.50	16.6	
	Zinc (Zn)-Dissolved (ug/L)	<5.0	<5.0	<5.0	23.3	
Speciated Metals	Methylmercury (as MeHg)-Dissolved (ug/L)	0.000062	0.000057	<0.000050	0.000164	

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

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Dissolved Organic Carbon	MS-B	L1931960-1, -2, -3, -4
Matrix Spike	Total Organic Carbon	MS-B	L1931960-1, -2, -3, -4
Matrix Spike	Barium (Ba)-Total	MS-B	L1931960-1, -2, -3, -4
Matrix Spike	Calcium (Ca)-Total	MS-B	L1931960-1, -2, -3, -4
Matrix Spike	Sodium (Na)-Total	MS-B	L1931960-1, -2, -3, -4
Matrix Spike	Strontium (Sr)-Total	MS-B	L1931960-1, -2, -3, -4
Matrix Spike	Sulfate (SO4)	MS-B	L1931960-1, -2, -3, -4

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.
RRR	Refer to Report Remarks for issues regarding this analysis

Test Method References:

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

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

ANIONS-N+N-CALC-VA	Water	Nitrite & Nitrate in Water (Calculation)	EPA 300.0

Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).

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

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

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

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

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

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

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

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

COLOUR-TRUE-VA	Water	Colour (True) by Spectrometer	BCMOE Colour Single Wavelength

This analysis is carried out using procedures adapted from British Columbia Environmental Manual "Colour- Single Wavelength." Colour (True Colour) is determined by filtering a sample through a 0.45 micron membrane filter followed by analysis of the filtrate using the platinum-cobalt colourimetric method.
Colour measurements can be highly pH dependent, and apply to the pH of the sample as received (at time of testing), without pH adjustment. Concurrent measurement of sample pH is recommended.

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

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

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

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

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

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

HARDNESS-CALC-VA	Water	Hardness	APHA 2340B

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

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

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

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

Reference Information

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

IONBALANCE-VA Water Ion Balance Calculation APHA 1030E

Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:

Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum]

MEHG-D-GCAF-VA Water Diss. Methylmercury in Water by GCAFS EPA 1630

This method follows Method 1630 of the US EPA. Samples are distilled under an inert gas flow to isolate methylmercury and minimize matrix interferences. The distillate is analyzed by aqueous phase ethylation, purge and trap, desorption and GC separation. The separated species are the pyrolized to elemental Hg and quantified by cold vapour atomic flourescence spectroscopy. Results are reported "as MeHg".

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

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

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

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

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

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

N-T-COL-VA Water Total Nitrogen in water by Colour APHA4500-P(J)/NEMI9171/USGS03-4174

This analysis is carried out using procedures adapted from APHA Method 4500-P (J) "Persulphate Method for Simultaneous Determination of Total Nitrogen and Total Phosphorus" and National Environmental Methods Index - Nemi method 5735.

NH3-F-VA Water Ammonia in Water by Fluorescence APHA 4500 NH3-NITROGEN (AMMONIA)

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Reference Information

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

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

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

SILICATE-COL-VA	Water	Silicate by Colourimetric analysis	APHA 4500-SiO2 E.

This analysis is carried out using procedures adapted from APHA Method 4500-SiO2 E. "Silica". Silicate (molybdate-reactive silica) is determined by the molybdosilicate-heteropoly blue colourimetric method.

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

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

TDS-CALC-VA	Water	TDS (Calculated)	APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".
The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

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

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

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

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

TURBIDITY-VA	Water	Turbidity by Meter	APHA 2130 Turbidity

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

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

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

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

Chain of Custody Numbers:

14-

GLOSSARY OF REPORT TERMS

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

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

Tetra Tech Canada Inc.
ATTN: Danielle MacDonald
14940-123 Ave., NW
Edmonton AB T5V 1B4

Date Received: 26-MAY-17
Report Date: 07-JUN-17 13:17 (MT)
Version: FINAL

Client Phone: 780-886-3055

Certificate of Analysis

Lab Work Order #: L1932382

Project P.O. #: NOT SUBMITTED
Job Reference: VENW03060
C of C Numbers: 14-473821
Legal Site Desc:

Brent Mack, B.Sc.
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L1932382-2	L1932382-3	L1932382-4	L1932382-6	L1932382-7
Description	Water	Water	Water	Water	Water
Sampled Date	26-MAY-17	26-MAY-17	26-MAY-17		26-MAY-17
Sampled Time	12:00	16:00	15:45		15:00
Client ID	W1-SHALLOW	D1-DEEP	D1-SHALLOW	DUP1	FIELD BLANK
Grouping **Analyte**					
FILTER					
Plant Pigments Chlorophyll a (ug/L)	0.495	0.676	0.481	0.597	<0.010

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L1932382-1	L1932382-2	L1932382-3	L1932382-4	L1932382-5
Description	Water	Water	Water	Water	Water
Sampled Date	26-MAY-17	26-MAY-17	26-MAY-17	26-MAY-17	
Sampled Time	11:45	12:00	16:00	15:45	
Client ID	W1-DEEP	W1-SHALLOW	D1-DEEP	D1-SHALLOW	TRIP BLANK
Grouping / **Analyte**					
WATER					
Physical Tests Colour, True (CU)	5.9	5.9 HTD	20.4 HTD	21.7 HTD	<5.0 HTD
Conductivity (uS/cm)	192	191	184	185	<2.0
Hardness (as CaCO3) (ug/L)	84100	90800	86900	86400	<500
pH (pH)	8.07	8.14	8.13	8.10	5.21
Total Suspended Solids (ug/L)	<3000	<3000	15800	16400	<3000
TDS (Calculated) (ug/L)	100000	101000	98800	101000	<1000
Turbidity (NTU)	1.48	1.26	33.7	38.6	<0.10
Anions and Nutrients Alkalinity, Bicarbonate (as CaCO3) (ug/L)	88000	85100	81900	84700	<1000
Alkalinity, Carbonate (as CaCO3) (ug/L)	<1000	<1000	<1000	<1000	<1000
Alkalinity, Hydroxide (as CaCO3) (ug/L)	<1000	<1000	<1000	<1000	<1000
Alkalinity, Phenolphthalein (as CaCO3) (ug/L)	<2000	<2000	<2000	<2000	<2000
Alkalinity, Total (as CaCO3) (ug/L)	88000	85100	81900	84700	<1000
Bromide (Br) (ug/L)	<50	<50	<50	<50	<50
Chloride (Cl) (ug/L)	<500	<500	<500	<500	<500
Fluoride (F) (ug/L)	38	37	43	44	<20
Nitrate and Nitrite (as N) (ug/L)	62.3	62.0	93.2	98.6	<5.1
Nitrate (as N) (ug/L)	62.3	62.0	93.2	98.6	<5.0
Nitrite (as N) (ug/L)	<1.0	<1.0	<1.0	<1.0	<1.0
Orthophosphate-Dissolved (as P) (ug/L)	<1.0	<1.0	1.2	1.3	<1.0
Silicate (as SiO2) (ug/L)	4440	4190	4320	4320	<500
Sulfate (SO4) (ug/L)	14200	14200	13100	13200	<300
Anion Sum (meq/L)	2.06	2.00	1.92	1.98	<0.10
Cation Sum (meq/L)	1.68	1.81	1.74	1.73	<0.10
Cation - Anion Balance (%)	-10.1	-4.9	-4.9	-6.7	0.0
Organic / Inorganic Carbon Dissolved Organic Carbon (ug/L)	3720 RRV	2560	4400	4560	<500
Total Organic Carbon (ug/L)	2570 RRV	2540	4930	5380	<500
Bacteriological Tests E. coli (MPN/100mL)					<1
HPC (CFU/1mL)					<1
Coliform Bacteria - Total (MPN/100mL)					<1
Total Metals Aluminum (Al)-Total (ug/L)	43.8	44.2	1000	1080	<5.0
Antimony (Sb)-Total (ug/L)	<0.50	<0.50	<0.50	<0.50	<0.50
Arsenic (As)-Total (ug/L)	<0.50	<0.50	0.58	0.64	<0.50
Barium (Ba)-Total (ug/L)	32	32	72	75	<20
Beryllium (Be)-Total (ug/L)	<1.0	<1.0	<1.0	<1.0	<1.0
Bismuth (Bi)-Total (ug/L)	<200	<200	<200	<200	<200

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1932382-6	L1932382-7			
	Description	Water	Water			
	Sampled Date		26-MAY-17			
	Sampled Time		15:00			
	Client ID	DUP1	FIELD BLANK			
Grouping	**Analyte**					
WATER						
Physical Tests	Colour, True (CU)	21.6 HTD	<5.0 HTD			
	Conductivity (uS/cm)	179	<2.0			
	Hardness (as CaCO3) (ug/L)	87100	<500			
	pH (pH)	8.08	5.25			
	Total Suspended Solids (ug/L)	18000	<3000			
	TDS (Calculated) (ug/L)	100000	<1000			
	Turbidity (NTU)	40.0	<0.10			
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (ug/L)	83400	<1000			
	Alkalinity, Carbonate (as CaCO3) (ug/L)	<1000	<1000			
	Alkalinity, Hydroxide (as CaCO3) (ug/L)	<1000	<1000			
	Alkalinity, Phenolphthalein (as CaCO3) (ug/L)	<2000	<2000			
	Alkalinity, Total (as CaCO3) (ug/L)	83400	<1000			
	Bromide (Br) (ug/L)	<50	<50			
	Chloride (Cl) (ug/L)	<500	<500			
	Fluoride (F) (ug/L)	44	<20			
	Nitrate and Nitrite (as N) (ug/L)	98.8	<5.1			
	Nitrate (as N) (ug/L)	98.8	<5.0			
	Nitrite (as N) (ug/L)	<1.0	<1.0			
	Orthophosphate-Dissolved (as P) (ug/L)	1.5	<1.0			
	Silicate (as SiO2) (ug/L)	4550	<500			
	Sulfate (SO4) (ug/L)	13300	<300			
	Anion Sum (meq/L)	1.95	<0.10			
	Cation Sum (meq/L)	1.74	<0.10			
	Cation - Anion Balance (%)	-5.7	0.0			
Organic / Inorganic Carbon	Dissolved Organic Carbon (ug/L)	4590	760 RRV			
	Total Organic Carbon (ug/L)	5250	<500			
Bacteriological Tests	E. coli (MPN/100mL)		<1			
	HPC (CFU/1mL)		<1			
	Coliform Bacteria - Total (MPN/100mL)		<1			
Total Metals	Aluminum (Al)-Total (ug/L)	1390	<5.0			
	Antimony (Sb)-Total (ug/L)	<0.50	<0.50			
	Arsenic (As)-Total (ug/L)	0.64	<0.50			
	Barium (Ba)-Total (ug/L)	79	<20			
	Beryllium (Be)-Total (ug/L)	<1.0	<1.0			
	Bismuth (Bi)-Total (ug/L)	<200	<200			

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1932382-1	L1932382-2	L1932382-3	L1932382-4	L1932382-5
	Description	Water	Water	Water	Water	Water
	Sampled Date	26-MAY-17	26-MAY-17	26-MAY-17	26-MAY-17	
	Sampled Time	11:45	12:00	16:00	15:45	
	Client ID	W1-DEEP	W1-SHALLOW	D1-DEEP	D1-SHALLOW	TRIP BLANK
Grouping	**Analyte**					
WATER						
Total Metals	Boron (B)-Total (ug/L)	<100	<100	<100	<100	<100
	Cadmium (Cd)-Total (ug/L)	0.0184	0.0176	0.0520	0.0561	<0.0050
	Calcium (Ca)-Total (ug/L)	27700	28000	26300	26500	<100
	Chromium (Cr)-Total (ug/L)	<1.0	<1.0	1.9	1.9	<1.0
	Cobalt (Co)-Total (ug/L)	<0.30	<0.30	0.39	0.47	<0.30
	Copper (Cu)-Total (ug/L)	<1.0	<1.0	1.9	2.0	<1.0
	Iron (Fe)-Total (ug/L)	65	59	1040	1210	<30
	Lead (Pb)-Total (ug/L)	<0.50	<0.50	0.51	0.61	<0.50
	Lithium (Li)-Total (ug/L)	1.3	1.3	2.3	2.5	<1.0
	Magnesium (Mg)-Total (ug/L)	6390	6420	6770	6780	<100
	Manganese (Mn)-Total (ug/L)	3.75	3.49	14.6	16.8	<0.10
	Mercury (Hg)-Total (ug/L)	<0.0050	<0.0050	<0.0050	0.0061	<0.0050
	Molybdenum (Mo)-Total (ug/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Nickel (Ni)-Total (ug/L)	<1.0	<1.0	2.2	2.6	<1.0
	Phosphorus (P)-Total (ug/L)	<300	<300	<300	<300	<300
	Potassium (K)-Total (ug/L)	<2000	<2000	<2000	<2000	<2000
	Selenium (Se)-Total (ug/L)	0.221	0.245	0.285	0.319	<0.050
	Silicon (Si)-Total (ug/L)	2360	2350	4640	4490	<100
	Silver (Ag)-Total (ug/L)	<0.020	<0.020	<0.020	<0.020	<0.020
	Sodium (Na)-Total (ug/L)	<2000	<2000	<2000	<2000	<2000
	Strontium (Sr)-Total (ug/L)	109	105	102	103	<5.0
	Thallium (Tl)-Total (ug/L)	<0.20	<0.20	<0.20	<0.20	<0.20
	Tin (Sn)-Total (ug/L)	<0.50	<0.50	<0.50	<0.50	<0.50
	Titanium (Ti)-Total (ug/L)	<10	<10	19	<24 DLM	<10
	Uranium (U)-Total (ug/L)	0.49	0.47	0.47	0.49	<0.20
	Vanadium (V)-Total (ug/L)	<0.50	<0.50	4.05	4.35	<0.50
	Zinc (Zn)-Total (ug/L)	<5.0	<5.0	5.5	6.8	<5.0
Dissolved Metals	Dissolved MeHg Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (ug/L)	<5.0	<5.0	8.8	10.5	<5.0
	Antimony (Sb)-Dissolved (ug/L)	<0.50	<0.50	<0.50	<0.50	<0.50
	Arsenic (As)-Dissolved (ug/L)	<0.50	<0.50	<0.50	<0.50	<0.50
	Barium (Ba)-Dissolved (ug/L)	32	58	49	47	<20
	Beryllium (Be)-Dissolved (ug/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Bismuth (Bi)-Dissolved (ug/L)	<200	<200	<200	<200	<200
	Boron (B)-Dissolved (ug/L)	<100	<100	<100	<100	<100

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1932382-6	L1932382-7			
	Description	Water	Water			
	Sampled Date		26-MAY-17			
	Sampled Time		15:00			
	Client ID	DUP1	FIELD BLANK			
Grouping	**Analyte**					
WATER						
Total Metals	Boron (B)-Total (ug/L)	<100	<100			
	Cadmium (Cd)-Total (ug/L)	0.0615	<0.0050			
	Calcium (Ca)-Total (ug/L)	27700	<100			
	Chromium (Cr)-Total (ug/L)	2.5	<1.0			
	Cobalt (Co)-Total (ug/L)	0.47	<0.30			
	Copper (Cu)-Total (ug/L)	2.0	<1.0			
	Iron (Fe)-Total (ug/L)	1270	<30			
	Lead (Pb)-Total (ug/L)	0.64	<0.50			
	Lithium (Li)-Total (ug/L)	2.7	<1.0			
	Magnesium (Mg)-Total (ug/L)	6970	<100			
	Manganese (Mn)-Total (ug/L)	16.7	<0.10			
	Mercury (Hg)-Total (ug/L)	0.0059	<0.0050			
	Molybdenum (Mo)-Total (ug/L)	<1.0	<1.0			
	Nickel (Ni)-Total (ug/L)	2.6	<1.0			
	Phosphorus (P)-Total (ug/L)	<300	<300			
	Potassium (K)-Total (ug/L)	<2000	<2000			
	Selenium (Se)-Total (ug/L)	0.319	<0.050			
	Silicon (Si)-Total (ug/L)	5140	<100			
	Silver (Ag)-Total (ug/L)	<0.020	<0.020			
	Sodium (Na)-Total (ug/L)	<2000	<2000			
	Strontium (Sr)-Total (ug/L)	100	<5.0			
	Thallium (Tl)-Total (ug/L)	<0.20	<0.20			
	Tin (Sn)-Total (ug/L)	<0.50	<0.50			
	Titanium (Ti)-Total (ug/L)	35	<10			
	Uranium (U)-Total (ug/L)	0.51	<0.20			
	Vanadium (V)-Total (ug/L)	5.30	<0.50			
	Zinc (Zn)-Total (ug/L)	7.1	<5.0			
Dissolved Metals	Dissolved MeHg Filtration Location	FIELD	FIELD			
	Dissolved Mercury Filtration Location	FIELD	FIELD			
	Dissolved Metals Filtration Location	FIELD	FIELD			
	Aluminum (Al)-Dissolved (ug/L)	10.2	<5.0			
	Antimony (Sb)-Dissolved (ug/L)	<0.50	<0.50			
	Arsenic (As)-Dissolved (ug/L)	<0.50	<0.50			
	Barium (Ba)-Dissolved (ug/L)	73	<20			
	Beryllium (Be)-Dissolved (ug/L)	<1.0	<1.0			
	Bismuth (Bi)-Dissolved (ug/L)	<200	<200			
	Boron (B)-Dissolved (ug/L)	<100	<100			

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1932382-1 Water 26-MAY-17 11:45 W1-DEEP	L1932382-2 Water 26-MAY-17 12:00 W1-SHALLOW	L1932382-3 Water 26-MAY-17 16:00 D1-DEEP	L1932382-4 Water 26-MAY-17 15:45 D1-SHALLOW	L1932382-5 Water TRIP BLANK
WATER						
Dissolved Metals	Cadmium (Cd)-Dissolved (ug/L)	0.0143	0.0125	0.0162	0.0184	<0.0050
	Calcium (Ca)-Dissolved (ug/L)	24900	27400	25700	25800	<100
	Chromium (Cr)-Dissolved (ug/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Cobalt (Co)-Dissolved (ug/L)	<0.30	<0.30	<0.30	<0.30	<0.30
	Copper (Cu)-Dissolved (ug/L)	<1.0	1.1	<1.0	<1.0	<1.0
	Iron (Fe)-Dissolved (ug/L)	<30	<30	<30	<30	<30
	Lead (Pb)-Dissolved (ug/L)	<0.50	<0.50	<0.50	<0.50	<0.50
	Lithium (Li)-Dissolved (ug/L)	<1.0	<1.0	1.1	1.2	<1.0
	Magnesium (Mg)-Dissolved (ug/L)	5350	5430	5530	5330	<100
	Manganese (Mn)-Dissolved (ug/L)	1.50	1.63	3.51	3.55	<0.10
	Mercury (Hg)-Dissolved (ug/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Molybdenum (Mo)-Dissolved (ug/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Nickel (Ni)-Dissolved (ug/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Phosphorus (P)-Dissolved (ug/L)	<300	<300	<300	<300	<300
	Potassium (K)-Dissolved (ug/L)	<2000	<2000	<2000	<2000	<2000
	Selenium (Se)-Dissolved (ug/L)	0.272	0.216	0.257	0.299	<0.050
	Silicon (Si)-Dissolved (ug/L)	2190	2200	2220	2130	<50
	Silver (Ag)-Dissolved (ug/L)	<0.020	<0.020	<0.020	<0.020	<0.020
	Sodium (Na)-Dissolved (ug/L)	<2000	<2000	<2000	<2000	<2000
	Strontium (Sr)-Dissolved (ug/L)	94.2	104	92.9	93.1	<5.0
	Thallium (Tl)-Dissolved (ug/L)	<0.20	<0.20	<0.20	<0.20	<0.20
	Tin (Sn)-Dissolved (ug/L)	<0.50	<0.50	<0.50	<0.50	<0.50
	Titanium (Ti)-Dissolved (ug/L)	<10	<10	<10	<10	<10
	Uranium (U)-Dissolved (ug/L)	0.41	0.45	0.39	0.40	<0.20
	Vanadium (V)-Dissolved (ug/L)	<0.50	<0.50	<0.50	<0.50	<0.50
	Zinc (Zn)-Dissolved (ug/L)	<5.0	<5.0	<5.0	<5.0	<5.0
Speciated Metals	Methylmercury (as MeHg)-Dissolved (ug/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1932382-6	L1932382-7			
	Description	Water	Water			
	Sampled Date		26-MAY-17			
	Sampled Time		15:00			
	Client ID	DUP1	FIELD BLANK			
Grouping	**Analyte**					
WATER						
Dissolved Metals	Cadmium (Cd)-Dissolved (ug/L)	0.0172	<0.0050			
	Calcium (Ca)-Dissolved (ug/L)	25900	<100			
	Chromium (Cr)-Dissolved (ug/L)	<1.0	<1.0			
	Cobalt (Co)-Dissolved (ug/L)	<0.30	<0.30			
	Copper (Cu)-Dissolved (ug/L)	1.1	<1.0			
	Iron (Fe)-Dissolved (ug/L)	<30	<30			
	Lead (Pb)-Dissolved (ug/L)	<0.50	<0.50			
	Lithium (Li)-Dissolved (ug/L)	1.2	<1.0			
	Magnesium (Mg)-Dissolved (ug/L)	5450	<100			
	Manganese (Mn)-Dissolved (ug/L)	3.45	<0.10			
	Mercury (Hg)-Dissolved (ug/L)	<0.0050	<0.0050			
	Molybdenum (Mo)-Dissolved (ug/L)	<1.0	<1.0			
	Nickel (Ni)-Dissolved (ug/L)	<1.0	<1.0			
	Phosphorus (P)-Dissolved (ug/L)	<300	<300			
	Potassium (K)-Dissolved (ug/L)	<2000	<2000			
	Selenium (Se)-Dissolved (ug/L)	0.269	<0.050			
	Silicon (Si)-Dissolved (ug/L)	2110	<50			
	Silver (Ag)-Dissolved (ug/L)	<0.020	<0.020			
	Sodium (Na)-Dissolved (ug/L)	<2000	<2000			
	Strontium (Sr)-Dissolved (ug/L)	93.7	<5.0			
	Thallium (Tl)-Dissolved (ug/L)	<0.20	<0.20			
	Tin (Sn)-Dissolved (ug/L)	<0.50	<0.50			
	Titanium (Ti)-Dissolved (ug/L)	<10	<10			
	Uranium (U)-Dissolved (ug/L)	0.39	<0.20			
	Vanadium (V)-Dissolved (ug/L)	<0.50	<0.50			
	Zinc (Zn)-Dissolved (ug/L)	<5.0	<5.0			
Speciated Metals	Methylmercury (as MeHg)-Dissolved (ug/L)	<0.000050	<0.000050			

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

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Total Organic Carbon	MS-B	L1932382-1
Matrix Spike	Barium (Ba)-Total	MS-B	L1932382-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Calcium (Ca)-Total	MS-B	L1932382-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Magnesium (Mg)-Total	MS-B	L1932382-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Strontium (Sr)-Total	MS-B	L1932382-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Sulfate (SO4)	MS-B	L1932382-1, -2, -3, -4, -5, -6, -7

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
HTD	Hold time exceeded for re-analysis or dilution, but initial testing was conducted within hold time.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.
RRV	Reported Result Verified By Repeat Analysis

Test Method References:

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

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

ANIONS-N+N-CALC-VA	Water	Nitrite & Nitrate in Water (Calculation)	EPA 300.0

Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).

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

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

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

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

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

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

CHLOROA-F-VA	Filter	Chlorophyll a by Fluorometer (Filter)	EPA 445.0

This analysis is done using procedures modified from EPA Method 445.0. Chlorophyll-a is determined by a routine acetone extraction followed with analysis by fluorometry using the non-acidification procedure. This method is not subject to interferences from chlorophyll b.

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

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

COLOUR-TRUE-VA	Water	Colour (True) by Spectrometer	BCMOE Colour Single Wavelength

This analysis is carried out using procedures adapted from British Columbia Environmental Manual "Colour- Single Wavelength." Colour (True Colour) is determined by filtering a sample through a 0.45 micron membrane filter followed by analysis of the filtrate using the platinum-cobalt colourimetric method.
Colour measurements can be highly pH dependent, and apply to the pH of the sample as received (at time of testing), without pH adjustment. Concurrent measurement of sample pH is recommended.

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

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

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

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

ECOLI-COLI-ENV-VA	Water	E.coli by Colilert	APHA METHOD 9223

This analysis is carried out using procedures adapted from APHA Method 9223 "Enzyme Substrate Coliform Test". E. coli and Total Coliform are determined simultaneously. The sample is mixed with a mixture hydrolyzable substrates and then sealed in a multi-well packet. The packet is incubated for 18 or 24 hours and then the number of wells exhibiting a positive response are counted. The final result is obtained by comparing the positive responses to a probability table.

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

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

Reference Information

HARDNESS-CALC-VA Water Hardness APHA 2340B

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

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

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

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

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

HPC-PP-ENV-VA Water HPC by pour plate APHA METHOD 9215

This analysis is carried out using procedures adapted from APHA Method 9215 "Heterotropic Plate Count". Heterotropic plate count (standard plate count or total plate count) is determined by culturing and colony counting using the pour plate method with a 48 hour incubation period. The test measures colonies formed by heterotropic bacteria.

IONBALANCE-VA Water Ion Balance Calculation APHA 1030E

Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:

Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum]

MEHG-D-GCAF-VA Water Diss. Methylmercury in Water by GCAFS EPA 1630

This method follows Method 1630 of the US EPA. Samples are distilled under an inert gas flow to isolate methylmercury and minimize matrix interferences. The distillate is analyzed by aqueous phase ethylation, purge and trap, desorption and GC separation. The separated species are the pyrolized to elemental Hg and quantified by cold vapour atomic flourescence spectroscopy. Results are reported "as MeHg".

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

SILICATE-COL-VA Water Silicate by Colourimetric analysis APHA 4500-SiO2 E.

This analysis is carried out using procedures adapted from APHA Method 4500-SiO2 E. "Silica". Silicate (molybdate-reactive silica) is determined by the molybdosilicate-heteropoly blue colourimetric method.

Reference Information

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

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

TCOLI-COLI-ENV-VA	Water	Total coliform by Colilert	APHA METHOD 9223

This analysis is carried out using procedures adapted from APHA Method 9223 "Enzyme Substrate Coliform Test". E. coli and Total Coliform are determined simultaneously. The sample is mixed with a mixture hydrolyzable substrates and then sealed in a multi-well packet. The packet is incubated for 18 or 24 hours and then the number of wells exhibiting a positive response are counted. The final result is quantified by a statistical estimation of bacteria density (most probable number).

TDS-CALC-VA	Water	TDS (Calculated)	APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".
The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

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

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

TURBIDITY-VA	Water	Turbidity by Meter	APHA 2130 Turbidity

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

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

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

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

Chain of Custody Numbers:

14-473821

GLOSSARY OF REPORT TERMS

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

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

Tetra Tech Canada Inc.
ATTN: Danielle MacDonald
14940-123 Ave., NW
Edmonton AB T5V 1B4

Date Received: 27-MAY-17
Report Date: 08-JUN-17 11:07 (MT)
Version: FINAL

Client Phone: 780-886-3055

Certificate of Analysis

Lab Work Order #: L1932532

Project P.O. #: NOT SUBMITTED
Job Reference: VENWO3060
C of C Numbers:
Legal Site Desc:

Comments: RRR = The observed discrepancy between Total Kjeldahl Nitrogen (TKN) and Total Nitrogen (TN) - TKN>TN in samples L1932532 (1 -7) has been confirmed through review of current analytical and/or historical data for the site. The two methods of analysis utilize different digestion and measurement techniques and, for select matrix types, will exhibit a bias in measured results. This is inherent to the combination of sample matrix and analytical techniques.

Brent Mack, B.Sc.
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1932532-1 Water 27-MAY-17 10:45 PEACE AT BEATTON (PD2)	L1932532-2 Water 27-MAY-17 11:15 BEATTON RIVER (BEATTON)	L1932532-3 Water 27-MAY-17 11:40 PEACE AT KISKATINAW (PD3)	L1932532-4 Water 27-MAY-17 12:00 KISKATINAW RIVER (KR)	L1932532-5 Water 27-MAY-17 12:30 PEACE AT POUCE COUPE (PD4)
WATER						
Physical Tests	Colour, True (CU)	32.0	198	33.1	71.9	39.9
	Conductivity (uS/cm)	235	136	220	244	218
	Hardness (as CaCO3) (ug/L)	116000	56800	108000	122000	107000
	pH (pH)	8.06	7.44	8.06	8.08	8.04
	Total Suspended Solids (ug/L)	757000	660000	754000	1950000	846000
	TDS (Calculated) (ug/L)	154000	116000	145000	215000	142000
	Turbidity (NTU)	507	505	460	2470	524
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (ug/L)	122000	36700	120000	192000	119000
	Alkalinity, Carbonate (as CaCO3) (ug/L)	<1000	<1000	<1000	<1000	<1000
	Alkalinity, Hydroxide (as CaCO3) (ug/L)	<1000	<1000	<1000	<1000	<1000
	Alkalinity, Phenolphthalein (as CaCO3) (ug/L)	<2000	<2000	<2000	<2000	<2000
	Alkalinity, Total (as CaCO3) (ug/L)	122000	36700	120000	192000	119000
	Ammonia, Total (as N) (ug/L)	18.6	36.3	17.8	57.5	18.3
	Bromide (Br) (ug/L)	<50	<50	<50	<50	<50
	Chloride (Cl) (ug/L)	<500	570	<500	<500	<500
	Fluoride (F) (ug/L)	71	72	66	81	67
	Nitrate and Nitrite (as N) (ug/L)	99.0	11.8	104	51.6	99.1
	Nitrate (as N) (ug/L)	99.0	11.8	104	49.9	99.1
	Nitrite (as N) (ug/L)	<1.0	<1.0	<1.0	1.7	<1.0
	Total Kjeldahl Nitrogen (ug/L)	1200 RRR	1590 RRR	1020 RRR	2590 RRR	1270 RRR
	Total Nitrogen (ug/L)	670	1020	560	1010	620
	Orthophosphate-Dissolved (as P) (ug/L)	6.4	7.4	5.7	7.4	5.5
	Phosphorus (P)-Total Dissolved (ug/L)	10.0	25.2	9.2	14.8	9.0
	Phosphorus (P)-Total (ug/L)	822	547	630	1570	780
	Silicate (as SiO2) (ug/L)	3720	4000	3500	4320	3550
	Sulfate (SO4) (ug/L)	18200	26100	15600	9160	15700
	Anion Sum (meq/L)	2.84	1.30	2.74	4.03	2.72
	Cation Sum (meq/L)	2.32	1.40	2.17	2.61	2.15
	Cation - Anion Balance (%)	-9.9	3.7	-11.6	-21.3	-11.7
Organic / Inorganic Carbon	Dissolved Organic Carbon (ug/L)	7770	30100	8660	18000	9390
	Total Organic Carbon (ug/L)	20500	41700	18100	43100	15900
Total Metals	Aluminum (Al)-Total (ug/L)	7250	7630	6940	21600	8100
	Antimony (Sb)-Total (ug/L)	0.53	<0.50	<0.50	0.61	<0.50
	Arsenic (As)-Total (ug/L)	6.72	8.08	6.24	15.3	7.31
	Barium (Ba)-Total (ug/L)	415	328	375	900	428
	Beryllium (Be)-Total (ug/L)	<1.0	<1.0	<1.0	1.5	<1.0

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1932532-6	L1932532-7			
	Description	Water	Water			
	Sampled Date	27-MAY-17	27-MAY-17			
	Sampled Time	12:50	15:00			
	Client ID	POUCE COUPE (POUCE)	PEACE AT MANY ISLANDS (PD5)			
Grouping	**Analyte**					
WATER						
Physical Tests	Colour, True (CU)	147	45.5			
	Conductivity (uS/cm)	259	218			
	Hardness (as CaCO3) (ug/L)	137000	105000			
	pH (pH)	7.90	8.17			
	Total Suspended Solids (ug/L)	1600000	817000			
	TDS (Calculated) (ug/L)	225000	153000			
	Turbidity (NTU)	1580	573			
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (ug/L)	94900	120000			
	Alkalinity, Carbonate (as CaCO3) (ug/L)	<1000	<1000			
	Alkalinity, Hydroxide (as CaCO3) (ug/L)	<1000	<1000			
	Alkalinity, Phenolphthalein (as CaCO3) (ug/L)	<2000	<2000			
	Alkalinity, Total (as CaCO3) (ug/L)	94900	120000			
	Ammonia, Total (as N) (ug/L)	94.5	19.9			
	Bromide (Br) (ug/L)	<50	<50			
	Chloride (Cl) (ug/L)	2670	<500			
	Fluoride (F) (ug/L)	113	69			
	Nitrate and Nitrite (as N) (ug/L)	87.2	95.1			
	Nitrate (as N) (ug/L)	79.3	95.1			
	Nitrite (as N) (ug/L)	7.9	<1.0			
	Total Kjeldahl Nitrogen (ug/L)	3340 RRR	1250 RRR			
	Total Nitrogen (ug/L)	1750 RRR	670 RRR			
	Orthophosphate-Dissolved (as P) (ug/L)	13.8	5.7			
	Phosphorus (P)-Total Dissolved (ug/L)	32.5	10.8			
	Phosphorus (P)-Total (ug/L)	1110	690			
	Silicate (as SiO2) (ug/L)	3420	3410			
	Sulfate (SO4) (ug/L)	39800	16600			
	Anion Sum (meq/L)	2.81	2.76			
	Cation Sum (meq/L)	3.90	2.19			
	Cation - Anion Balance (%)	16.3	-11.4			
Organic / Inorganic Carbon	Dissolved Organic Carbon (ug/L)	28600	11100			
	Total Organic Carbon (ug/L)	54800	24800			
Total Metals	Aluminum (Al)-Total (ug/L)	19600	8270			
	Antimony (Sb)-Total (ug/L)	<0.50	<0.50			
	Arsenic (As)-Total (ug/L)	20.4	7.44			
	Barium (Ba)-Total (ug/L)	636	402			
	Beryllium (Be)-Total (ug/L)	1.3	<1.0			

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1932532-1 Water 27-MAY-17 10:45 PEACE AT BEATTON (PD2)	L1932532-2 Water 27-MAY-17 11:15 BEATTON RIVER (BEATTON)	L1932532-3 Water 27-MAY-17 11:40 PEACE AT KISKATINAW (PD3)	L1932532-4 Water 27-MAY-17 12:00 KISKATINAW RIVER (KR)	L1932532-5 Water 27-MAY-17 12:30 PEACE AT POUCE COUPE (PD4)
WATER						
Total Metals	Bismuth (Bi)-Total (ug/L)	<200	<200	<200	<200	<200
	Boron (B)-Total (ug/L)	<100	<100	<100	<100	<100
	Cadmium (Cd)-Total (ug/L)	0.925	0.549	0.771	1.82	0.930
	Calcium (Ca)-Total (ug/L)	62100	20900	55000	116000	61000
	Chromium (Cr)-Total (ug/L)	14.1	14.1	12.9	36.8	15.1
	Cobalt (Co)-Total (ug/L)	6.70	8.50	6.29	21.7	8.00
	Copper (Cu)-Total (ug/L)	18.0	23.0	16.5	53.2	20.1
	Iron (Fe)-Total (ug/L)	16900	19600	16300	48300	19600
	Lead (Pb)-Total (ug/L)	8.86	10.1	8.30	25.9	10.1
	Lithium (Li)-Total (ug/L)	13.1	15.4	12.5	34.2	14.7
	Magnesium (Mg)-Total (ug/L)	15200	6880	13500	29700	14900
	Manganese (Mn)-Total (ug/L)	246	239	234	817	307
	Mercury (Hg)-Total (ug/L)	<0.050 DLM	0.059	<0.050 DLM	0.107	0.055
	Molybdenum (Mo)-Total (ug/L)	2.2	<1.0	1.8	1.3	1.6
	Nickel (Ni)-Total (ug/L)	25.4	30.0	23.2	72.0	28.1
	Phosphorus (P)-Total (ug/L)	780	550	660	1590	850
	Potassium (K)-Total (ug/L)	2700	3300	2600	5600	2900
	Selenium (Se)-Total (ug/L)	1.37	0.905	1.19	1.28	1.09
	Silicon (Si)-Total (ug/L)	12400	13300	11700	32900	13500
	Silver (Ag)-Total (ug/L)	0.182	0.202	0.178	0.480	0.197
	Sodium (Na)-Total (ug/L)	2000	5100	<2000	4500	2100
	Strontium (Sr)-Total (ug/L)	192	90.9	164	293	171
	Thallium (Tl)-Total (ug/L)	0.28	0.21	0.24	0.52	0.26
	Tin (Sn)-Total (ug/L)	<0.50	<0.50	<0.50	<0.50	<0.50
	Titanium (Ti)-Total (ug/L)	37	32	36	61	34
	Uranium (U)-Total (ug/L)	1.34	1.19	1.13	2.41	1.30
	Vanadium (V)-Total (ug/L)	33.9	27.9	30.6	69.9	33.5
	Zinc (Zn)-Total (ug/L)	86.6	86.8	78.0	220	90.9
Dissolved Metals	Dissolved MeHg Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (ug/L)	15.0	68.7	11.9	24.0	12.8
	Antimony (Sb)-Dissolved (ug/L)	<0.50	<0.50	<0.50	<0.50	<0.50
	Arsenic (As)-Dissolved (ug/L)	<0.50	0.71	<0.50	0.63	<0.50
	Barium (Ba)-Dissolved (ug/L)	62	41	62	72	62
	Beryllium (Be)-Dissolved (ug/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Bismuth (Bi)-Dissolved (ug/L)	<200	<200	<200	<200	<200

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1932532-6	L1932532-7			
	Description	Water	Water			
	Sampled Date	27-MAY-17	27-MAY-17			
	Sampled Time	12:50	15:00			
	Client ID	POUCE COUPE (POUCE)	PEACE AT MANY ISLANDS (PD5)			
Grouping	**Analyte**					
WATER						
Total Metals	Bismuth (Bi)-Total (ug/L)	<200	<200			
	Boron (B)-Total (ug/L)	<100	<100			
	Cadmium (Cd)-Total (ug/L)	0.712	0.846			
	Calcium (Ca)-Total (ug/L)	49500	55400			
	Chromium (Cr)-Total (ug/L)	32.8	15.1			
	Cobalt (Co)-Total (ug/L)	20.0	7.69			
	Copper (Cu)-Total (ug/L)	49.6	20.2			
	Iron (Fe)-Total (ug/L)	46000	19700			
	Lead (Pb)-Total (ug/L)	25.4	10.2			
	Lithium (Li)-Total (ug/L)	35.8	14.9			
	Magnesium (Mg)-Total (ug/L)	16900	13900			
	Manganese (Mn)-Total (ug/L)	492	279			
	Mercury (Hg)-Total (ug/L)	0.109	0.053			
	Molybdenum (Mo)-Total (ug/L)	1.2	1.7			
	Nickel (Ni)-Total (ug/L)	63.1	28.2			
	Phosphorus (P)-Total (ug/L)	1230	740			
	Potassium (K)-Total (ug/L)	7500	3000			
	Selenium (Se)-Total (ug/L)	1.31	1.18			
	Silicon (Si)-Total (ug/L)	31800	13500			
	Silver (Ag)-Total (ug/L)	0.360	0.198			
	Sodium (Na)-Total (ug/L)	7500	2400			
	Strontium (Sr)-Total (ug/L)	230	165			
	Thallium (Tl)-Total (ug/L)	0.38	0.26			
	Tin (Sn)-Total (ug/L)	<0.50	<0.50			
	Titanium (Ti)-Total (ug/L)	48	37			
	Uranium (U)-Total (ug/L)	2.67	1.26			
	Vanadium (V)-Total (ug/L)	60.2	33.9			
	Zinc (Zn)-Total (ug/L)	184	93.3			
Dissolved Metals	Dissolved MeHg Filtration Location	FIELD	FIELD			
	Dissolved Mercury Filtration Location	FIELD	FIELD			
	Dissolved Metals Filtration Location	FIELD	FIELD			
	Aluminum (Al)-Dissolved (ug/L)	2810	13.1			
	Antimony (Sb)-Dissolved (ug/L)	<0.50	<0.50			
	Arsenic (As)-Dissolved (ug/L)	3.43	<0.50			
	Barium (Ba)-Dissolved (ug/L)	231	60			
	Beryllium (Be)-Dissolved (ug/L)	<1.0	<1.0			
	Bismuth (Bi)-Dissolved (ug/L)	<200	<200			

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1932532-1 Water 27-MAY-17 10:45 PEACE AT BEATTON (PD2)	L1932532-2 Water 27-MAY-17 11:15 BEATTON RIVER (BEATTON)	L1932532-3 Water 27-MAY-17 11:40 PEACE AT KISKATINAW (PD3)	L1932532-4 Water 27-MAY-17 12:00 KISKATINAW RIVER (KR)	L1932532-5 Water 27-MAY-17 12:30 PEACE AT POUCE COUPE (PD4)
WATER						
Dissolved Metals	Boron (B)-Dissolved (ug/L)	<100	<100	<100	<100	<100
	Cadmium (Cd)-Dissolved (ug/L)	0.0536	0.0499	0.0390	0.0121	0.0323
	Calcium (Ca)-Dissolved (ug/L)	32500	15900	30700	33900	30100
	Chromium (Cr)-Dissolved (ug/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Cobalt (Co)-Dissolved (ug/L)	<0.30	0.46	<0.30	<0.30	<0.30
	Copper (Cu)-Dissolved (ug/L)	1.2	3.5	1.2	3.1	1.4
	Iron (Fe)-Dissolved (ug/L)	47	611	58	69	70
	Lead (Pb)-Dissolved (ug/L)	<0.50	<0.50	<0.50	<0.50	<0.50
	Lithium (Li)-Dissolved (ug/L)	3.0	4.2	3.0	2.1	3.0
	Magnesium (Mg)-Dissolved (ug/L)	8490	4160	7710	8970	7800
	Manganese (Mn)-Dissolved (ug/L)	4.62	30.9	4.73	5.01	5.37
	Mercury (Hg)-Dissolved (ug/L)	<0.0050	0.0078	<0.0050	<0.0050	<0.0050
	Molybdenum (Mo)-Dissolved (ug/L)	1.5	<1.0	1.2	<1.0	1.1
	Nickel (Ni)-Dissolved (ug/L)	1.9	5.6	1.8	2.7	2.0
	Phosphorus (P)-Dissolved (ug/L)	<300	<300	<300	<300	<300
	Potassium (K)-Dissolved (ug/L)	<2000	<2000	<2000	<2000	<2000
	Selenium (Se)-Dissolved (ug/L)	0.821	0.298	0.650	0.327	0.608
	Silicon (Si)-Dissolved (ug/L)	1820	2000	1690	2240	1660
	Silver (Ag)-Dissolved (ug/L)	<0.020	<0.020	<0.020	<0.020	<0.020
	Sodium (Na)-Dissolved (ug/L)	<2000	5000	<2000	4000	<2000
	Strontium (Sr)-Dissolved (ug/L)	119	57.8	106	135	102
	Thallium (Tl)-Dissolved (ug/L)	<0.20	<0.20	<0.20	<0.20	<0.20
	Tin (Sn)-Dissolved (ug/L)	<0.50	<0.50	<0.50	<0.50	<0.50
	Titanium (Ti)-Dissolved (ug/L)	<10	<10	<10	<10	<10
	Uranium (U)-Dissolved (ug/L)	0.45	0.27	0.38	0.50	0.38
	Vanadium (V)-Dissolved (ug/L)	<0.50	<0.50	<0.50	0.55	<0.50
	Zinc (Zn)-Dissolved (ug/L)	5.1	<5.0	<5.0	<5.0	<5.0
Speciated Metals	Methylmercury (as MeHg)-Dissolved (ug/L)	<0.000050	0.000297	<0.000050	0.000059	0.000112

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1932532-6	L1932532-7			
	Description	Water	Water			
	Sampled Date	27-MAY-17	27-MAY-17			
	Sampled Time	12:50	15:00			
	Client ID	POUCE COUPE (POUCE)	PEACE AT MANY ISLANDS (PD5)			
Grouping	**Analyte**					
WATER						
Dissolved Metals	Boron (B)-Dissolved (ug/L)	<100	<100			
	Cadmium (Cd)-Dissolved (ug/L)	0.262	0.0319			
	Calcium (Ca)-Dissolved (ug/L)	37200	29700			
	Chromium (Cr)-Dissolved (ug/L)	4.6	<1.0			
	Cobalt (Co)-Dissolved (ug/L)	5.17	<0.30			
	Copper (Cu)-Dissolved (ug/L)	15.4	1.6			
	Iron (Fe)-Dissolved (ug/L)	7430	78			
	Lead (Pb)-Dissolved (ug/L)	6.03	<0.50			
	Lithium (Li)-Dissolved (ug/L)	9.8	3.0			
	Magnesium (Mg)-Dissolved (ug/L)	10700	7420			
	Manganese (Mn)-Dissolved (ug/L)	157	4.22			
	Mercury (Hg)-Dissolved (ug/L)	<0.10 DLM	<0.0050			
	Molybdenum (Mo)-Dissolved (ug/L)	<1.0	1.1			
	Nickel (Ni)-Dissolved (ug/L)	18.7	2.1			
	Phosphorus (P)-Dissolved (ug/L)	380	<300			
	Potassium (K)-Dissolved (ug/L)	4900	<2000			
	Selenium (Se)-Dissolved (ug/L)	0.299	0.590			
	Silicon (Si)-Dissolved (ug/L)	6960	1640			
	Silver (Ag)-Dissolved (ug/L)	<0.020	<0.020			
	Sodium (Na)-Dissolved (ug/L)	7400	2100			
	Strontium (Sr)-Dissolved (ug/L)	155	101			
	Thallium (Tl)-Dissolved (ug/L)	<0.20	<0.20			
	Tin (Sn)-Dissolved (ug/L)	<0.50	<0.50			
	Titanium (Ti)-Dissolved (ug/L)	35	<10			
	Uranium (U)-Dissolved (ug/L)	1.25	0.40			
	Vanadium (V)-Dissolved (ug/L)	11.8	<0.50			
	Zinc (Zn)-Dissolved (ug/L)	41.3	<5.0			
Speciated Metals	Methylmercury (as MeHg)-Dissolved (ug/L)	<0.000050	0.000073			

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

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Total Organic Carbon	MS-B	L1932532-2, -4, -6
Matrix Spike	Calcium (Ca)-Total	MS-B	L1932532-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Magnesium (Mg)-Total	MS-B	L1932532-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Sodium (Na)-Total	MS-B	L1932532-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Strontium (Sr)-Total	MS-B	L1932532-1, -2, -3, -4, -5, -6, -7

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.
RRR	Refer to Report Remarks for issues regarding this analysis

Test Method References:

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

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

ANIONS-N+N-CALC-VA	Water	Nitrite & Nitrate in Water (Calculation)	EPA 300.0

Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).

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

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

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

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

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

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

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

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

COLOUR-TRUE-VA	Water	Colour (True) by Spectrometer	BCMOE Colour Single Wavelength

This analysis is carried out using procedures adapted from British Columbia Environmental Manual "Colour- Single Wavelength." Colour (True Colour) is determined by filtering a sample through a 0.45 micron membrane filter followed by analysis of the filtrate using the platinum-cobalt colourimetric method.
Colour measurements can be highly pH dependent, and apply to the pH of the sample as received (at time of testing), without pH adjustment. Concurrent measurement of sample pH is recommended.

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

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

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

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

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

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

HARDNESS-CALC-VA	Water	Hardness	APHA 2340B

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

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

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

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

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

IONBALANCE-VA	Water	Ion Balance Calculation	APHA 1030E

Reference Information

Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:

Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum]

MEHG-D-GCAF-VA Water Diss. Methylmercury in Water by GCAFS EPA 1630

This method follows Method 1630 of the US EPA. Samples are distilled under an inert gas flow to isolate methylmercury and minimize matrix interferences. The distillate is analyzed by aqueous phase ethylation, purge and trap, desorption and GC separation. The separated species are the pyrolized to elemental Hg and quantified by cold vapour atomic flourescence spectroscopy. Results are reported "as MeHg".

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

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

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

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

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

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

N-T-COL-VA Water Total Nitrogen in water by Colour APHA4500-P(J)/NEMI9171/USGS03-4174

This analysis is carried out using procedures adapted from APHA Method 4500-P (J) "Persulphate Method for Simultaneous Determination of Total Nitrogen and Total Phosphorus" and National Environmental Methods Index - Nemi method 5735.

NH3-F-VA Water Ammonia in Water by Fluorescence APHA 4500 NH3-NITROGEN (AMMONIA)

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Reference Information

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

SILICATE-COL-VA	Water	Silicate by Colourimetric analysis	APHA 4500-SiO2 E.

This analysis is carried out using procedures adapted from APHA Method 4500-SiO2 E. "Silica". Silicate (molybdate-reactive silica) is determined by the molybdosilicate-heteropoly blue colourimetric method.

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

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

TDS-CALC-VA	Water	TDS (Calculated)	APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".
The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

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

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

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

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

TURBIDITY-VA	Water	Turbidity by Meter	APHA 2130 Turbidity

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

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

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

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

Chain of Custody Numbers:

GLOSSARY OF REPORT TERMS

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

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

Tetra Tech Canada Inc.
ATTN: Danielle MacDonald
14940-123 Ave., NW
Edmonton AB T5V 1B4

Date Received: 08-JUN-17
Report Date: 15-JUN-17 11:57 (MT)
Version: FINAL

Client Phone: 780-886-3055

Certificate of Analysis

Lab Work Order #: L1938976

Project P.O. #: NOT SUBMITTED
Job Reference: VENW03060-002
C of C Numbers:
Legal Site Desc:

Brent Mack, B.Sc.
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1938976-1				
	Description	filter				
	Sampled Date	26-MAY-17				
	Sampled Time	11:45				
	Client ID	WILLISTON DEEP (W1-DEEP)				
Grouping	**Analyte**					
FILTER						
Plant Pigments	Chlorophyll a (ug/L)	0.256				

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
CHLOROA-F-VA	Filter	Chlorophyll a by Fluorometer (Filter)	EPA 445.0

This analysis is done using procedures modified from EPA Method 445.0. Chlorophyll-a is determined by a routine acetone extraction followed with analysis by fluorometry using the non-acidification procedure. This method is not subject to interferences from chlorophyll b.

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

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

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

Chain of Custody Numbers:

GLOSSARY OF REPORT TERMS

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

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

Tetra Tech Canada Inc.
ATTN: Danielle MacDonald
14940 - 123 Avenue, NW
Edmonton AB T5V 1B4

Date Received: 27-JUN-17
Report Date: 17-JUL-17 18:24 (MT)
Version: FINAL

Client Phone: 780-886-3055

Certificate of Analysis

Lab Work Order #: L1949651

Project P.O. #: NOT SUBMITTED
Job Reference: VENW03060
C of C Numbers:
Legal Site Desc:

Brent Mack, B.Sc.
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1949651-1	L1949651-2	L1949651-3	L1949651-4	
	Description	WATER	WATER	WATER	WATER	
	Sampled Date	27-JUN-17	27-JUN-17	27-JUN-17	27-JUN-17	
	Sampled Time	12:53	11:45	14:59	14:02	
	Client ID	MOBERLY RIVER-DOWNSTREAM (MD)	LOWER SITE C RESERVOIR (PR3)	PEACE AT PINE (PD1)	PINE RIVER (PINE)	
Grouping	**Analyte**					
WATER						
Physical Tests	Colour, True (CU)	32.6	7.9	9.8	9.4	
	Conductivity (uS/cm)	202	244	238	252	
	Hardness (as CaCO3) (mg/L)	106	131	136	136	
	pH (pH)	8.22	8.22	8.23	8.24	
	Total Suspended Solids (mg/L)	74.6	28.6	32.4	42.6	
	TDS (Calculated) (mg/L)	119	141	143	146	
	Turbidity (NTU)	73.7	22.1	24.7	34.6	
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	104	111	110	123	
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	
	Alkalinity, Phenolphthalein (as CaCO3) (mg/L)	<2.0	<2.0	<2.0	<2.0	
	Alkalinity, Total (as CaCO3) (mg/L)	104	111	110	123	
	Ammonia, Total (as N) (mg/L)	0.0067	<0.0050	0.0244	<0.0050	
	Bromide (Br) (mg/L)	<0.050	<0.050	<0.050	<0.050	
	Chloride (Cl) (mg/L)	<0.50	<0.50	<0.50	0.62	
	Fluoride (F) (mg/L)	0.070	0.056	0.057	0.061	
	Nitrate and Nitrite (as N) (mg/L)	0.0545	0.0300	0.0308	0.0642	
	Nitrate (as N) (mg/L)	0.0545	0.0300	0.0308	0.0642	
	Nitrite (as N) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	
	Total Kjeldahl Nitrogen (mg/L)	0.389	0.234	0.77	0.228	
	Total Nitrogen (mg/L)	0.321	0.173	0.209	0.157	
	Orthophosphate-Dissolved (as P) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	
	Phosphorus (P)-Total Dissolved (mg/L)	0.0042	<0.0020	0.0025	0.0028	
	Phosphorus (P)-Total (mg/L)	0.0634	0.0203	0.220	0.0393	
	Silicate (as SiO2) (mg/L)	3.83	4.02	4.06	3.16	
	Sulfate (SO4) (mg/L)	9.00	24.1	22.8	16.3	
	Anion Sum (meq/L)	2.27	2.73	2.67	2.82	
	Cation Sum (meq/L)	2.12	2.62	2.72	2.83	
	Cation - Anion Balance (%)	-3.5	-2.1	0.8	0.1	
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	10.6	3.86	3.83	3.93	
	Total Organic Carbon (mg/L)	10.4	4.16	6.66	4.42	
Bacteriological Tests	E. coli (MPN/100mL)	29	27	48	11	
	HPC (CFU/1mL)	474 PEHR	164 PEHR	394	37	
	Coliform Bacteria - Total (MPN/100mL)	>200.5	74	>200.5	101	
Total Metals	Aluminum (Al)-Total (mg/L)	1.89	0.615	3.26	0.957	

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1949651-1 WATER 27-JUN-17 12:53 MOBERLY RIVER-DOWNSTREAM (MD)	L1949651-2 WATER 27-JUN-17 11:45 LOWER SITE C RESERVOIR (PR3)	L1949651-3 WATER 27-JUN-17 14:59 PEACE AT PINE (PD1)	L1949651-4 WATER 27-JUN-17 14:02 PINE RIVER (PINE)	
WATER						
Total Metals	Antimony (Sb)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Arsenic (As)-Total (mg/L)	0.00140	0.00052	0.00197	0.00065	
	Barium (Ba)-Total (mg/L)	0.196	0.068	0.143	0.109	
	Beryllium (Be)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	
	Bismuth (Bi)-Total (mg/L)	<0.20	<0.20	<0.20	<0.20	
	Boron (B)-Total (mg/L)	<0.10	<0.10	<0.10	<0.10	
	Cadmium (Cd)-Total (mg/L)	0.000119	0.0000614	0.000152	0.0000533	
	Calcium (Ca)-Total (mg/L)	31.9	38.6	39.5	40.5	
	Chromium (Cr)-Total (mg/L)	0.0035	0.0012	0.0058	0.0016	
	Cobalt (Co)-Total (mg/L)	0.00126	0.00035	0.00209	0.00061	
	Copper (Cu)-Total (mg/L)	0.0048	0.0015	0.0068	0.0019	
	Iron (Fe)-Total (mg/L)	3.22	0.822	4.86	1.51	
	Lead (Pb)-Total (mg/L)	0.00151	<0.00050	0.00266	0.00073	
	Lithium (Li)-Total (mg/L)	0.0056	0.0036	0.0076	0.0062	
	Magnesium (Mg)-Total (mg/L)	9.40	9.97	10.7	10.3	
	Manganese (Mn)-Total (mg/L)	0.0546	0.0145	0.0572	0.0252	
	Mercury (Hg)-Total (mg/L)	<0.000025 DLM	<0.000025 DLM	0.000029	0.0000060	
	Molybdenum (Mo)-Total (mg/L)	<0.0010	0.0018	0.0018	<0.0010	
	Nickel (Ni)-Total (mg/L)	0.0061	0.0020	0.0077	0.0026	
	Phosphorus (P)-Total (mg/L)	<0.30	<0.30	<0.30	<0.30	
	Potassium (K)-Total (mg/L)	<2.0	<2.0	<2.0	<2.0	
	Selenium (Se)-Total (mg/L)	0.000326	0.000794	0.000893	0.000514	
	Silicon (Si)-Total (mg/L)	4.59	2.91	7.00	2.73	
	Silver (Ag)-Total (mg/L)	0.000027	<0.000020	0.000042	<0.000020	
	Sodium (Na)-Total (mg/L)	2.0	<2.0	2.0	2.3	
	Strontium (Sr)-Total (mg/L)	0.0806	0.164	0.171	0.128	
	Thallium (Tl)-Total (mg/L)	<0.00020	<0.00020	<0.00020	<0.00020	
	Tin (Sn)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Titanium (Ti)-Total (mg/L)	0.023	<0.010	0.024	<0.010	
	Uranium (U)-Total (mg/L)	0.00034	0.00060	0.00081	0.00036	
	Vanadium (V)-Total (mg/L)	0.00756	0.00305	0.0128	0.00361	
	Zinc (Zn)-Total (mg/L)	0.0167	0.0051	0.0257	0.0156	
Dissolved Metals	Dissolved Fe2 Filtration Location	FIELD	FIELD	FIELD	FIELD	
	Dissolved MeHg Filtration Location	FIELD	FIELD	FIELD	FIELD	
	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	
	Aluminum (Al)-Dissolved (mg/L)	0.0209	0.0052	0.0100	0.0131	

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1949651-1 WATER 27-JUN-17 12:53 MOBERLY RIVER-DOWNSTREAM (MD)	L1949651-2 WATER 27-JUN-17 11:45 LOWER SITE C RESERVOIR (PR3)	L1949651-3 WATER 27-JUN-17 14:59 PEACE AT PINE (PD1)	L1949651-4 WATER 27-JUN-17 14:02 PINE RIVER (PINE)	
WATER						
Dissolved Metals	Antimony (Sb)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Arsenic (As)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Barium (Ba)-Dissolved (mg/L)	0.136	0.075	0.083	0.086	
	Beryllium (Be)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	
	Bismuth (Bi)-Dissolved (mg/L)	<0.20	<0.20	<0.20	<0.20	
	Boron (B)-Dissolved (mg/L)	<0.10	<0.10	<0.10	<0.10	
	Cadmium (Cd)-Dissolved (mg/L)	0.0000110	0.0000124	0.0000099	0.0000105	
	Calcium (Ca)-Dissolved (mg/L)	28.9	36.6	37.3	38.9	
	Chromium (Cr)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	
	Cobalt (Co)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	
	Copper (Cu)-Dissolved (mg/L)	0.0014	0.0010	0.0011	<0.0010	
	Iron (Fe)-Dissolved (mg/L)	0.077	<0.030	<0.030	<0.030	
	Ferrous Iron, Dissolved (mg/L)	0.032	<0.020	<0.020	<0.020	
	Lead (Pb)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Lithium (Li)-Dissolved (mg/L)	0.0033	0.0028	0.0029	0.0049	
	Magnesium (Mg)-Dissolved (mg/L)	8.10	9.64	10.3	9.56	
	Manganese (Mn)-Dissolved (mg/L)	0.00828	0.00224	0.00469	0.00545	
	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	
	Molybdenum (Mo)-Dissolved (mg/L)	<0.0010	0.0016	0.0015	<0.0010	
	Nickel (Ni)-Dissolved (mg/L)	0.0018	<0.0010	0.0011	<0.0010	
	Phosphorus (P)-Dissolved (mg/L)	<0.30	<0.30	<0.30	<0.30	
	Potassium (K)-Dissolved (mg/L)	<2.0	<2.0	<2.0	<2.0	
	Selenium (Se)-Dissolved (mg/L)	0.000261	0.000666	0.000662	0.000483	
	Silicon (Si)-Dissolved (mg/L)	1.68	1.86	1.88	1.31	
	Silver (Ag)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	
	Sodium (Na)-Dissolved (mg/L)	<2.0	<2.0	<2.0	2.3	
	Strontium (Sr)-Dissolved (mg/L)	0.0716	0.157	0.156	0.124	
	Thallium (Tl)-Dissolved (mg/L)	<0.00020	<0.00020	<0.00020	<0.00020	
	Tin (Sn)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Titanium (Ti)-Dissolved (mg/L)	<0.010	<0.010	<0.010	<0.010	
	Uranium (U)-Dissolved (mg/L)	0.00023	0.00054	0.00040	0.00030	
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Zinc (Zn)-Dissolved (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	
Speciated Metals	Methylmercury (as MeHg)-Dissolved (ug/L)	<0.000050	<0.000050	<0.000050	<0.000050	

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

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L1949651-1, -2, -3, -4
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L1949651-1, -2, -3, -4
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L1949651-1, -2, -3, -4
Matrix Spike	Silicon (Si)-Dissolved	MS-B	L1949651-1, -2, -3, -4
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L1949651-1, -2, -3, -4
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1949651-1, -2, -3, -4
Matrix Spike	Aluminum (Al)-Total	MS-B	L1949651-1, -2, -3, -4
Matrix Spike	Barium (Ba)-Total	MS-B	L1949651-1, -2, -3, -4
Matrix Spike	Calcium (Ca)-Total	MS-B	L1949651-1, -2, -3, -4
Matrix Spike	Magnesium (Mg)-Total	MS-B	L1949651-1, -2, -3, -4
Matrix Spike	Manganese (Mn)-Total	MS-B	L1949651-1, -2, -3, -4
Matrix Spike	Strontium (Sr)-Total	MS-B	L1949651-1, -2, -3, -4
Matrix Spike	Total Nitrogen	MS-B	L1949651-1, -2, -3, -4

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.
PEHR	Parameter Exceeded Recommended Holding Time On Receipt: Proceed With Analysis As Requested.

Test Method References:

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

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

ANIONS-N+N-CALC-VA	Water	Nitrite & Nitrate in Water (Calculation)	EPA 300.0

Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).

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

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

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

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

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

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

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

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

COLOUR-TRUE-VA	Water	Colour (True) by Spectrometer	BCMOE Colour Single Wavelength

This analysis is carried out using procedures adapted from British Columbia Environmental Manual "Colour- Single Wavelength." Colour (True Colour) is determined by filtering a sample through a 0.45 micron membrane filter followed by analysis of the filtrate using the platinum-cobalt colourimetric method.
Colour measurements can be highly pH dependent, and apply to the pH of the sample as received (at time of testing), without pH adjustment. Concurrent measurement of sample pH is recommended.

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

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

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

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

ECOLI-COLI-ENV-VA	Water	E.coli by Colilert	APHA METHOD 9223

This analysis is carried out using procedures adapted from APHA Method 9223 "Enzyme Substrate Coliform Test". E. coli and Total Coliform are determined simultaneously. The sample is mixed with a mixture hydrolyzable substrates and then sealed in a multi-well packet. The packet is incubated for 18 or 24 hours and then the number of wells exhibiting a positive response are counted. The final result is obtained by comparing the positive responses to a probability table.

Reference Information

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

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

FE2-D-COL-VA	Water	Diss. Ferrous Iron in Water by Colour	APHA 3500-Fe B/James Ball et al (1999)

This analysis is carried out using procedures adapted from APHA 3500-Fe B and "A New Method for the Direct Determination of Dissolved Iron Concentration in Acid Mine Waters" published by James W. Ball et al (1999). The procedure involves preliminary sample filtration, and ferrous iron is determined using the "FerroZine" colourimetric method.

HARDNESS-CALC-VA	Water	Hardness	APHA 2340B

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

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

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

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

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

HPC-PP-ENV-VA	Water	HPC by pour plate	APHA METHOD 9215

This analysis is carried out using procedures adapted from APHA Method 9215 "Heterotropic Plate Count". Heterotropic plate count (standard plate count or total plate count) is determined by culturing and colony counting using the pour plate method with a 48 hour incubation period. The test measures colonies formed by heterotropic bacteria.

IONBALANCE-VA	Water	Ion Balance Calculation	APHA 1030E

Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:

Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum]

MEHG-D-GCAF-VA	Water	Diss. Methylmercury in Water by GCAFS	EPA 1630

This method follows Method 1630 of the US EPA. Samples are distilled under an inert gas flow to isolate methylmercury and minimize matrix interferences. The distillate is analyzed by aqueous phase ethylation, purge and trap, desorption and GC separation. The separated species are the pyrolized to elemental Hg and quantified by cold vapour atomic flourescence spectroscopy. Results are reported "as MeHg".

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

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

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

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

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

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

N-T-COL-VA	Water	Total Nitrogen in water by Colour	APHA4500-P(J)/NEMI9171/USGS03-4174

This analysis is carried out using procedures adapted from APHA Method 4500-P (J) "Persulphate Method for Simultaneous Determination of Total Nitrogen and Total Phosphorus" and National Environmental Methods Index - Nemi method 5735.

NH3-F-VA	Water	Ammonia in Water by Fluorescence	APHA 4500 NH3-NITROGEN (AMMONIA)

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

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

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

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

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

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

Reference Information

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

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

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

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

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

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

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

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

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

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

SILICATE-COL-VA Water Silicate by Colourimetric analysis APHA 4500-SiO2 E.

This analysis is carried out using procedures adapted from APHA Method 4500-SiO2 E. "Silica". Silicate (molybdate-reactive silica) is determined by the molybdosilicate-heteropoly blue colourimetric method.

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

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

TCOLI-COLI-ENV-VA Water Total coliform by Colilert APHA METHOD 9223

This analysis is carried out using procedures adapted from APHA Method 9223 "Enzyme Substrate Coliform Test". E. coli and Total Coliform are determined simultaneously. The sample is mixed with a mixture hydrolyzable substrates and then sealed in a multi-well packet. The packet is incubated for 18 or 24 hours and then the number of wells exhibiting a positive response are counted. The final result is quantified by a statistical estimation of bacteria density (most probable number).

TDS-CALC-VA Water TDS (Calculated) APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".
The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

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

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

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

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

TURBIDITY-VA Water Turbidity by Meter APHA 2130 Turbidity

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

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

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

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

Chain of Custody Numbers:

Reference Information

GLOSSARY OF REPORT TERMS

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

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

Tetra Tech Canada Inc.
ATTN: Danielle MacDonald
14940 - 123 Avenue, NW
Edmonton AB T5V 1B4

Date Received: 28-JUN-17
Report Date: 19-JUL-17 12:13 (MT)
Version: FINAL

Client Phone: 780-886-3055

Certificate of Analysis

Lab Work Order #: L1950526

Project P.O. #: NOT SUBMITTED
Job Reference: VENW003060
C of C Numbers: 14-
Legal Site Desc:

Brent Mack, B.Sc.
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1950526-1 Water 28-JUN-17 09:10 PEACE AT BEATTON (PD2)	L1950526-2 Water 28-JUN-17 09:28 BEATTON RIVER (BEATTON)	L1950526-3 Water 28-JUN-17 09:48 PEACE AT KISKATINAW (PD3)	L1950526-4 Water 28-JUN-17 10:08 KISKATINAW RIVER (KR)	L1950526-5 Water 28-JUN-17 10:32 PEACE AT POUCE COUPE (PD4)
WATER						
Physical Tests	Colour, True (CU)	9.4	213	45.0	38.8	28.6
	Conductivity (uS/cm)	248	147	229	345	238
	pH (pH)	8.22	7.66	8.17	8.43	8.20
	Total Suspended Solids (mg/L)	63.3	111	67.1	801	53.9
	Total Dissolved Solids (mg/L)	151	175	164	460	159
	Turbidity (NTU)	47.3	103	50.5	875	45.8
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	111	41.6	100	169	110
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	8.2	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Phenolphthalein (as CaCO3) (mg/L)	<2.0	<2.0	<2.0	4.1	<2.0
	Alkalinity, Total (as CaCO3) (mg/L)	111	41.6	100	177	110
	Ammonia, Total (as N) (mg/L)	0.0089	0.0141	0.0069	0.0501	0.0066
	Bromide (Br) (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Chloride (Cl) (mg/L)	0.53	0.64	<0.50	0.64	<0.50
	Fluoride (F) (mg/L)	0.059	0.077	0.063	0.090	0.063
	Nitrate and Nitrite (as N) (mg/L)	0.0456	<0.0051	0.0356	0.0505	0.0396
	Nitrate (as N) (mg/L)	0.0456	<0.0050	0.0356	0.0432	0.0396
	Nitrite (as N) (mg/L)	<0.0010	<0.0010	<0.0010	0.0073	<0.0010
	Total Kjeldahl Nitrogen (mg/L)	0.248	0.94 DLM	0.314	2.03 DLM	0.253
	Total Nitrogen (mg/L)	0.166	0.720	0.247	0.62	0.206
	Orthophosphate-Dissolved (as P) (mg/L)	0.0011	0.0052	0.0018	0.0023	0.0016
	Phosphorus (P)-Total Dissolved (mg/L)	<0.0020	0.0148	0.0045	0.0075	0.0035
	Phosphorus (P)-Total (mg/L)	0.0372	0.184	0.074	0.512	0.0414
	Silicate (as SiO2) (mg/L)	3.88	5.8	4.07	4.75	3.80
	Sulfate (SO4) (mg/L)	22.6	28.4	23.0	20.8	22.1
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	3.51	32.1	8.94	14.1	6.87
	Total Organic Carbon (mg/L)	3.89	36.4	8.96	13.2	8.14

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1950526-6	L1950526-7			
	Description	Water	Water			
	Sampled Date	28-JUN-17	28-JUN-17			
	Sampled Time	11:13	12:30			
	Client ID	POUCE COUPE (POUCE)	PEACE AT MANY ISLANDS (PD5)			
Grouping	**Analyte**					
WATER						
Physical Tests	Colour, True (CU)	77.3	24.9			
	Conductivity (uS/cm)	541	238			
	pH (pH)	8.31	8.16			
	Total Suspended Solids (mg/L)	121	65.5			
	Total Dissolved Solids (mg/L)	436	164			
	Turbidity (NTU)	204	46.6			
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	155	116			
	Alkalinity, Carbonate (as CaCO3) (mg/L)	2.8	<1.0			
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0			
	Alkalinity, Phenolphthalein (as CaCO3) (mg/L)	<2.0	<2.0			
	Alkalinity, Total (as CaCO3) (mg/L)	158	116			
	Ammonia, Total (as N) (mg/L)	0.0207	<0.0050			
	Bromide (Br) (mg/L)	<0.050	<0.050			
	Chloride (Cl) (mg/L)	9.46	<0.50			
	Fluoride (F) (mg/L)	0.172	0.063			
	Nitrate and Nitrite (as N) (mg/L)	1.57	0.0425			
	Nitrate (as N) (mg/L)	1.56	0.0425			
	Nitrite (as N) (mg/L)	0.0095	<0.0010			
	Total Kjeldahl Nitrogen (mg/L)	1.75	0.209			
	Total Nitrogen (mg/L)	2.89	0.203			
	Orthophosphate-Dissolved (as P) (mg/L)	0.0012	0.0015			
	Phosphorus (P)-Total Dissolved (mg/L)	0.0126	0.0027			
	Phosphorus (P)-Total (mg/L)	0.22	0.069			
	Silicate (as SiO2) (mg/L)	3.09	4.07			
	Sulfate (SO4) (mg/L)	125	22.2			
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	25.0	6.96			
	Total Organic Carbon (mg/L)	29.9	7.85			

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

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Dissolved Organic Carbon	MS-B	L1950526-2, -6
Matrix Spike	Total Organic Carbon	MS-B	L1950526-2, -6
Matrix Spike	Total Nitrogen	MS-B	L1950526-1, -2, -3, -4, -5, -6, -7

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

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

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

ANIONS-N+N-CALC-VA	Water	Nitrite & Nitrate in Water (Calculation)	EPA 300.0

Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).

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

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

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

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

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

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

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

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

COLOUR-TRUE-VA	Water	Colour (True) by Spectrometer	BCMOE Colour Single Wavelength

This analysis is carried out using procedures adapted from British Columbia Environmental Manual "Colour- Single Wavelength." Colour (True Colour) is determined by filtering a sample through a 0.45 micron membrane filter followed by analysis of the filtrate using the platinum-cobalt colourimetric method.
Colour measurements can be highly pH dependent, and apply to the pH of the sample as received (at time of testing), without pH adjustment. Concurrent measurement of sample pH is recommended.

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

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

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

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

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

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

N-T-COL-VA	Water	Total Nitrogen in water by Colour	APHA4500-P(J)/NEMI9171/USGS03-4174

This analysis is carried out using procedures adapted from APHA Method 4500-P (J) "Persulphate Method for Simultaneous Determination of Total Nitrogen and Total Phosphorus" and National Environmental Methods Index - Nemi method 5735.

NH3-F-VA	Water	Ammonia in Water by Fluorescence	APHA 4500 NH3-NITROGEN (AMMONIA)

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

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

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

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

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

Reference Information

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

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

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

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

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

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

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

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

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

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

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

SILICATE-COL-VA	Water	Silicate by Colourimetric analysis	APHA 4500-SiO2 E.

This analysis is carried out using procedures adapted from APHA Method 4500-SiO2 E. "Silica". Silicate (molybdate-reactive silica) is determined by the molybdosilicate-heteropoly blue colourimetric method.

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

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

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

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

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

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

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

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

TURBIDITY-VA	Water	Turbidity by Meter	APHA 2130 Turbidity

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

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

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

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

Chain of Custody Numbers:

Reference Information

GLOSSARY OF REPORT TERMS

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

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

Tetra Tech Canada Inc.
ATTN: Danielle MacDonald
14940 - 123 Avenue, NW
Edmonton AB T5V 1B4

Date Received: 29-JUN-17
Report Date: 19-JUL-17 12:22 (MT)
Version: FINAL

Client Phone: 780-886-3055

Certificate of Analysis

Lab Work Order #: L1951349

Project P.O. #: NOT SUBMITTED
Job Reference: VENW03060
C of C Numbers: 14-
Legal Site Desc:

Brent Mack, B.Sc.
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1951349-1 WATER 29-JUN-17 10:38 WILLISTON SHALLOW (W1-SHALLOW)	L1951349-2 WATER 29-JUN-17 10:52 WILLISTON DEEP (W1-DEEP)	L1951349-3 WATER 29-JUN-17 13:34 DINOSAUR SHALLOW (D1-SHALLOW)	L1951349-4 WATER 29-JUN-17 13:48 DINOSAUR DEEP (D1-DEEP)	L1951349-5 WATER 29-JUN-17 10:00 DUPLICATE 1 (DUP 1)
WATER						
Physical Tests	Colour, True (CU)	5.4 HTD	5.3 HTD	6.1 HTD	6.1 HTD	6.6 HTD
	Conductivity (uS/cm)	181	181	184	182	185
	pH (pH)	8.03	8.06	8.07	8.09	8.08
	Total Suspended Solids (mg/L)	3.7	<3.0	<3.0	<3.0	<3.0
	Total Dissolved Solids (mg/L)	115	114	116	116	112
	Turbidity (NTU)	2.16	1.97	0.85	1.08	1.01
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	81.7	79.2	82.9	83.9	84.9
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Phenolphthalein (as CaCO3) (mg/L)	<2.0	<2.0	<2.0	<2.0	<2.0
	Alkalinity, Total (as CaCO3) (mg/L)	81.7	79.2	82.9	83.9	84.9
	Ammonia, Total (as N) (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Bromide (Br) (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Chloride (Cl) (mg/L)	<0.50	<0.50	<0.50	<0.50	<0.50
	Fluoride (F) (mg/L)	0.036	0.036	0.039	0.042	0.040
	Nitrate and Nitrite (as N) (mg/L)	0.0494	0.0493	0.0446	0.0457	0.0454
	Nitrate (as N) (mg/L)	0.0494	0.0493	0.0446	0.0457	0.0454
	Nitrite (as N) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Total Kjeldahl Nitrogen (mg/L)	0.122	0.187	0.123	0.143	0.145
	Total Nitrogen (mg/L)	0.118	0.142	0.128	0.136	0.119
	Orthophosphate-Dissolved (as P) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Phosphorus (P)-Total Dissolved (mg/L)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Phosphorus (P)-Total (mg/L)	0.0063	0.014	<0.0020	0.0030	<0.0020
	Silicate (as SiO2) (mg/L)	4.32	4.50	4.50	4.61	4.36
	Sulfate (SO4) (mg/L)	14.8	14.7	15.0	15.1	14.8
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	3.01	3.61	4.34	3.78	3.31
	Total Organic Carbon (mg/L)	2.71	3.02	2.91 RRV	3.26	3.48
Bacteriological Tests	E. coli (MPN/100mL)					<1
	HPC (CFU/1mL)					1 PEHR
	Coliform Bacteria - Total (MPN/100mL)					2
Plant Pigments	Chlorophyll a (ug/L)	0.742	0.719	0.795	0.702	0.764

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1951349-6	L1951349-7			
	Description	WATER	WATER			
	Sampled Date	29-JUN-17	29-JUN-17			
	Sampled Time	10:15	13:48			
	Client ID	FIELD BLANK	TRAVEL BLANK			
Grouping	**Analyte**					
WATER						
Physical Tests	Colour, True (CU)	<5.0	<5.0			
	Conductivity (uS/cm)	<2.0	<2.0			
	pH (pH)	5.28	5.25			
	Total Suspended Solids (mg/L)	<3.0	<3.0			
	Total Dissolved Solids (mg/L)	<10	<10			
	Turbidity (NTU)	<0.10	<0.10			
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	<1.0	<1.0			
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0			
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0			
	Alkalinity, Phenolphthalein (as CaCO3) (mg/L)	<2.0	<2.0			
	Alkalinity, Total (as CaCO3) (mg/L)	<1.0	<1.0			
	Ammonia, Total (as N) (mg/L)	<0.0050	0.0129 RRV			
	Bromide (Br) (mg/L)	<0.050	<0.050			
	Chloride (Cl) (mg/L)	<0.50	<0.50			
	Fluoride (F) (mg/L)	<0.020	<0.020			
	Nitrate and Nitrite (as N) (mg/L)	<0.0051	<0.0051			
	Nitrate (as N) (mg/L)	<0.0050	<0.0050			
	Nitrite (as N) (mg/L)	<0.0010	<0.0010			
	Total Kjeldahl Nitrogen (mg/L)	<0.050	0.050			
	Total Nitrogen (mg/L)	<0.030	<0.030			
	Orthophosphate-Dissolved (as P) (mg/L)	<0.0010	<0.0010			
	Phosphorus (P)-Total Dissolved (mg/L)	<0.0020	<0.0020			
	Phosphorus (P)-Total (mg/L)	<0.0020	<0.0020			
	Silicate (as SiO2) (mg/L)	<0.50	<0.50			
	Sulfate (SO4) (mg/L)	<0.30	<0.30			
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	0.69 RRV				
	Total Organic Carbon (mg/L)	<0.50	<0.50			
Bacteriological Tests	E. coli (MPN/100mL)	<1	<1			
	HPC (CFU/1mL)	<1 PEHR	<1			
	Coliform Bacteria - Total (MPN/100mL)	<1	<1			
Plant Pigments	Chlorophyll a (ug/L)	<0.010				

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

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Method Blank	Alkalinity, Total (as CaCO3)	B	L1951349-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Total Nitrogen	MS-B	L1951349-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Nitrate (as N)	MS-B	L1951349-1, -2, -3, -4

Qualifiers for Individual Parameters Listed:

Qualifier	Description
B	Method Blank exceeds ALS DQO. Associated sample results which are < Limit of Reporting or > 5 times blank level are considered reliable.
HTD	Hold time exceeded for re-analysis or dilution, but initial testing was conducted within hold time.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.
PEHR	Parameter Exceeded Recommended Holding Time On Receipt: Proceed With Analysis As Requested.
RRV	Reported Result Verified By Repeat Analysis

Test Method References:

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

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

ANIONS-N+N-CALC-VA	Water	Nitrite & Nitrate in Water (Calculation)	EPA 300.0

Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).

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

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

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

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

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

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

CHLOROA-F-VA	Water	Chlorophyll a by Fluorometer	EPA 445.0

This analysis is done using procedures modified from EPA Method 445.0. Chlorophyll-a is determined by a routine acetone extraction followed with analysis by fluorometry using the non-acidification procedure. This method is not subject to interferences from chlorophyll b.

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

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

COLOUR-TRUE-VA	Water	Colour (True) by Spectrometer	BCMOE Colour Single Wavelength

This analysis is carried out using procedures adapted from British Columbia Environmental Manual "Colour- Single Wavelength." Colour (True Colour) is determined by filtering a sample through a 0.45 micron membrane filter followed by analysis of the filtrate using the platinum-cobalt colourimetric method.
Colour measurements can be highly pH dependent, and apply to the pH of the sample as received (at time of testing), without pH adjustment. Concurrent measurement of sample pH is recommended.

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

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

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

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

ECOLI-COLI-ENV-VA	Water	E.coli by Colilert	APHA METHOD 9223

This analysis is carried out using procedures adapted from APHA Method 9223 "Enzyme Substrate Coliform Test". E. coli and Total Coliform are determined simultaneously. The sample is mixed with a mixture hydrolyzable substrates and then sealed in a multi-well packet. The packet is incubated for 18 or 24 hours and then the number of wells exhibiting a positive response are counted. The final result is obtained by comparing the positive responses to a probability table.

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

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

HPC-PP-ENV-VA	Water	HPC by pour plate	APHA METHOD 9215

Reference Information

This analysis is carried out using procedures adapted from APHA Method 9215 "Heterotropic Plate Count". Heterotropic plate count (standard plate count or total plate count) is determined by culturing and colony counting using the pour plate method with a 48 hour incubation period. The test measures colonies formed by heterotropic bacteria.

N-T-COL-VA Water Total Nitrogen in water by Colour APHA4500-P(J)/NEMI9171/USGS03-4174

This analysis is carried out using procedures adapted from APHA Method 4500-P (J) "Persulphate Method for Simultaneous Determination of Total Nitrogen and Total Phosphorus" and National Environmental Methods Index - Nemi method 5735.

NH3-F-VA Water Ammonia in Water by Fluorescence APHA 4500 NH3-NITROGEN (AMMONIA)

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

SILICATE-COL-VA Water Silicate by Colourimetric analysis APHA 4500-SiO2 E.

This analysis is carried out using procedures adapted from APHA Method 4500-SiO2 E. "Silica". Silicate (molybdate-reactive silica) is determined by the molybdosilicate-heteropoly blue colourimetric method.

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

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

TCOLI-COLI-ENV-VA Water Total coliform by Colilert APHA METHOD 9223

This analysis is carried out using procedures adapted from APHA Method 9223 "Enzyme Substrate Coliform Test". E. coli and Total Coliform are determined simultaneously. The sample is mixed with a mixture hydrolyzable substrates and then sealed in a multi-well packet. The packet is incubated for 18 or 24 hours and then the number of wells exhibiting a positive response are counted. The final result is quantified by a statistical estimation of bacteria density (most probable number).

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

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

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

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

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

Reference Information

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

TURBIDITY-VA Water Turbidity by Meter APHA 2130 Turbidity

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

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

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

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

Chain of Custody Numbers:

14-

GLOSSARY OF REPORT TERMS

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

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

Tetra Tech Canada Inc.
ATTN: Danielle MacDonald
14940 - 123 Avenue, NW
Edmonton AB T5V 1B4

Date Received: 30-JUN-17
Report Date: 19-JUL-17 17:04 (MT)
Version: FINAL

Client Phone: 780-886-3055

Certificate of Analysis

Lab Work Order #: L1951924

Project P.O. #: NOT SUBMITTED
Job Reference: VENW03060
C of C Numbers: 14-
Legal Site Desc:

Brent Mack, B.Sc.
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1951924-1 WATER 30-JUN-17 11:28 HALFWAY RIVER DOWNSTREAM (HD)	L1951924-2 WATER 30-JUN-17 11:44 MIDDLE SITE C RESERVOIR (PR2)	L1951924-3 WATER 30-JUN-17 08:53 PEACE CANYON (PC1)	L1951924-4 WATER 30-JUN-17 09:38 UPPER SITE C RESERVOIR (PR1)	L1951924-5 WATER 30-JUN-17 09:48 DUP 2
WATER						
Physical Tests	Colour, True (CU)	12.8 HTD	7.3 HTD	6.9 HTD	6.8 HTD	7.2 HTD
	Conductivity (uS/cm)	374	199	187	190	184
	Hardness (as CaCO3) (mg/L)	195	94.8		115	94.8
	pH (pH)	8.34	8.11	8.06	8.10	8.12
	Total Suspended Solids (mg/L)	75.0	8.6	<3.0	<3.0	<3.0
	Total Dissolved Solids (mg/L)			118		
	TDS (Calculated) (mg/L)	223	170		116	103
	Turbidity (NTU)	72.8	5.47	1.81	1.34	1.35
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	161	84.4	84.2	84.0	85.5
	Alkalinity, Carbonate (as CaCO3) (mg/L)	5.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Phenolphthalein (as CaCO3) (mg/L)	2.5	<2.0	<2.0	<2.0	<2.0
	Alkalinity, Total (as CaCO3) (mg/L)	166	84.4	84.2	84.0	85.5
	Ammonia, Total (as N) (mg/L)	0.0076	<0.0050	<0.0050	<0.0050	<0.0050
	Bromide (Br) (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Chloride (Cl) (mg/L)	<0.50	<0.50	<0.50	<0.50	<0.50
	Fluoride (F) (mg/L)	0.097	0.041	0.041	0.039	0.040
	Nitrate and Nitrite (as N) (mg/L)	<0.0051	0.0471	0.0520	0.0433	0.0439
	Nitrate (as N) (mg/L)	<0.0050	0.0471	0.0520	0.0433	0.0439
	Nitrite (as N) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Total Kjeldahl Nitrogen (mg/L)	3.19	0.141	0.152	0.127	0.126
	Total Nitrogen (mg/L)	3.24	0.144	0.159	0.137	0.136
	Orthophosphate-Dissolved (as P) (mg/L)	0.0018	<0.0010	<0.0010	<0.0010	<0.0010
	Phosphorus (P)-Total Dissolved (mg/L)	0.0040	0.0050	0.0029	<0.0020	<0.0020
	Phosphorus (P)-Total (mg/L)	0.0925	0.0046	<0.0020	<0.0020	0.0023
	Silicate (as SiO2) (mg/L)	4.03	4.53	4.62	4.39	4.15
	Sulfate (SO4) (mg/L)	46.7	15.4	14.7	14.8	14.8
	Anion Sum (meq/L)	4.30	2.01		1.99	2.02
	Cation Sum (meq/L)	4.02	1.89		2.73	1.89
	Cation - Anion Balance (%)	-3.4	-3.1		15.7	-3.2
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	4.50	2.94	4.09 RRV	3.92 RRV	3.20
	Total Organic Carbon (mg/L)	5.48	2.99	2.89 RRV	2.55 RRV	2.87
Bacteriological Tests	E. coli (MPN/100mL)	45	4		1	1
	HPC (CFU/1mL)	107	21		8	14
	Coliform Bacteria - Total (MPN/100mL)	>200.5	62		8	22

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1951924-1 WATER 30-JUN-17 11:28 HALFWAY RIVER DOWNSTREAM (HD)	L1951924-2 WATER 30-JUN-17 11:44 MIDDLE SITE C RESERVOIR (PR2)	L1951924-3 WATER 30-JUN-17 08:53 PEACE CANYON (PC1)	L1951924-4 WATER 30-JUN-17 09:38 UPPER SITE C RESERVOIR (PR1)	L1951924-5 WATER 30-JUN-17 09:48 DUP 2
WATER						
Total Metals	Aluminum (Al)-Total (mg/L)	1.49	0.108		0.0344	0.0307
	Antimony (Sb)-Total (mg/L)	<0.00050	<0.00050		<0.00050	<0.00050
	Arsenic (As)-Total (mg/L)	0.00125	<0.00050		<0.00050	<0.00050
	Barium (Ba)-Total (mg/L)	0.135	0.038		0.035	0.035
	Beryllium (Be)-Total (mg/L)	<0.00010	<0.00010		<0.00010	<0.00010
	Bismuth (Bi)-Total (mg/L)	<0.20	<0.20		<0.20	<0.20
	Boron (B)-Total (mg/L)	<0.10	<0.10		<0.10	<0.10
	Cadmium (Cd)-Total (mg/L)	0.000165	0.0000302		0.0000186	0.0000194
	Calcium (Ca)-Total (mg/L)	58.5	28.3		27.6	28.0
	Chromium (Cr)-Total (mg/L)	0.0026	<0.0010		<0.0010	<0.0010
	Cobalt (Co)-Total (mg/L)	0.00111	<0.00030		<0.00030	<0.00030
	Copper (Cu)-Total (mg/L)	0.0037	<0.0010		<0.0010	<0.0010
	Iron (Fe)-Total (mg/L)	2.51	0.163		0.045	0.038
	Lead (Pb)-Total (mg/L)	0.00133	<0.00050		<0.00050	<0.00050
	Lithium (Li)-Total (mg/L)	0.0058	<0.0010		<0.0010	<0.0010
	Magnesium (Mg)-Total (mg/L)	16.7	7.01		6.88	6.98
	Manganese (Mn)-Total (mg/L)	0.0454	0.00596		0.00252	0.00241
	Mercury (Hg)-Total (mg/L)	0.0000102	<0.0000050		<0.0000050	<0.0000050
	Molybdenum (Mo)-Total (mg/L)	0.0039	<0.0010		<0.0010	<0.0010
	Nickel (Ni)-Total (mg/L)	0.0056	0.0010		<0.0010	<0.0010
	Phosphorus (P)-Total (mg/L)	<0.30	<0.30		<0.30	<0.30
	Potassium (K)-Total (mg/L)	<2.0	<2.0		<2.0	<2.0
	Selenium (Se)-Total (mg/L)	0.00165	0.000314		0.000289	0.000281
	Silicon (Si)-Total (mg/L)	4.10	2.26		2.09	2.10
	Silver (Ag)-Total (mg/L)	0.000028	<0.000020		<0.000020	<0.000020
	Sodium (Na)-Total (mg/L)	2.9	<2.0		<2.0	<2.0
	Strontium (Sr)-Total (mg/L)	0.290	0.116		0.111	0.109
	Thallium (Tl)-Total (mg/L)	<0.00020	<0.00020		<0.00020	<0.00020
	Tin (Sn)-Total (mg/L)	<0.00050	<0.00050		<0.00050	<0.00050
	Titanium (Ti)-Total (mg/L)	0.018	<0.010		<0.010	<0.010
	Uranium (U)-Total (mg/L)	0.00102	0.00052		0.00052	0.00050
	Vanadium (V)-Total (mg/L)	0.00686	0.00073		<0.00050	<0.00050
	Zinc (Zn)-Total (mg/L)	0.0159	<0.0050		<0.0050	<0.0050
Dissolved Metals	Dissolved Mercury Filtration Location	LAB	LAB		LAB	LAB
	Dissolved Metals Filtration Location	FIELD	FIELD		FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0077	<0.0050		<0.0050	<0.0050
	Antimony (Sb)-Dissolved (mg/L)	<0.00050	<0.00050		<0.00050	<0.00050

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1951924-1 WATER 30-JUN-17 11:28 HALFWAY RIVER DOWNSTREAM (HD)	L1951924-2 WATER 30-JUN-17 11:44 MIDDLE SITE C RESERVOIR (PR2)	L1951924-3 WATER 30-JUN-17 08:53 PEACE CANYON (PC1)	L1951924-4 WATER 30-JUN-17 09:38 UPPER SITE C RESERVOIR (PR1)	L1951924-5 WATER 30-JUN-17 09:48 DUP 2
WATER						
Dissolved Metals	Arsenic (As)-Dissolved (mg/L)	<0.00050	<0.00050		<0.00050	<0.00050
	Barium (Ba)-Dissolved (mg/L)	0.105	0.057		0.032	0.058
	Beryllium (Be)-Dissolved (mg/L)	<0.0010	<0.0010		<0.00010	<0.0010
	Bismuth (Bi)-Dissolved (mg/L)	<0.20	<0.20		<0.20	<0.20
	Boron (B)-Dissolved (mg/L)	<0.10	<0.10		<0.10	<0.10
	Cadmium (Cd)-Dissolved (mg/L)	0.0000207	0.0000110		0.0000070	0.0000118
	Calcium (Ca)-Dissolved (mg/L)	53.5	27.4		26.4	27.3
	Chromium (Cr)-Dissolved (mg/L)	<0.0010	<0.0010		<0.0010	<0.0010
	Cobalt (Co)-Dissolved (mg/L)	<0.00030	<0.00030		<0.00030	<0.00030
	Copper (Cu)-Dissolved (mg/L)	0.0011	<0.0010		<0.0010	0.0012
	Iron (Fe)-Dissolved (mg/L)	<0.030	<0.030		<0.030	<0.030
	Lead (Pb)-Dissolved (mg/L)	<0.00050	<0.00050		<0.00050	<0.00050
	Lithium (Li)-Dissolved (mg/L)	0.0046	<0.0010		0.0052 DTC	<0.0010
	Magnesium (Mg)-Dissolved (mg/L)	15.0	6.42		11.9 DTC	6.46
	Manganese (Mn)-Dissolved (mg/L)	0.00667	0.00094		0.00062	0.00058
	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050		<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.0038	<0.0010		0.0014	<0.0010
	Nickel (Ni)-Dissolved (mg/L)	0.0018	<0.0010		<0.0010	<0.0010
	Phosphorus (P)-Dissolved (mg/L)	<0.30	<0.30		<0.30	<0.30
	Potassium (K)-Dissolved (mg/L)	<2.0	<2.0		<2.0	<2.0
	Selenium (Se)-Dissolved (mg/L)	0.00157	0.000260		0.000267	0.000264
	Silicon (Si)-Dissolved (mg/L)	1.80	1.99		2.62 DTC	2.03
	Silver (Ag)-Dissolved (mg/L)	<0.000020	<0.000020		<0.000020	<0.000020
	Sodium (Na)-Dissolved (mg/L)	2.7	<2.0		10.0 DTC	<2.0
	Strontium (Sr)-Dissolved (mg/L)	0.257	0.103		0.102	0.103
	Thallium (Tl)-Dissolved (mg/L)	<0.00020	<0.00020		<0.00020	<0.00020
	Tin (Sn)-Dissolved (mg/L)	<0.00050	<0.00050		<0.00050	<0.00050
	Titanium (Ti)-Dissolved (mg/L)	<0.010	<0.010		<0.010	<0.010
	Uranium (U)-Dissolved (mg/L)	0.00083	0.00049		0.00079	0.00049
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050		<0.00050	<0.00050
	Zinc (Zn)-Dissolved (mg/L)	<0.0050	<0.0050		<0.0050	<0.0050

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

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Method Blank	Alkalinity, Total (as CaCO3)	B	L1951924-1, -3, -4, -5
Duplicate	E. coli	DUPM	L1951924-1, -2, -4, -5
Matrix Spike	Barium (Ba)-Total	MS-B	L1951924-1, -2, -4, -5
Matrix Spike	Calcium (Ca)-Total	MS-B	L1951924-1, -2, -4, -5
Matrix Spike	Magnesium (Mg)-Total	MS-B	L1951924-1, -2, -4, -5
Matrix Spike	Strontium (Sr)-Total	MS-B	L1951924-1, -2, -4, -5
Matrix Spike	Total Nitrogen	MS-B	L1951924-2, -3, -4, -5

Qualifiers for Individual Parameters Listed:

Qualifier	Description
B	Method Blank exceeds ALS DQO. Associated sample results which are < Limit of Reporting or > 5 times blank level are considered reliable.
DTC	Dissolved concentration exceeds total. Results were confirmed by re-analysis.
DUPM	MPN duplicate results were outside default ALS Data Quality Objective, but within 95% confidence interval for MPN reference method. Sample results are reliable.
HTD	Hold time exceeded for re-analysis or dilution, but initial testing was conducted within hold time.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.
RRV	Reported Result Verified By Repeat Analysis

Test Method References:

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

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

ANIONS-N+N-CALC-VA	Water	Nitrite & Nitrate in Water (Calculation)	EPA 300.0

Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).

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

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

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

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

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

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

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

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

COLOUR-TRUE-VA	Water	Colour (True) by Spectrometer	BCMOE Colour Single Wavelength

This analysis is carried out using procedures adapted from British Columbia Environmental Manual "Colour- Single Wavelength." Colour (True Colour) is determined by filtering a sample through a 0.45 micron membrane filter followed by analysis of the filtrate using the platinum-cobalt colourimetric method.
Colour measurements can be highly pH dependent, and apply to the pH of the sample as received (at time of testing), without pH adjustment. Concurrent measurement of sample pH is recommended.

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

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

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

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

ECOLI-COLI-ENV-VA	Water	E.coli by Colilert	APHA METHOD 9223

This analysis is carried out using procedures adapted from APHA Method 9223 "Enzyme Substrate Coliform Test". E. coli and Total Coliform are determined simultaneously. The sample is mixed with a mixture hydrolyzable substrates and then sealed in a multi-well packet. The packet is incubated for 18 or 24 hours and then the number of wells exhibiting a positive response are counted. The final result is obtained by comparing the positive responses to a probability table.

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

Reference Information

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

HARDNESS-CALC-VA Water Hardness APHA 2340B

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

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

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

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

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

HPC-PP-ENV-VA Water HPC by pour plate APHA METHOD 9215

This analysis is carried out using procedures adapted from APHA Method 9215 "Heterotropic Plate Count". Heterotropic plate count (standard plate count or total plate count) is determined by culturing and colony counting using the pour plate method with a 48 hour incubation period. The test measures colonies formed by heterotropic bacteria.

IONBALANCE-VA Water Ion Balance Calculation APHA 1030E

Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:

Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum]

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

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

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

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

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

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

N-T-COL-VA Water Total Nitrogen in water by Colour APHA4500-P(J)/NEMI9171/USGS03-4174

This analysis is carried out using procedures adapted from APHA Method 4500-P (J) "Persulphate Method for Simultaneous Determination of Total Nitrogen and Total Phosphorus" and National Environmental Methods Index - Nemi method 5735.

NH3-F-VA Water Ammonia in Water by Fluorescence APHA 4500 NH3-NITROGEN (AMMONIA)

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

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

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

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

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

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

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

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

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

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

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

Reference Information

available for these types of samples.

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

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

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

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

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

SILICATE-COL-VA Water Silicate by Colourimetric analysis APHA 4500-SiO2 E.

This analysis is carried out using procedures adapted from APHA Method 4500-SiO2 E. "Silica". Silicate (molybdate-reactive silica) is determined by the molybdosilicate-heteropoly blue colourimetric method.

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

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

TCOLI-COLI-ENV-VA Water Total coliform by Colilert APHA METHOD 9223

This analysis is carried out using procedures adapted from APHA Method 9223 "Enzyme Substrate Coliform Test". E. coli and Total Coliform are determined simultaneously. The sample is mixed with a mixture hydrolyzable substrates and then sealed in a multi-well packet. The packet is incubated for 18 or 24 hours and then the number of wells exhibiting a positive response are counted. The final result is quantified by a statistical estimation of bacteria density (most probable number).

TDS-CALC-VA Water TDS (Calculated) APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".
The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

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

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

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

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

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

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

TURBIDITY-VA Water Turbidity by Meter APHA 2130 Turbidity

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

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

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

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

Chain of Custody Numbers:

Reference Information

GLOSSARY OF REPORT TERMS

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

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

Tetra Tech Canada Inc.
ATTN: Danielle MacDonald
14940 - 123 Avenue, NW
Edmonton AB T5V 1B4

Date Received: 18-JUL-17
Report Date: 27-JUL-17 16:25 (MT)
Version: FINAL

Client Phone: 780-886-3055

Certificate of Analysis

Lab Work Order #: L1960524

Project P.O. #: NOT SUBMITTED
Job Reference: VENW03060
C of C Numbers: 14-
Legal Site Desc:

Brent Mack, B.Sc.
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1960524-1	L1960524-2	L1960524-3	L1960524-4	
	Description	Water	Water	Water	Water	
	Sampled Date	18-JUL-17	18-JUL-17	18-JUL-17	18-JUL-17	
	Sampled Time	12:12	11:37	12:50	13:12	
	Client ID	MOBERLY RIVER - DOWNSTREAM (MD)	LOWER SITE C RESERVOIR (PR3)	PEACE AT PINE (PD1)	PINE RIVER (PINE)	
Grouping	**Analyte**					
WATER						
Physical Tests	Colour, True (CU)	39.0	11.2	10.5	10.9	
	Conductivity (uS/cm)	230	237	236	293	
	pH (pH)	8.25	8.22	8.24	8.34	
	Total Suspended Solids (mg/L)	28.1	12.5	15.1	37.3	
	Total Dissolved Solids (mg/L)	158	148	146	216	
	Turbidity (NTU)	34.2	13.2	13.3	40.6	
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	120	107	109	137	
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	5.0	
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	
	Alkalinity, Phenolphthalein (as CaCO3) (mg/L)	<2.0	<2.0	<2.0	2.5	
	Alkalinity, Total (as CaCO3) (mg/L)	120	107	109	142	
	Ammonia, Total (as N) (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	
	Bromide (Br) (mg/L)	<0.050	<0.050	<0.050	<0.050	
	Chloride (Cl) (mg/L)	0.59	<0.50	<0.50	1.02	
	Fluoride (F) (mg/L)	0.077	0.052	0.053	0.073	
	Nitrate and Nitrite (as N) (mg/L)	<0.0051	0.0289	0.0292	0.0159	
	Nitrate (as N) (mg/L)	<0.0050	0.0289	0.0292	0.0159	
	Nitrite (as N) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	
	Total Kjeldahl Nitrogen (mg/L)	0.339	0.158	<0.25	0.228	
	Total Nitrogen (mg/L)	0.301	0.147	0.141	0.156	
	Orthophosphate-Dissolved (as P) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	
	Phosphorus (P)-Total Dissolved (mg/L)	0.0027	<0.0020	<0.0020	<0.0020	
	Phosphorus (P)-Total (mg/L)	0.0294	<0.0020	0.0113	<0.0020	
	Silicate (as SiO2) (mg/L)	3.23	4.03	4.29	2.85	
	Sulfate (SO4) (mg/L)	10.1	22.9	22.4	21.8	
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	9.65	3.90	3.57	4.01	
	Total Organic Carbon (mg/L)	9.19	3.27	3.29	4.46	

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

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Dissolved Organic Carbon	MS-B	L1960524-1, -3, -4
Matrix Spike	Dissolved Organic Carbon	MS-B	L1960524-1, -3, -4
Matrix Spike	Dissolved Organic Carbon	MS-B	L1960524-2
Matrix Spike	Total Organic Carbon	MS-B	L1960524-1, -3, -4
Matrix Spike	Total Organic Carbon	MS-B	L1960524-2
Matrix Spike	Total Organic Carbon	MS-B	L1960524-2
Matrix Spike	Total Nitrogen	MS-B	L1960524-1, -2, -3, -4

Qualifiers for Individual Parameters Listed:

Qualifier	Description
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

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

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

ANIONS-N+N-CALC-VA	Water	Nitrite & Nitrate in Water (Calculation)	EPA 300.0

Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).

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

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

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

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

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

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

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

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

COLOUR-TRUE-VA	Water	Colour (True) by Spectrometer	BCMOE Colour Single Wavelength

This analysis is carried out using procedures adapted from British Columbia Environmental Manual "Colour- Single Wavelength." Colour (True Colour) is determined by filtering a sample through a 0.45 micron membrane filter followed by analysis of the filtrate using the platinum-cobalt colourimetric method.
Colour measurements can be highly pH dependent, and apply to the pH of the sample as received (at time of testing), without pH adjustment. Concurrent measurement of sample pH is recommended.

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

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

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

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

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

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

N-T-COL-VA	Water	Total Nitrogen in water by Colour	APHA4500-P(J)/NEMI9171/USGS03-4174

This analysis is carried out using procedures adapted from APHA Method 4500-P (J) "Persulphate Method for Simultaneous Determination of Total Nitrogen and Total Phosphorus" and National Environmental Methods Index - Nemi method 5735.

NH3-F-VA	Water	Ammonia in Water by Fluorescence	APHA 4500 NH3-NITROGEN (AMMONIA)

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

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

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

Reference Information

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

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

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

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

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

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

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

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

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

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

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

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

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

SILICATE-COL-VA	Water	Silicate by Colourimetric analysis	APHA 4500-SiO2 E.

This analysis is carried out using procedures adapted from APHA Method 4500-SiO2 E. "Silica". Silicate (molybdate-reactive silica) is determined by the molybdosilicate-heteropoly blue colourimetric method.

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

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

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

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

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

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

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

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

TURBIDITY-VA	Water	Turbidity by Meter	APHA 2130 Turbidity

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

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

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

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

Chain of Custody Numbers:

Reference Information

GLOSSARY OF REPORT TERMS

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

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

Tetra Tech Canada Inc.
ATTN: Danielle MacDonald
14940 - 123 Avenue, NW
Edmonton AB T5V 1B4

Date Received: 19-JUL-17
Report Date: 01-AUG-17 14:36 (MT)
Version: FINAL

Client Phone: 780-886-3055

Certificate of Analysis

Lab Work Order #: L1961413

Project P.O. #: NOT SUBMITTED
Job Reference: VENW003060
C of C Numbers:
Legal Site Desc:

Brent Mack, B.Sc.
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1961413-1 Water 19-JUL-17 09:26 PEACE AT BEATTON	L1961413-2 Water 19-JUL-17 10:19 BEATTON RIVER	L1961413-3 Water 19-JUL-17 10:54 PEACE AT KISKATINAW	L1961413-4 Water 19-JUL-17 11:15 KISKATINAW RIVER	L1961413-5 Water 19-JUL-17 11:44 PEACE AT POUCE COUPE
WATER						
Physical Tests	Colour, True (CU)	10.2	333	34.2	53.8	29.1
	Conductivity (uS/cm)	250	196	244	397	251
	pH (pH)	8.27	7.84	8.22	8.47	8.24
	Total Suspended Solids (mg/L)	21.9	59.7	30.7	82.3	31.3
	Total Dissolved Solids (mg/L)	159	221	166	310	163
	Turbidity (NTU)	17.3	65.9	24.3	195	28.8
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	111	58.2	112	196	114
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	10.4	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	111	58.2	112	206	114
	Ammonia, Total (as N) (mg/L)	<0.0050	0.0163	<0.0050	0.0142	<0.0050
	Bromide (Br) (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Chloride (Cl) (mg/L)	<0.50	0.68	<0.50	1.74	0.53
	Fluoride (F) (mg/L)	0.053	0.090	0.057	0.096	0.059
	Nitrate and Nitrite (as N) (mg/L)	0.0295	0.0161	0.0269	0.0843	0.0266
	Nitrate (as N) (mg/L)	0.0295	0.0143	0.0269	0.0815	0.0266
	Nitrite (as N) (mg/L)	<0.0010	0.0018	<0.0010	0.0029	<0.0010
	Total Kjeldahl Nitrogen (mg/L)	0.182	1.12	0.246	0.79	0.275
	Total Nitrogen (mg/L)	0.153	0.952 DLM	0.161	0.664 DLM	0.206
	Orthophosphate-Dissolved (as P) (mg/L)	<0.0010	0.0197	0.0014	0.0076	0.0017
	Phosphorus (P)-Total Dissolved (mg/L)	0.0021	0.044	0.0044	0.0148	0.0035
	Phosphorus (P)-Total (mg/L)	0.0193	0.121	0.0281	0.166	0.0305
	Silicate (as SiO2) (mg/L)	3.91	5.78	4.05	5.22	3.84
	Sulfate (SO4) (mg/L)	21.2	34.7	22.0	21.1	22.6
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	4.04	40.7	7.31	16.6	8.13 RRV
	Total Organic Carbon (mg/L)	3.73	43.2	6.30	16.7	5.58 RRV

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1961413-6	L1961413-7			
	Description	Water	Water			
	Sampled Date	19-JUL-17	19-JUL-17			
	Sampled Time	12:07	13:28			
	Client ID	POUCE COUPE	PEACE AT MANY ISLANDS			
Grouping	**Analyte**					
WATER						
Physical Tests	Colour, True (CU)	68.8	33.9			
	Conductivity (uS/cm)	607	256			
	pH (pH)	8.18	8.24			
	Total Suspended Solids (mg/L)	348	49.7			
	Total Dissolved Solids (mg/L)	558	188			
	Turbidity (NTU)	542	42.1			
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	146	117			
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0			
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0			
	Alkalinity, Total (as CaCO3) (mg/L)	146	117			
	Ammonia, Total (as N) (mg/L)	0.0648	<0.0050			
	Bromide (Br) (mg/L)	0.088	<0.050			
	Chloride (Cl) (mg/L)	17.1	0.68			
	Fluoride (F) (mg/L)	0.218	0.063			
	Nitrate and Nitrite (as N) (mg/L)	1.33	0.0409			
	Nitrate (as N) (mg/L)	1.29	0.0409			
	Nitrite (as N) (mg/L)	0.0411	<0.0010			
	Total Kjeldahl Nitrogen (mg/L)	2.28	0.286			
	Total Nitrogen (mg/L)	2.76	0.252			
	Orthophosphate-Dissolved (as P) (mg/L)	0.0189	0.0017			
	Phosphorus (P)-Total Dissolved (mg/L)	0.0338	0.0045			
	Phosphorus (P)-Total (mg/L)	0.491	0.0380			
	Silicate (as SiO2) (mg/L)	4.96	3.80			
	Sulfate (SO4) (mg/L)	148	24.5			
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	25.2	8.91			
	Total Organic Carbon (mg/L)	28.9	7.67			

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

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Dissolved Organic Carbon	MS-B	L1961413-1, -3, -4, -6, -7
Matrix Spike	Dissolved Organic Carbon	MS-B	L1961413-2
Matrix Spike	Dissolved Organic Carbon	MS-B	L1961413-5
Matrix Spike	Total Organic Carbon	MS-B	L1961413-3, -4, -6, -7
Matrix Spike	Total Organic Carbon	MS-B	L1961413-1, -2
Matrix Spike	Total Organic Carbon	MS-B	L1961413-5
Matrix Spike	Total Nitrogen	MS-B	L1961413-1, -2, -3, -4, -5, -6, -7

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.
RRV	Reported Result Verified By Repeat Analysis

Test Method References:

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

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

ANIONS-N+N-CALC-VA	Water	Nitrite & Nitrate in Water (Calculation)	EPA 300.0

Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).

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

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

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

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

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

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

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

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

COLOUR-TRUE-VA	Water	Colour (True) by Spectrometer	BCMOE Colour Single Wavelength

This analysis is carried out using procedures adapted from British Columbia Environmental Manual "Colour- Single Wavelength." Colour (True Colour) is determined by filtering a sample through a 0.45 micron membrane filter followed by analysis of the filtrate using the platinum-cobalt colourimetric method.
Colour measurements can be highly pH dependent, and apply to the pH of the sample as received (at time of testing), without pH adjustment. Concurrent measurement of sample pH is recommended.

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

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

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

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

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

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

N-T-COL-VA	Water	Total Nitrogen in water by Colour	APHA4500-P(J)/NEMI9171/USGS03-4174

This analysis is carried out using procedures adapted from APHA Method 4500-P (J) "Persulphate Method for Simultaneous Determination of Total Nitrogen and Total Phosphorus" and National Environmental Methods Index - Nemi method 5735.

NH3-F-VA	Water	Ammonia in Water by Fluorescence	APHA 4500 NH3-NITROGEN (AMMONIA)

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

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

Reference Information

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

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

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

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

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

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

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

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

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

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

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

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

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

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

SILICATE-COL-VA Water Silicate by Colourimetric analysis APHA 4500-SiO2 E.

This analysis is carried out using procedures adapted from APHA Method 4500-SiO2 E. "Silica". Silicate (molybdate-reactive silica) is determined by the molybdosilicate-heteropoly blue colourimetric method.

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

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

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

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

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

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

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

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

TURBIDITY-VA Water Turbidity by Meter APHA 2130 Turbidity

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

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

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

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

Chain of Custody Numbers:

Reference Information

GLOSSARY OF REPORT TERMS

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

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

Tetra Tech Canada Inc.
ATTN: Danielle MacDonald
14940 - 123 Avenue, NW
Edmonton AB T5V 1B4

Date Received: 20-JUL-17
Report Date: 01-AUG-17 17:04 (MT)
Version: FINAL

Client Phone: 780-886-3055

Certificate of Analysis

Lab Work Order #: L1962155

Project P.O. #: NOT SUBMITTED
Job Reference: VENW03060
C of C Numbers:
Legal Site Desc:

Brent Mack, B.Sc.
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1962155-1	L1962155-2	L1962155-3	L1962155-4	L1962155-5
	Description	Water	Water	Water	Water	Water
	Sampled Date	20-JUL-17	20-JUL-17	20-JUL-17	20-JUL-17	20-JUL-17
	Sampled Time	10:05	10:22	13:27	13:44	13:10
	Client ID	WILLISTON SHALLOW (W1 - SHALLOW)	WILLISTON DEEP (W1 - DEEP)	DINOSAUR SHALLOW (D1 - SHALLOW)	DINOSAUR DEEP (D1 - DEEP)	DUPLICATE 1 (DUP 1)
Grouping	**Analyte**					
FILTER						
Plant Pigments	Chlorophyll a (ug/L)	0.759	0.644	0.799	1.32	0.989

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L1962155-6				
Description	Water				
Sampled Date	20-JUL-17				
Sampled Time	13:20				
Client ID	FIELD BLANK				
Grouping **Analyte**					
FILTER					
Plant Pigments Chlorophyll a (ug/L)	<0.010				

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1962155-1 Water 20-JUL-17 10:05 WILLISTON SHALLOW (W1 - SHALLOW)	L1962155-2 Water 20-JUL-17 10:22 WILLISTON DEEP (W1 - DEEP)	L1962155-3 Water 20-JUL-17 13:27 DINOSAUR SHALLOW (D1 - SHALLOW)	L1962155-4 Water 20-JUL-17 13:44 DINOSAUR DEEP (D1 - DEEP)	L1962155-5 Water 20-JUL-17 13:10 DUPLICATE 1 (DUP 1)
WATER						
Physical Tests	Colour, True (CU)	7.4	7.9	6.9	6.5	<5.0
	Conductivity (uS/cm)	182	181	186	186	190
	pH (pH)	8.04	8.05	8.08	8.05	8.09
	Total Suspended Solids (mg/L)	<3.0	<3.0	<3.0	<3.0	<3.0
	Total Dissolved Solids (mg/L)	117	113	115	116	118
	Turbidity (NTU)	2.86	3.48	1.01	1.18	1.02
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	84.1	84.4	87.7	86.0	86.2
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Phenolphthalein (as CaCO3) (mg/L)	<2.0	<2.0	<2.0	<2.0	<2.0
	Alkalinity, Total (as CaCO3) (mg/L)	84.1	84.4	87.7	86.0	86.2
	Ammonia, Total (as N) (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Bromide (Br) (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Chloride (Cl) (mg/L)	<0.50	<0.50	<0.50	<0.50	<0.50
	Fluoride (F) (mg/L)	0.034	0.034	0.037	0.036	0.037
	Nitrate and Nitrite (as N) (mg/L)	0.0473	0.0474	0.0327	0.0375	0.0327
	Nitrate (as N) (mg/L)	0.0473	0.0474	0.0327	0.0375	0.0327
	Nitrite (as N) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Total Kjeldahl Nitrogen (mg/L)	0.112	0.100	0.081	0.127	0.089
	Total Nitrogen (mg/L)	0.120	0.166	0.115	0.130	0.112
	Orthophosphate-Dissolved (as P) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Phosphorus (P)-Total Dissolved (mg/L)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Phosphorus (P)-Total (mg/L)	0.0034	0.0028	<0.0020	<0.0020	<0.0020
	Silicate (as SiO2) (mg/L)	4.43	4.35	4.11	4.19	3.92
	Sulfate (SO4) (mg/L)	13.3	13.3	14.2	14.0	14.2
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	4.98 RRV	5.18 RRV	4.23	4.69 RRV	4.08 RRV
	Total Organic Carbon (mg/L)	2.92 RRV	2.78 RRV	2.73 RRV	2.78 RRV	2.96 RRV

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1962155-6	L1962155-7			
	Description	Water	Water			
	Sampled Date	20-JUL-17	20-JUL-17			
	Sampled Time	13:20	13:44			
	Client ID	FIELD BLANK	TRAVEL BLANK			
Grouping	**Analyte**					
WATER						
Physical Tests	Colour, True (CU)	<5.0				
	Conductivity (uS/cm)	<2.0	<2.0			
	pH (pH)	5.12	5.15			
	Total Suspended Solids (mg/L)	<3.0	<3.0			
	Total Dissolved Solids (mg/L)	<10	<10			
	Turbidity (NTU)	<0.10	<0.10			
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	<1.0	<1.0			
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0			
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0			
	Alkalinity, Phenolphthalein (as CaCO3) (mg/L)	<2.0	<2.0			
	Alkalinity, Total (as CaCO3) (mg/L)	<1.0	<1.0			
	Ammonia, Total (as N) (mg/L)	<0.0050	<0.023 RRV			
	Bromide (Br) (mg/L)	<0.050	<0.050			
	Chloride (Cl) (mg/L)	<0.50	<0.50			
	Fluoride (F) (mg/L)	<0.020	<0.020			
	Nitrate and Nitrite (as N) (mg/L)	<0.0051	<0.0051			
	Nitrate (as N) (mg/L)	<0.0050	<0.0050			
	Nitrite (as N) (mg/L)	<0.0010	<0.0010			
	Total Kjeldahl Nitrogen (mg/L)	<0.050	<0.050			
	Total Nitrogen (mg/L)	<0.030	<0.030			
	Orthophosphate-Dissolved (as P) (mg/L)	<0.0010	<0.0010			
	Phosphorus (P)-Total Dissolved (mg/L)	<0.0020	<0.0020			
	Phosphorus (P)-Total (mg/L)	<0.0020	<0.0020			
	Silicate (as SiO2) (mg/L)	<0.50	<0.50			
	Sulfate (SO4) (mg/L)	<0.30	<0.30			
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	2.39 RRV				
	Total Organic Carbon (mg/L)	<0.50 RRV	<0.50			

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

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Method Blank	Conductivity	B	L1962155-1, -2, -3, -4, -5, -6, -7
Method Blank	Conductivity	B	L1962155-1, -2, -3, -4, -5, -6, -7
Certified Reference Material	Conductivity	LCS-H	L1962155-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Dissolved Organic Carbon	MS-B	L1962155-3
Matrix Spike	Total Organic Carbon	MS-B	L1962155-1, -2
Matrix Spike	Total Organic Carbon	MS-B	L1962155-1, -2
Matrix Spike	Total Organic Carbon	MS-B	L1962155-3
Matrix Spike	Total Nitrogen	MS-B	L1962155-1, -2, -3, -4, -5, -6, -7

Qualifiers for Individual Parameters Listed:

Qualifier	Description
B	Method Blank exceeds ALS DQO. Associated sample results which are < Limit of Reporting or > 5 times blank level are considered reliable.
LCS-H	Lab Control Sample recovery was above ALS DQO. Non-detected sample results are considered reliable. Other results, if reported, have been qualified.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.
RRV	Reported Result Verified By Repeat Analysis

Test Method References:

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

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

ANIONS-N+N-CALC-VA	Water	Nitrite & Nitrate in Water (Calculation)	EPA 300.0

Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).

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

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

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

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

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

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

CHLOROA-F-VA	Filter	Chlorophyll a by Fluorometer (Filter)	EPA 445.0

This analysis is done using procedures modified from EPA Method 445.0. Chlorophyll-a is determined by a routine acetone extraction followed with analysis by fluorometry using the non-acidification procedure. This method is not subject to interferences from chlorophyll b.

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

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

COLOUR-TRUE-VA	Water	Colour (True) by Spectrometer	BCMOE Colour Single Wavelength

This analysis is carried out using procedures adapted from British Columbia Environmental Manual "Colour- Single Wavelength." Colour (True Colour) is determined by filtering a sample through a 0.45 micron membrane filter followed by analysis of the filtrate using the platinum-cobalt colourimetric method.
Colour measurements can be highly pH dependent, and apply to the pH of the sample as received (at time of testing), without pH adjustment. Concurrent measurement of sample pH is recommended.

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

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

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

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

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

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

N-T-COL-VA	Water	Total Nitrogen in water by Colour	APHA4500-P(J)/NEMI9171/USGS03-4174

Reference Information

This analysis is carried out using procedures adapted from APHA Method 4500-P (J) "Persulphate Method for Simultaneous Determination of Total Nitrogen and Total Phosphorus" and National Environmental Methods Index - Nemi method 5735.

NH3-F-VA Water Ammonia in Water by Fluorescence APHA 4500 NH3-NITROGEN (AMMONIA)

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

SILICATE-COL-VA Water Silicate by Colourimetric analysis APHA 4500-SiO2 E.

This analysis is carried out using procedures adapted from APHA Method 4500-SiO2 E. "Silica". Silicate (molybdate-reactive silica) is determined by the molybdosilicate-heteropoly blue colourimetric method.

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

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

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

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

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

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

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

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

TURBIDITY-VA Water Turbidity by Meter APHA 2130 Turbidity

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

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

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

Reference Information

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

Chain of Custody Numbers:

GLOSSARY OF REPORT TERMS

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

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

Tetra Tech Canada Inc.
ATTN: Danielle MacDonald
14940 - 123 Avenue, NW
Edmonton AB T5V 1B4

Date Received: 21-JUL-17
Report Date: 31-JUL-17 11:13 (MT)
Version: FINAL

Client Phone: 780-886-3055

Certificate of Analysis

Lab Work Order #: L1962772

Project P.O. #: NOT SUBMITTED
Job Reference: VENW03060
C of C Numbers:
Legal Site Desc:

Brent Mack, B.Sc.
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1962772-1 Water 21-JUL-17 09:53 HALFWAY RIVER - DOWNSTREAM (HD)	L1962772-2 Water 21-JUL-17 10:06 MIDDLE SITE C RESERVOIR (PR2)	L1962772-3 Water 21-JUL-17 08:09 PEACE CANYON (PC1)	L1962772-4 Water 21-JUL-17 08:41 UPPER SITE C RESERVOIR (PR1)	L1962772-5 Water 21-JUL-17 10:12 DUP 2
WATER						
Physical Tests	Colour, True (CU)	9.9	7.4	7.1	6.5	7.6
	Conductivity (uS/cm)	413	194	191	191	193
	pH (pH)	8.42	8.17	8.15	8.17	8.16
	Total Suspended Solids (mg/L)	41.3	6.7	<3.0	<3.0	9.7
	Total Dissolved Solids (mg/L)	279	122	117	129	123
	Turbidity (NTU)	38.8	3.50	1.37	1.43	3.35
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	177	85.4	83.3	84.4	84.4
	Alkalinity, Carbonate (as CaCO3) (mg/L)	9.8	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Phenolphthalein (as CaCO3) (mg/L)	4.9	<2.0	<2.0	<2.0	<2.0
	Alkalinity, Total (as CaCO3) (mg/L)	187	85.4	83.3	84.4	84.4
	Ammonia, Total (as N) (mg/L)	0.0174	<0.0050	0.0072	<0.0050	<0.0050
	Bromide (Br) (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Chloride (Cl) (mg/L)	<0.50	<0.50	<0.50	<0.50	<0.50
	Fluoride (F) (mg/L)	0.101	0.037	0.036	0.035	0.037
	Nitrate and Nitrite (as N) (mg/L)	<0.0051	0.0543	0.0542	0.0515	0.0530
	Nitrate (as N) (mg/L)	<0.0050	0.0543	0.0542	0.0515	0.0530
	Nitrite (as N) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Total Kjeldahl Nitrogen (mg/L)	0.223	0.097	0.106	0.082	0.098
	Total Nitrogen (mg/L)	0.157	0.134	0.165	0.122	0.130
	Orthophosphate-Dissolved (as P) (mg/L)	0.0020	<0.0010	<0.0010	<0.0010	<0.0010
	Phosphorus (P)-Total Dissolved (mg/L)	0.0033	0.0033	<0.0020	<0.0020	0.0029
	Phosphorus (P)-Total (mg/L)	0.0585	0.0118	0.0077	<0.0020	0.0057
	Silicate (as SiO2) (mg/L)	3.88	4.19	4.45	4.21	4.40
	Sulfate (SO4) (mg/L)	51.5	14.2 RRV	13.8	13.8 RRV	14.2 RRV
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	4.73	5.43 RRV	3.74	3.83 RRV	4.23 RRV
	Total Organic Carbon (mg/L)	4.33	3.43 RRV	3.32	2.84 RRV	2.76 RRV

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

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Dissolved Organic Carbon	MS-B	L1962772-2
Matrix Spike	Total Organic Carbon	MS-B	L1962772-2
Matrix Spike	Total Nitrogen	MS-B	L1962772-1, -2, -3, -4, -5
Matrix Spike	Sulfate (SO4)	MS-B	L1962772-1, -2, -3, -4, -5
Matrix Spike	Sulfate (SO4)	MS-B	L1962772-1, -2, -3, -4, -5

Qualifiers for Individual Parameters Listed:

Qualifier	Description
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.
RRV	Reported Result Verified By Repeat Analysis

Test Method References:

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

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

ANIONS-N+N-CALC-VA	Water	Nitrite & Nitrate in Water (Calculation)	EPA 300.0

Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).

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

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

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

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

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

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

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

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

COLOUR-TRUE-VA	Water	Colour (True) by Spectrometer	BCMOE Colour Single Wavelength

This analysis is carried out using procedures adapted from British Columbia Environmental Manual "Colour- Single Wavelength." Colour (True Colour) is determined by filtering a sample through a 0.45 micron membrane filter followed by analysis of the filtrate using the platinum-cobalt colourimetric method.
Colour measurements can be highly pH dependent, and apply to the pH of the sample as received (at time of testing), without pH adjustment. Concurrent measurement of sample pH is recommended.

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

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

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

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

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

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

N-T-COL-VA	Water	Total Nitrogen in water by Colour	APHA4500-P(J)/NEMI9171/USGS03-4174

This analysis is carried out using procedures adapted from APHA Method 4500-P (J) "Persulphate Method for Simultaneous Determination of Total Nitrogen and Total Phosphorus" and National Environmental Methods Index - Nemi method 5735.

NH3-F-VA	Water	Ammonia in Water by Fluorescence	APHA 4500 NH3-NITROGEN (AMMONIA)

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

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

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

Reference Information

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

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

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

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

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

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

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

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

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

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

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

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

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

SILICATE-COL-VA	Water	Silicate by Colourimetric analysis	APHA 4500-SiO2 E.

This analysis is carried out using procedures adapted from APHA Method 4500-SiO2 E. "Silica". Silicate (molybdate-reactive silica) is determined by the molybdosilicate-heteropoly blue colourimetric method.

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

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

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

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

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

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

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

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

TURBIDITY-VA	Water	Turbidity by Meter	APHA 2130 Turbidity

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

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

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

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

Chain of Custody Numbers:

Reference Information

GLOSSARY OF REPORT TERMS

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

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

Tetra Tech Canada Inc.
ATTN: Danielle MacDonald
14940 - 123 Avenue, NW
Edmonton AB T5V 1B4

Date Received: 09-AUG-17
Report Date: 21-AUG-17 11:45 (MT)
Version: FINAL

Client Phone: 780-886-3055

Certificate of Analysis

Lab Work Order #: L1972424

Project P.O. #: NOT SUBMITTED
Job Reference: VENW03060
C of C Numbers:
Legal Site Desc:

Brent Mack, B.Sc.
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1972424-1 Water 09-AUG-17 13:40 MOBERLY RIVER - DOWNSTREAM (MD)	L1972424-2 Water 09-AUG-17 14:15 LOWER SITE C RESERVOIR (PR3)	L1972424-3 Water 09-AUG-17 14:36 PEACE AT PINE (PD1)	L1972424-4 Water 09-AUG-17 16:05 PINE RIVER (PINE)	
WATER						
Physical Tests	Colour, True (CU)	17.1	6.8	7.5	6.3	
	Conductivity (uS/cm)	277	194	195	320	
	pH (pH)	8.31	8.12	8.16	8.44	
	Total Suspended Solids (mg/L)	9.5	34.1	51.5	6.7	
	Total Dissolved Solids (mg/L)	171	128	117	180	
	Turbidity (NTU)	7.95	7.20	9.56	4.92	
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	138	88.3	88.2	140	
	Alkalinity, Carbonate (as CaCO3) (mg/L)	2.2	<1.0	<1.0	8.0	
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	
	Alkalinity, Total (as CaCO3) (mg/L)	141	88.3	88.2	148	
	Ammonia, Total (as N) (mg/L)	0.0053	<0.0050	<0.0050	<0.0050	
	Bromide (Br) (mg/L)	<0.050	<0.050	<0.050	<0.050	
	Chloride (Cl) (mg/L)	0.53	<0.50	<0.50	1.26	
	Fluoride (F) (mg/L)	0.087	0.040	0.040	0.074	
	Nitrate and Nitrite (as N) (mg/L)	<0.0051	0.0542	0.0553	<0.0051	
	Nitrate (as N) (mg/L)	<0.0050	0.0542	0.0553	<0.0050	
	Nitrite (as N) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	
	Total Kjeldahl Nitrogen (mg/L)	0.124	0.061	0.092	0.067	
	Total Nitrogen (mg/L)	0.188	0.148	0.137	0.083	
	Orthophosphate-Dissolved (as P) (mg/L)	0.0013	<0.0010	<0.0010	<0.0010	
	Phosphorus (P)-Total Dissolved (mg/L)	0.0037	<0.0020	0.0026	<0.0020	
	Phosphorus (P)-Total (mg/L)	0.0102	0.0302	0.0194	0.0053	
	Silicate (as SiO2) (mg/L)	3.42	4.48	4.34	2.47	
	Sulfate (SO4) (mg/L)	14.0	16.4	16.3	25.6	
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	6.20	2.95	2.65	3.78	
	Total Organic Carbon (mg/L)	5.93	3.15	3.01	2.15 RRV	

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

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Dissolved Organic Carbon	MS-B	L1972424-1, -2, -3
Matrix Spike	Dissolved Organic Carbon	MS-B	L1972424-1, -2, -3
Matrix Spike	Dissolved Organic Carbon	MS-B	L1972424-4
Matrix Spike	Total Organic Carbon	MS-B	L1972424-1, -2, -3
Matrix Spike	Total Organic Carbon	MS-B	L1972424-1, -2, -3
Matrix Spike	Orthophosphate-Dissolved (as P)	MS-B	L1972424-1, -2, -3, -4
Matrix Spike	Sulfate (SO4)	MS-B	L1972424-1, -2, -3, -4
Matrix Spike	Total Kjeldahl Nitrogen	MS-B	L1972424-1, -2, -3, -4

Qualifiers for Individual Parameters Listed:

Qualifier	Description
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.
RRV	Reported Result Verified By Repeat Analysis

Test Method References:

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

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

ANIONS-N+N-CALC-VA	Water	Nitrite & Nitrate in Water (Calculation)	EPA 300.0

Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).

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

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

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

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

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

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

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

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

COLOUR-TRUE-VA	Water	Colour (True) by Spectrometer	BCMOE Colour Single Wavelength

This analysis is carried out using procedures adapted from British Columbia Environmental Manual "Colour- Single Wavelength." Colour (True Colour) is determined by filtering a sample through a 0.45 micron membrane filter followed by analysis of the filtrate using the platinum-cobalt colourimetric method.
Colour measurements can be highly pH dependent, and apply to the pH of the sample as received (at time of testing), without pH adjustment. Concurrent measurement of sample pH is recommended.

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

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

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

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

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

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

N-T-COL-VA	Water	Total Nitrogen in water by Colour	APHA4500-P(J)/NEMI9171/USGS03-4174

This analysis is carried out using procedures adapted from APHA Method 4500-P (J) "Persulphate Method for Simultaneous Determination of Total Nitrogen and Total Phosphorus" and National Environmental Methods Index - Nemi method 5735.

NH3-F-VA	Water	Ammonia in Water by Fluorescence	APHA 4500 NH3-NITROGEN (AMMONIA)

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

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

Reference Information

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

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

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

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

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

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

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

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

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

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

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

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

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

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

SILICATE-COL-VA Water Silicate by Colourimetric analysis APHA 4500-SiO2 E.

This analysis is carried out using procedures adapted from APHA Method 4500-SiO2 E. "Silica". Silicate (molybdate-reactive silica) is determined by the molybdosilicate-heteropoly blue colourimetric method.

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

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

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

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

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

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

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

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

TURBIDITY-VA Water Turbidity by Meter APHA 2130 Turbidity

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

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

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

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

Chain of Custody Numbers:

Reference Information

GLOSSARY OF REPORT TERMS

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

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

Tetra Tech Canada Inc.
ATTN: Danielle MacDonald
14940 - 123 Avenue, NW
Edmonton AB T5V 1B4

Date Received: 10-AUG-17
Report Date: 22-AUG-17 15:02 (MT)
Version: FINAL REV. 2

Client Phone: 780-886-3055

Certificate of Analysis

Lab Work Order #: L1973238

Project P.O. #: NOT SUBMITTED
Job Reference: VENW003060
C of C Numbers:
Legal Site Desc:

Comments:

22-AUG-2017 This report replaces the previous version and contains additional Anions data not included in the original report.

Brent Mack, B.Sc.
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1973238-1	L1973238-2	L1973238-3	L1973238-4	L1973238-5
	Description	Water	Water	Water	Water	Water
	Sampled Date	10-AUG-17	10-AUG-17	10-AUG-17	10-AUG-17	10-AUG-17
	Sampled Time	09:30	10:00		10:20	10:40
	Client ID	PEACE AT BEATTON (PD2)	BEATTON RIVER (BEATTON)	DUPLICATE 2 (DUP 2)	PEACE AT KISKATINAW (PD3)	KISKATINAW RIVER (KR)
Grouping	**Analyte**					
WATER						
Physical Tests	Colour, True (CU)	7.0	353	19.1	8.5	18.8
	Conductivity (uS/cm)	193	191	195	195	469
	pH (pH)	8.12	7.91	8.15	8.13	8.54
	Total Suspended Solids (mg/L)	73.1	20.3	77.3	99.3	5.3
	Total Dissolved Solids (mg/L)	132	227	127	132	294
	Turbidity (NTU)	15.4	32.8	15.1	15.4	6.77
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	86.4	64.6	88.9	87.2	215
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	17.4
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	86.4	64.6	88.9	87.2	232
	Ammonia, Total (as N) (mg/L)	<0.0050	0.0088	<0.0050	<0.0050	<0.0050
	Bromide (Br) (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Chloride (Cl) (mg/L)	<0.50	0.65	<0.50	<0.50	1.11
	Fluoride (F) (mg/L)	0.037	0.087	0.041	0.040	0.102
	Nitrate and Nitrite (as N) (mg/L)	0.0508	0.0075	0.0466	0.0472	<0.0051
	Nitrate (as N) (mg/L)	0.0508	0.0061	0.0466	0.0472	<0.0050
	Nitrite (as N) (mg/L)	<0.0010	0.0013	<0.0010	<0.0010	<0.0010
	Total Kjeldahl Nitrogen (mg/L)	0.152	1.09	0.170	0.178	0.382
	Total Nitrogen (mg/L)	0.138	0.948	0.150	0.156	0.346
	Orthophosphate-Dissolved (as P) (mg/L)	0.0019	0.0136	0.0021	0.0010 HTD	<0.0010
	Phosphorus (P)-Total Dissolved (mg/L)	<0.0020	0.0322	0.0023	0.0022	0.0027
	Phosphorus (P)-Total (mg/L)	0.0236	0.071	0.0517	0.115	0.0084
	Silicate (as SiO2) (mg/L)	4.04	6.27	3.93	4.05	4.48
	Sulfate (SO4) (mg/L)	16.0	32.3	16.4	16.4	36.8
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	2.98	41.8	4.37 RRV	3.16	10.4
	Total Organic Carbon (mg/L)	2.71	41.5	3.33 RRV	4.18 M	9.81

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1973238-6	L1973238-7	L1973238-8		
	Description	Water	Water	Water		
	Sampled Date	10-AUG-17	10-AUG-17	10-AUG-17		
	Sampled Time	11:10	11:25	13:40		
	Client ID	PEACE AT POUCE COUPE (PD4)	POUCE COUPE (POUCE)	PEACE AT MANY ISLANDS (PD5)		
Grouping	**Analyte**					
WATER						
Physical Tests	Colour, True (CU)	18.1	36.6	19.5		
	Conductivity (uS/cm)	201	922	196		
	pH (pH)	8.13	8.51	8.12		
	Total Suspended Solids (mg/L)	86.3	7.1	75.5		
	Total Dissolved Solids (mg/L)	128	652	128		
	Turbidity (NTU)	15.2	13.5	18.2		
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	89.9	232	89.5		
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	17.2	<1.0		
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0		
	Alkalinity, Total (as CaCO3) (mg/L)	89.9	249	89.5		
	Ammonia, Total (as N) (mg/L)	<0.0050	0.0106	<0.0050		
	Bromide (Br) (mg/L)	<0.050	<0.25 DLDS	<0.050		
	Chloride (Cl) (mg/L)	<0.50	12.9	<0.50		
	Fluoride (F) (mg/L)	0.042	0.22	0.040		
	Nitrate and Nitrite (as N) (mg/L)	0.0458	<0.025	0.0462		
	Nitrate (as N) (mg/L)	0.0458	<0.025 DLDS	0.0462		
	Nitrite (as N) (mg/L)	<0.0010	<0.0050 DLDS	<0.0010		
	Total Kjeldahl Nitrogen (mg/L)	0.175	0.875	0.163		
	Total Nitrogen (mg/L)	0.170	0.856	0.161		
	Orthophosphate-Dissolved (as P) (mg/L)	0.0020	<0.0010	0.0016		
	Phosphorus (P)-Total Dissolved (mg/L)	0.0025	0.0077	0.0024		
	Phosphorus (P)-Total (mg/L)	0.0364	0.0198	0.0289		
	Silicate (as SiO2) (mg/L)	4.25	0.72	3.99		
	Sulfate (SO4) (mg/L)	17.2	262	17.3		
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	4.08	19.0	4.29		
	Total Organic Carbon (mg/L)	5.56	19.1	4.23		

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

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Dissolved Organic Carbon	MS-B	L1973238-2, -4, -5, -7
Matrix Spike	Dissolved Organic Carbon	MS-B	L1973238-1, -3, -6, -8
Matrix Spike	Total Organic Carbon	MS-B	L1973238-1, -2, -4, -5, -6, -7
Matrix Spike	Total Organic Carbon	MS-B	L1973238-3, -8
Matrix Spike	Total Organic Carbon	MS-B	L1973238-3, -8
Matrix Spike	Total Organic Carbon	MS-B	L1973238-3, -8
Matrix Spike	Total Nitrogen	MS-B	L1973238-7
Matrix Spike	Ammonia, Total (as N)	MS-B	L1973238-1, -2, -3, -4, -5, -6, -7, -8

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLDS	Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity.
HTD	Hold time exceeded for re-analysis or dilution, but initial testing was conducted within hold time.
M	A peak has been manually integrated.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.
RRV	Reported Result Verified By Repeat Analysis

Test Method References:

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

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

ANIONS-N+N-CALC-VA	Water	Nitrite & Nitrate in Water (Calculation)	EPA 300.0

Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).

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

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

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

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

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

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

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

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

COLOUR-TRUE-VA	Water	Colour (True) by Spectrometer	BCMOE Colour Single Wavelength

This analysis is carried out using procedures adapted from British Columbia Environmental Manual "Colour- Single Wavelength." Colour (True Colour) is determined by filtering a sample through a 0.45 micron membrane filter followed by analysis of the filtrate using the platinum-cobalt colourimetric method.
Colour measurements can be highly pH dependent, and apply to the pH of the sample as received (at time of testing), without pH adjustment. Concurrent measurement of sample pH is recommended.

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

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

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

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

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

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

N-T-COL-VA	Water	Total Nitrogen in water by Colour	APHA4500-P(J)/NEMI9171/USGS03-4174

This analysis is carried out using procedures adapted from APHA Method 4500-P (J) "Persulphate Method for Simultaneous Determination of Total Nitrogen and Total Phosphorus" and National Environmental Methods Index - Nemi method 5735.

NH3-F-VA	Water	Ammonia in Water by Fluorescence	APHA 4500 NH3-NITROGEN (AMMONIA)

Reference Information

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

SILICATE-COL-VA	Water	Silicate by Colourimetric analysis	APHA 4500-SiO2 E.

This analysis is carried out using procedures adapted from APHA Method 4500-SiO2 E. "Silica". Silicate (molybdate-reactive silica) is determined by the molybdosilicate-heteropoly blue colourimetric method.

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

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

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

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

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

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

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

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

TURBIDITY-VA	Water	Turbidity by Meter	APHA 2130 Turbidity

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

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

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

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

Reference Information

Chain of Custody Numbers:

GLOSSARY OF REPORT TERMS

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

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

Tetra Tech Canada Inc.
ATTN: Danielle MacDonald
14940 - 123 Avenue, NW
Edmonton AB T5V 1B4

Date Received: 12-AUG-17
Report Date: 23-AUG-17 17:30 (MT)
Version: FINAL

Client Phone: 780-886-3055

Certificate of Analysis

Lab Work Order #: L1974039

Project P.O. #: NOT SUBMITTED
Job Reference: VENW03060
C of C Numbers:
Legal Site Desc:

Brent Mack, B.Sc.
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	Sample ID Description Sampled Date Sampled Time Client ID	L1974039-1 Water 11-AUG-17 10:45 WILLISTON SHALLOW (W1 - SHALLOW)	L1974039-2 Water 11-AUG-17 11:30 WILLISTON DEPP (W1 - DEEP)	L1974039-3 Water 11-AUG-17 14:00 DINOSAUR SHALLOW (D1 - SHALLOW)	L1974039-4 Water 11-AUG-17 15:00 DINOSAUR DEEP (D1 - DEEP)	L1974039-5 Water 11-AUG-17 DUPLICATE (DUP 1)
FILTER							
Plant Pigments	Chlorophyll a (ug/L)		1.01	0.925	0.109	0.170	0.094

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L1974039-6				
Description	Water				
Sampled Date	11-AUG-17				
Sampled Time	15:30				
Client ID	FIELD BLANK				
Grouping **Analyte**					
FILTER					
Plant Pigments Chlorophyll a (ug/L)	<0.010				

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1974039-1	L1974039-2	L1974039-3	L1974039-4	L1974039-5
	Description	Water	Water	Water	Water	Water
	Sampled Date	11-AUG-17	11-AUG-17	11-AUG-17	11-AUG-17	11-AUG-17
	Sampled Time	10:45	11:30	14:00	15:00	
	Client ID	WILLISTON SHALLOW (W1 - SHALLOW)	WILLISTON DEPP (W1 - DEEP)	DINOSAUR SHALLOW (D1 - SHALLOW)	DINOSAUR DEEP (D1 - DEEP)	DUPLICATE (DUP 1)
Grouping	**Analyte**					
WATER						
Physical Tests	Colour, True (CU)	8.0 HTD	8.5 HTD	7.2 HTD	7.3 HTD	7.7 HTD
	Conductivity (uS/cm)	170	170	176	176	178
	pH (pH)	8.13	8.14	8.12	8.13	8.14
	Total Suspended Solids (mg/L)	3.7	<3.0	<3.0	3.3	3.3
	Total Dissolved Solids (mg/L)	116	117	117	120	117
	Turbidity (NTU)	1.92	1.70	0.79	1.13	0.74
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	81.2	80.2	83.3	82.8	83.8
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	81.2	80.2	83.3	82.8	83.8
	Ammonia, Total (as N) (mg/L)	<0.0050	<0.0050	0.0072	0.0087	0.0097
	Bromide (Br) (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Chloride (Cl) (mg/L)	<0.50	<0.50	<0.50	<0.50	<0.50
	Fluoride (F) (mg/L)	0.034	0.036	0.037	0.037	0.037
	Nitrate and Nitrite (as N) (mg/L)	0.0433	0.0439	0.0601	0.0620	0.0604
	Nitrate (as N) (mg/L)	0.0433	0.0439	0.0601	0.0609	0.0604
	Nitrite (as N) (mg/L)	<0.0010	<0.0010	<0.0010	0.0011	<0.0010
	Total Kjeldahl Nitrogen (mg/L)	0.086	0.087	0.077	0.090	0.089
	Total Nitrogen (mg/L)	0.178	0.177	0.130	0.157	0.133
	Orthophosphate-Dissolved (as P) (mg/L)	<0.0010	<0.0010	0.0014	<0.0010	<0.0010
	Phosphorus (P)-Total Dissolved (mg/L)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Phosphorus (P)-Total (mg/L)	0.0025	0.0021	<0.0020	<0.0020	<0.010 DLM
	Silicate (as SiO2) (mg/L)	4.12	4.10	4.25	4.42	4.18
	Sulfate (SO4) (mg/L)	12.8	12.7	13.9	13.9	13.9
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	3.46	3.28	3.52 RRV	3.00	4.96 RRV
	Total Organic Carbon (mg/L)	2.90	3.15	2.93 RRV	2.87	2.95 RRV

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1974039-6				
	Description	Water				
	Sampled Date	11-AUG-17				
	Sampled Time	15:30				
	Client ID	FIELD BLANK				
Grouping	**Analyte**					
WATER						
Physical Tests	Colour, True (CU)	<5.0 HTD				
	Conductivity (uS/cm)	<2.0				
	pH (pH)	5.34				
	Total Suspended Solids (mg/L)	<3.0				
	Total Dissolved Solids (mg/L)	<10				
	Turbidity (NTU)	<0.10				
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	<1.0				
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0				
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0				
	Alkalinity, Total (as CaCO3) (mg/L)	<1.0				
	Ammonia, Total (as N) (mg/L)	<0.0050				
	Bromide (Br) (mg/L)	<0.050				
	Chloride (Cl) (mg/L)	<0.50				
	Fluoride (F) (mg/L)	<0.020				
	Nitrate and Nitrite (as N) (mg/L)	<0.0051				
	Nitrate (as N) (mg/L)	<0.0050				
	Nitrite (as N) (mg/L)	<0.0010				
	Total Kjeldahl Nitrogen (mg/L)	<0.050				
	Total Nitrogen (mg/L)	<0.030				
	Orthophosphate-Dissolved (as P) (mg/L)	<0.0010				
	Phosphorus (P)-Total Dissolved (mg/L)	<0.0020				
	Phosphorus (P)-Total (mg/L)	<0.0020				
	Silicate (as SiO2) (mg/L)	<0.50				
	Sulfate (SO4) (mg/L)	<0.30				
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	1.37 RRV				
	Total Organic Carbon (mg/L)	<0.50				

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

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Dissolved Organic Carbon	MS-B	L1974039-1, -2
Matrix Spike	Dissolved Organic Carbon	MS-B	L1974039-4
Matrix Spike	Dissolved Organic Carbon	MS-B	L1974039-3, -5, -6
Matrix Spike	Total Organic Carbon	MS-B	L1974039-1, -2
Matrix Spike	Total Organic Carbon	MS-B	L1974039-4, -6
Matrix Spike	Total Organic Carbon	MS-B	L1974039-3, -5
Matrix Spike	Fluoride (F)	MS-B	L1974039-1, -2, -3, -4, -5, -6
Matrix Spike	Total Nitrogen	MS-B	L1974039-1, -2, -3, -4, -5, -6

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
HTD	Hold time exceeded for re-analysis or dilution, but initial testing was conducted within hold time.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.
RRV	Reported Result Verified By Repeat Analysis

Test Method References:

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

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

ANIONS-N+N-CALC-VA	Water	Nitrite & Nitrate in Water (Calculation)	EPA 300.0

Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).

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

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

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

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

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

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

CHLOROA-F-VA	Filter	Chlorophyll a by Fluorometer (Filter)	EPA 445.0

This analysis is done using procedures modified from EPA Method 445.0. Chlorophyll-a is determined by a routine acetone extraction followed with analysis by fluorometry using the non-acidification procedure. This method is not subject to interferences from chlorophyll b.

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

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

COLOUR-TRUE-VA	Water	Colour (True) by Spectrometer	BCMOE Colour Single Wavelength

This analysis is carried out using procedures adapted from British Columbia Environmental Manual "Colour- Single Wavelength." Colour (True Colour) is determined by filtering a sample through a 0.45 micron membrane filter followed by analysis of the filtrate using the platinum-cobalt colourimetric method.
Colour measurements can be highly pH dependent, and apply to the pH of the sample as received (at time of testing), without pH adjustment. Concurrent measurement of sample pH is recommended.

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

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

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

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

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

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

N-T-COL-VA	Water	Total Nitrogen in water by Colour	APHA4500-P(J)/NEMI9171/USGS03-4174

This analysis is carried out using procedures adapted from APHA Method 4500-P (J) "Persulphate Method for Simultaneous Determination of Total Nitrogen and Total Phosphorus" and National Environmental Methods Index - Nemi method 5735.

Reference Information

NH3-F-VA	Water	Ammonia in Water by Fluorescence	APHA 4500 NH3-NITROGEN (AMMONIA)

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

SILICATE-COL-VA	Water	Silicate by Colourimetric analysis	APHA 4500-SiO2 E.

This analysis is carried out using procedures adapted from APHA Method 4500-SiO2 E. "Silica". Silicate (molybdate-reactive silica) is determined by the molybdosilicate-heteropoly blue colourimetric method.

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

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

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

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

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

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

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

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

TURBIDITY-VA	Water	Turbidity by Meter	APHA 2130 Turbidity

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

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

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

Laboratory Definition Code	Laboratory Location

Reference Information

VA ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

GLOSSARY OF REPORT TERMS

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

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

Tetra Tech Canada Inc.
ATTN: Danielle MacDonald
14940 - 123 Avenue, NW
Edmonton AB T5V 1B4

Date Received: 12-AUG-17
Report Date: 22-AUG-17 12:01 (MT)
Version: FINAL

Client Phone: 780-886-3055

Certificate of Analysis

Lab Work Order #: L1974040

Project P.O. #: NOT SUBMITTED
Job Reference: VENW03060
C of C Numbers:
Legal Site Desc:

Brent Mack, B.Sc.
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1974040-1 Water 12-AUG-17 13:50 HALFWAY RIVER - DOWNSTREAM (HD)	L1974040-2 Water 12-AUG-17 14:10 MIDDLE SITE C RESERVOIR (PR2)	L1974040-3 Water 12-AUG-17 12:05 PEACE CANYON (PC1)	L1974040-4 Water 12-AUG-17 11:45 UPPER SITE C RESERVOIR (PR1)	L1974040-5 Water 12-AUG-17 TRIP BLANK
WATER						
Physical Tests	Colour, True (CU)	5.9	7.9	6.7	6.0	<5.0
	Conductivity (uS/cm)	424	183	176	178	<2.0
	pH (pH)	8.45	8.16	8.13	8.14	5.34
	Total Suspended Solids (mg/L)	23.7	<3.0	<3.0	<3.0	<3.0
	Total Dissolved Solids (mg/L)	269	111	109	111	<10
	Turbidity (NTU)	12.8	2.39	1.16	1.06	<0.10
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	180	86.2	84.0	84.1	<1.0
	Alkalinity, Carbonate (as CaCO3) (mg/L)	12.2	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	193	86.2	84.0	84.1	<1.0
	Ammonia, Total (as N) (mg/L)	<0.0050	<0.0050	0.0079	<0.0050	<0.0050
	Bromide (Br) (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Chloride (Cl) (mg/L)	0.50	<0.50	<0.50	<0.50	<0.50
	Fluoride (F) (mg/L)	0.108	0.037	0.034	0.037	<0.020
	Nitrate and Nitrite (as N) (mg/L)	<0.0051	0.0558	0.0619	0.0606	<0.0051
	Nitrate (as N) (mg/L)	<0.0050	0.0558	0.0608	0.0595	<0.0050
	Nitrite (as N) (mg/L)	<0.0010	<0.0010	0.0011	0.0011	<0.0010
	Total Kjeldahl Nitrogen (mg/L)	0.125	0.096	0.070	0.065	<0.050
	Total Nitrogen (mg/L)	0.109	0.160	0.148	0.130	<0.030
	Orthophosphate-Dissolved (as P) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Phosphorus (P)-Total Dissolved (mg/L)	0.0024	<0.0020	<0.0020	<0.0020	<0.0020
	Phosphorus (P)-Total (mg/L)	0.0164	0.0056	0.0028	0.0021	<0.0020
	Silicate (as SiO2) (mg/L)	3.72	4.28	4.29	4.31	<0.50
	Sulfate (SO4) (mg/L)	56.8	14.5	13.8	13.8	<0.30
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	3.19	3.09	2.71	2.79	
	Total Organic Carbon (mg/L)	2.88	2.81	2.61	2.73	<0.50

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

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Dissolved Organic Carbon	MS-B	L1974040-1, -2, -3, -4
Matrix Spike	Total Organic Carbon	MS-B	L1974040-1, -2, -3, -4, -5
Matrix Spike	Fluoride (F)	MS-B	L1974040-1, -2, -3, -4, -5
Matrix Spike	Total Nitrogen	MS-B	L1974040-1, -2, -3, -4, -5

Qualifiers for Individual Parameters Listed:

Qualifier	Description
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

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

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

ANIONS-N+N-CALC-VA	Water	Nitrite & Nitrate in Water (Calculation)	EPA 300.0

Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).

BR-L-IC-N-VA	Water	Bromide in Water by IC (Low Level)	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

CARBONS-DOC-VA	Water	Dissolved organic carbon by combustion	APHA 5310B TOTAL ORGANIC CARBON (TOC)

This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis.

CARBONS-TOC-VA	Water	Total organic carbon by combustion	APHA 5310B TOTAL ORGANIC CARBON (TOC)

This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)".

CL-IC-N-VA	Water	Chloride in Water by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

COLOUR-TRUE-VA	Water	Colour (True) by Spectrometer	BCMOE Colour Single Wavelength

This analysis is carried out using procedures adapted from British Columbia Environmental Manual "Colour- Single Wavelength." Colour (True Colour) is determined by filtering a sample through a 0.45 micron membrane filter followed by analysis of the filtrate using the platinum-cobalt colourimetric method.
Colour measurements can be highly pH dependent, and apply to the pH of the sample as received (at time of testing), without pH adjustment. Concurrent measurement of sample pH is recommended.

EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510

Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.

F-IC-N-VA	Water	Fluoride in Water by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

N-T-COL-VA	Water	Total Nitrogen in water by Colour	APHA4500-P(J)/NEMI9171/USGS03-4174

This analysis is carried out using procedures adapted from APHA Method 4500-P (J) "Persulphate Method for Simultaneous Determination of Total Nitrogen and Total Phosphorus" and National Environmental Methods Index - Nemi method 5735.

NH3-F-VA	Water	Ammonia in Water by Fluorescence	APHA 4500 NH3-NITROGEN (AMMONIA)

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NH3-F-VA	Water	Ammonia in Water by Fluorescence	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-VA	Water	Nitrite in Water by IC (Low Level)	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

Reference Information

NO3-L-IC-N-VA	Water	Nitrate in Water by IC (Low Level)	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

P-T-PRES-COL-VA	Water	Total P in Water by Colour	APHA 4500-P Phosphorus

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorus is determined colourimetrically after persulphate digestion of the sample.
Samples with very high dissolved solids (i.e. seawaters, brackish waters) may produce a negative bias by this method. Alternate methods are available for these types of samples.

P-TD-COL-VA	Water	Total Dissolved P in Water by Colour	APHA 4500-P Phosphorous

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Dissolved Phosphorus is determined colourimetrically after persulphate digestion of a sample that has been lab or field filtered through a 0.45 micron membrane filter.
Samples with very high dissolved solids (i.e. seawaters, brackish waters) may produce a negative bias by this method. Alternate methods are available for these types of samples.

PH-PCT-VA	Water	pH by Meter (Automated)	APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

PO4-DO-COL-VA	Water	Diss. Orthophosphate in Water by Colour	APHA 4500-P Phosphorus

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Dissolved Orthophosphate is determined colourimetrically on a sample that has been lab or field filtered through a 0.45 micron membrane filter.
Samples with very high dissolved solids (i.e. seawaters, brackish waters) may produce a negative bias by this method. Alternate methods are available for these types of samples.

SILICATE-COL-VA	Water	Silicate by Colourimetric analysis	APHA 4500-SiO2 E.

This analysis is carried out using procedures adapted from APHA Method 4500-SiO2 E. "Silica". Silicate (molybdate-reactive silica) is determined by the molybdosilicate-heteropoly blue colourimetric method.

SO4-IC-N-VA	Water	Sulfate in Water by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-VA	Water	Total Dissolved Solids by Gravimetric	APHA 2540 C - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Dissolved Solids (TDS) are determined by filtering a sample through a glass fibre filter, TDS is determined by evaporating the filtrate to dryness at 180 degrees celsius.

TKN-F-VA	Water	TKN in Water by Fluorescence	APHA 4500-NORG D.

This analysis is carried out using procedures adapted from APHA Method 4500-Norg D. "Block Digestion and Flow Injection Analysis". Total Kjeldahl Nitrogen is determined using block digestion followed by Flow-injection analysis with fluorescence detection.

TSS-VA	Water	Total Suspended Solids by Gravimetric	APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.
Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

TURBIDITY-VA	Water	Turbidity by Meter	APHA 2130 Turbidity

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

Reference Information

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Tetra Tech Canada Inc.
ATTN: Danielle MacDonald
14940 - 123 Avenue, NW
Edmonton AB T5V 1B4

Date Received: 18-SEP-17
Report Date: 02-OCT-17 17:23 (MT)
Version: FINAL

Client Phone: 780-886-3055

Certificate of Analysis

Lab Work Order #: L1992751

Project P.O. #: NOT SUBMITTED
Job Reference: VENW03060
C of C Numbers: 14-
Legal Site Desc:

Brent Mack, B.Sc.
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L1992751-1	L1992751-2	L1992751-3	L1992751-4	L1992751-5
Description	Water	Water	Water	Water	Water
Sampled Date	17-SEP-17	17-SEP-17	17-SEP-17	17-SEP-17	17-SEP-17
Sampled Time	12:00	13:00	15:30	16:30	
Client ID	WILLISTON SHALLOW (W1-SHALLOW)	WILLISTON DEEP (W1- DEEP)	DINOSAUR SHALLOW (D1-SHALLOW)	DINOSAUR DEEP (D1- DEEP)	DUPLICATE 1 (DUP 1)
Grouping **Analyte**					
FILTER					
Plant Pigments Chlorophyll a (ug/L)	0.914	0.965	0.614	0.628	0.752

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1992751-1	L1992751-2	L1992751-3	L1992751-4	L1992751-5
	Description	Water	Water	Water	Water	Water
	Sampled Date	17-SEP-17	17-SEP-17	17-SEP-17	17-SEP-17	17-SEP-17
	Sampled Time	12:00	13:00	15:30	16:30	
	Client ID	WILLISTON SHALLOW (W1-SHALLOW)	WILLISTON DEEP (W1- DEEP)	DINOSAUR SHALLOW (D1-SHALLOW)	DINOSAUR DEEP (D1- DEEP)	DUPLICATE 1 (DUP 1)
Grouping	**Analyte**					
WATER						
Physical Tests	Colour, True (CU)	7.5	7.8	7.7	7.3	7.4
	Conductivity (uS/cm)	167	169	170	170	174
	Hardness (as CaCO3) (mg/L)	84.5	86.6	87.9	89.5	89.3
	pH (pH)	7.98	8.00	7.98	7.98	8.09
	Total Suspended Solids (mg/L)	<3.0	<3.0	<3.0	<3.0	<3.0
	TDS (Calculated) (mg/L)	92.2	94.5	95.1	95.7	96.2
	Turbidity (NTU)	1.03	1.03	1.26	1.33	1.40
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	77.6	79.9	79.8	79.7	80.9
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Phenolphthalein (as CaCO3) (mg/L)	<2.0	<2.0	<2.0	<2.0	<2.0
	Alkalinity, Total (as CaCO3) (mg/L)	77.6	79.9	79.8	79.7	80.9
	Ammonia, Total (as N) (mg/L)	0.0053	<0.0050	<0.0050	<0.0050	<0.0050
	Bromide (Br) (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Chloride (Cl) (mg/L)	<0.50	<0.50	<0.50	<0.50	<0.50
	Fluoride (F) (mg/L)	0.035	0.034	0.035	0.035	0.035
	Nitrate and Nitrite (as N) (mg/L)	0.0503	0.0488	0.0574	0.0572	0.0565
	Nitrate (as N) (mg/L)	0.0463	0.0446	0.0546	0.0543	0.0539
	Nitrite (as N) (mg/L)	0.0040	0.0043	0.0028	0.0028	0.0026
	Total Kjeldahl Nitrogen (mg/L)	0.117	0.118	0.113	0.112	0.101
	Total Nitrogen (mg/L)	0.150	0.139	0.142	0.135	0.139
	Orthophosphate-Dissolved (as P) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Phosphorus (P)-Total Dissolved (mg/L)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Phosphorus (P)-Total (mg/L)	0.0036	0.0035	0.0036	0.0036	0.0041
	Silicate (as SiO2) (mg/L)	4.35	4.30	4.65	4.38	4.58
	Sulfate (SO4) (mg/L)	12.5	12.4	13.0	13.0	13.0
	Anion Sum (meq/L)	1.82	1.86	1.87	1.87	1.89
	Cation Sum (meq/L)	1.69	1.73	1.76	1.79	1.79
	Cation - Anion Balance (%)	-3.6	-3.6	-3.2	-2.2	-2.9
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	2.93	2.89	2.90	2.47	2.46
	Total Organic Carbon (mg/L)	2.88	3.05	2.61	2.67	2.53
Total Metals	Aluminum (Al)-Total (mg/L)	0.0310	0.0341	0.0329	0.0366	0.0393
	Antimony (Sb)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Arsenic (As)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Barium (Ba)-Total (mg/L)	0.029	0.030	0.030	0.031	0.031
	Beryllium (Be)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1992751-1 Water 17-SEP-17 12:00 WILLISTON SHALLOW (W1-SHALLOW)	L1992751-2 Water 17-SEP-17 13:00 WILLISTON DEEP (W1- DEEP)	L1992751-3 Water 17-SEP-17 15:30 DINOSAUR SHALLOW (D1-SHALLOW)	L1992751-4 Water 17-SEP-17 16:30 DINOSAUR DEEP (D1- DEEP)	L1992751-5 Water 17-SEP-17 DUPLICATE 1 (DUP 1)
WATER						
Total Metals	Bismuth (Bi)-Total (mg/L)	<0.20	<0.20	<0.20	<0.20	<0.20
	Boron (B)-Total (mg/L)	<0.10	<0.10	<0.10	<0.10	<0.10
	Cadmium (Cd)-Total (mg/L)	0.0000132	0.0000104	0.0000144	0.0000107	0.0000173
	Calcium (Ca)-Total (mg/L)	24.6	25.1	25.7	25.8	26.2
	Chromium (Cr)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Cobalt (Co)-Total (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
	Copper (Cu)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Iron (Fe)-Total (mg/L)	0.036	0.041	0.040	0.042	0.045
	Lead (Pb)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Lithium (Li)-Total (mg/L)	0.0012	0.0014	0.0013	0.0014	0.0015
	Magnesium (Mg)-Total (mg/L)	5.76	5.97	6.02	6.09	5.92
	Manganese (Mn)-Total (mg/L)	0.00158	0.00186	0.00198	0.00213	0.00190
	Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Mercury (Hg)-Total (ug/L)	0.00062	<0.00050	<0.00050	<0.00050	<0.00050
	Molybdenum (Mo)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Nickel (Ni)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Phosphorus (P)-Total (mg/L)	<0.30	<0.30	<0.30	<0.30	<0.30
	Potassium (K)-Total (mg/L)	<2.0	<2.0	<2.0	<2.0	<2.0
	Selenium (Se)-Total (mg/L)	0.000233	0.000208	0.000262	0.000255	0.000244
	Silicon (Si)-Total (mg/L)	2.08	2.18	2.17	2.14	2.17
	Silver (Ag)-Total (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Sodium (Na)-Total (mg/L)	<2.0	<2.0	<2.0	<2.0	<2.0
	Strontium (Sr)-Total (mg/L)	0.0927	0.0955	0.0985	0.0965	0.0985
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Titanium (Ti)-Total (mg/L)	<0.010	<0.010	<0.010	<0.010	<0.010
	Uranium (U)-Total (mg/L)	0.00041	0.00043	0.00043	0.00043	0.00043
	Vanadium (V)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Zinc (Zn)-Total (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Dissolved Metals	Dissolved MeHg Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	<0.0050	<0.0050	<0.0050	0.0055	0.0136
	Antimony (Sb)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Arsenic (As)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Barium (Ba)-Dissolved (mg/L)	0.029	0.029	0.030	0.031	0.031
	Beryllium (Be)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L1992751-1	L1992751-2	L1992751-3	L1992751-4	L1992751-5
Description	Water	Water	Water	Water	Water
Sampled Date	17-SEP-17	17-SEP-17	17-SEP-17	17-SEP-17	17-SEP-17
Sampled Time	12:00	13:00	15:30	16:30	
Client ID	WILLISTON SHALLOW (W1-SHALLOW)	WILLISTON DEEP (W1- DEEP)	DINOSAUR SHALLOW (D1-SHALLOW)	DINOSAUR DEEP (D1- DEEP)	DUPLICATE 1 (DUP 1)
Grouping / **Analyte**					
WATER					
Dissolved Metals Bismuth (Bi)-Dissolved (mg/L)	<0.20	<0.20	<0.20	<0.20	<0.20
Boron (B)-Dissolved (mg/L)	<0.10	<0.10	<0.10	<0.10	<0.10
Cadmium (Cd)-Dissolved (mg/L)	0.0000074	<0.0000050	0.0000108	<0.0000050	0.0000115
Calcium (Ca)-Dissolved (mg/L)	24.2	25.0	25.2	25.9	26.0
Chromium (Cr)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Cobalt (Co)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
Copper (Cu)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Iron (Fe)-Dissolved (mg/L)	<0.030	<0.030	<0.030	<0.030	<0.030
Lead (Pb)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Lithium (Li)-Dissolved (mg/L)	0.0012	0.0013	0.0013	0.0014	0.0013
Magnesium (Mg)-Dissolved (mg/L)	5.83	5.85	6.03	6.04	5.93
Manganese (Mn)-Dissolved (mg/L)	0.00054	0.00060	0.00066	0.00071	0.00073
Mercury (Hg)-Dissolved (ug/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Molybdenum (Mo)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Nickel (Ni)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Phosphorus (P)-Dissolved (mg/L)	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)-Dissolved (mg/L)	<2.0	<2.0	<2.0	<2.0	<2.0
Selenium (Se)-Dissolved (mg/L)	0.000235	0.000233	0.000258	0.000228	0.000267
Silicon (Si)-Dissolved (mg/L)	1.96	2.02	2.04	2.09	2.04
Silver (Ag)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
Sodium (Na)-Dissolved (mg/L)	<2.0	<2.0	<2.0	<2.0	<2.0
Strontium (Sr)-Dissolved (mg/L)	0.0910	0.0940	0.0951	0.0971	0.0970
Thallium (Tl)-Dissolved (mg/L)	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Tin (Sn)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Titanium (Ti)-Dissolved (mg/L)	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium (U)-Dissolved (mg/L)	0.00036	0.00033	0.00036	0.00037	0.00038
Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Zinc (Zn)-Dissolved (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Speciated Metals Methylmercury (as MeHg)-Dissolved (ug/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Methylmercury (as MeHg)-Total (ug/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Dissolved Organic Carbon	MS-B	L1992751-1, -2, -3, -5
Matrix Spike	Total Organic Carbon	MS-B	L1992751-4, -5
Matrix Spike	Aluminum (Al)-Dissolved	MS-B	L1992751-5
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L1992751-1, -2, -3, -4, -5
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L1992751-5
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L1992751-5
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L1992751-5
Matrix Spike	Boron (B)-Dissolved	MS-B	L1992751-5
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L1992751-1, -2, -3, -4, -5
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L1992751-5
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L1992751-5
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L1992751-5
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L1992751-1, -2, -3, -4, -5
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L1992751-5
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L1992751-5
Matrix Spike	Molybdenum (Mo)-Dissolved	MS-B	L1992751-5
Matrix Spike	Potassium (K)-Dissolved	MS-B	L1992751-5
Matrix Spike	Selenium (Se)-Dissolved	MS-B	L1992751-5
Matrix Spike	Selenium (Se)-Dissolved	MS-B	L1992751-5
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L1992751-5
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L1992751-5
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1992751-1, -2, -3, -4, -5
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1992751-5
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1992751-5
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1992751-5
Matrix Spike	Uranium (U)-Dissolved	MS-B	L1992751-5
Matrix Spike	Calcium (Ca)-Total	MS-B	L1992751-1, -2, -3, -4, -5
Matrix Spike	Magnesium (Mg)-Total	MS-B	L1992751-1, -2, -3, -4, -5
Matrix Spike	Strontium (Sr)-Total	MS-B	L1992751-1, -2, -3, -4, -5
Matrix Spike	Total Nitrogen	MS-B	L1992751-1, -2, -3, -4, -5
Matrix Spike	Phosphorus (P)-Total	MS-B	L1992751-1, -2, -3, -4, -5

Qualifiers for Individual Parameters Listed:

Qualifier	Description
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

ANIONS-N+N-CALC-VA	Water	Nitrite & Nitrate in Water (Calculation)	EPA 300.0

Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).

BR-L-IC-N-VA	Water	Bromide in Water by IC (Low Level)	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

CARBONS-DOC-VA	Water	Dissolved organic carbon by combustion	APHA 5310B TOTAL ORGANIC CARBON (TOC)

This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis.

CARBONS-TOC-VA	Water	Total organic carbon by combustion	APHA 5310B TOTAL ORGANIC CARBON (TOC)

This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)".

CHLOROA-F-VA	Filter	Chlorophyll a by Fluorometer (Filter)	EPA 445.0

Reference Information

This analysis is done using procedures modified from EPA Method 445.0. Chlorophyll-a is determined by a routine acetone extraction followed with analysis by fluorometry using the non-acidification procedure. This method is not subject to interferences from chlorophyll b.

CL-IC-N-VA Water Chloride in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

COLOUR-TRUE-VA Water Colour (True) by Spectrometer BCMOE Colour Single Wavelength

This analysis is carried out using procedures adapted from British Columbia Environmental Manual "Colour- Single Wavelength." Colour (True Colour) is determined by filtering a sample through a 0.45 micron membrane filter followed by analysis of the filtrate using the platinum-cobalt colourimetric method.
Colour measurements can be highly pH dependent, and apply to the pH of the sample as received (at time of testing), without pH adjustment. Concurrent measurement of sample pH is recommended.

EC-PCT-VA Water Conductivity (Automated) APHA 2510 Auto. Conduc.

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

EC-SCREEN-VA Water Conductivity Screen (Internal Use Only) APHA 2510

Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.

F-IC-N-VA Water Fluoride in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

HARDNESS-CALC-VA Water Hardness APHA 2340B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HG-D-U-CVAF-VA Water Diss. Mercury in Water by CVAFS (Ultra) APHA 3030 B / EPA 1631 REV. E

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from Method 1631 Rev. E. by the United States Environmental Protection Agency (EPA). The procedure may involve preliminary sample treatment by filtration (APHA 3030B) and involves a cold-oxidation of the acidified sample using bromine monochloride prior to a purge and trap concentration step and final reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry.

HG-T-CVAA-VA Water Total Mercury in Water by CVAAS or CVAFS EPA 1631E (mod)

Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

HG-T-U-CVAF-VA Water Total Mercury in Water by CVAFS (Ultra) EPA 1631 REV. E

This analysis is carried out using procedures adapted from Method 1631 Rev. E. by the United States Environmental Protection Agency (EPA). The procedure involves a cold-oxidation of the acidified sample using bromine monochloride prior to a purge and trap concentration step and final reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry.

IONBALANCE-VA Water Ion Balance Calculation APHA 1030E

Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:

Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum]

MEHG-D-GCAF-VA Water Diss. Methylmercury in Water by GCAFS EPA 1630

This method follows Method 1630 of the US EPA. Samples are distilled under an inert gas flow to isolate methylmercury and minimize matrix interferences. The distillate is analyzed by aqueous phase ethylation, purge and trap, desorption and GC separation. The separated species are then pyrolized to elemental Hg and quantified by cold vapour atomic flourescence spectroscopy. Results are reported "as MeHg".

MEHG-T-GCAF-VA Water Total Methylmercury in Water by GCAFS EPA 1630

This method follows Method 1630 of the US EPA. Samples are distilled under an inert gas flow to isolate methylmercury and minimize matrix interferences. The distillate is analyzed by aqueous phase ethylation, purge and trap, desorption and GC separation. THe separated species are then pyrolized to elemental Hg and quantified by cold vapour atomic flourescence spectroscopy. Results are reported "as MeHg".

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)

Reference Information

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

N-T-COL-VA	Water	Total Nitrogen in water by Colour	APHA4500-P(J)/NEMI9171/USGS03-4174

This analysis is carried out using procedures adapted from APHA Method 4500-P (J) "Persulphate Method for Simultaneous Determination of Total Nitrogen and Total Phosphorus" and National Environmental Methods Index - Nemi method 5735.

NH3-F-VA	Water	Ammonia in Water by Fluorescence	APHA 4500 NH3-NITROGEN (AMMONIA)

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NH3-F-VA	Water	Ammonia in Water by Fluorescence	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-VA	Water	Nitrite in Water by IC (Low Level)	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-VA	Water	Nitrate in Water by IC (Low Level)	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

P-T-PRES-COL-VA	Water	Total P in Water by Colour	APHA 4500-P Phosphorus

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorus is determined colourimetrically after persulphate digestion of the sample.
Samples with very high dissolved solids (i.e. seawaters, brackish waters) may produce a negative bias by this method. Alternate methods are available for these types of samples.

Arsenic (5+), at elevated levels, is a positive interference on colourimetric phosphate analysis.

P-TD-COL-VA	Water	Total Dissolved P in Water by Colour	APHA 4500-P Phosphorous

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Dissolved Phosphorus is determined colourimetrically after persulphate digestion of a sample that has been lab or field filtered through a 0.45 micron membrane filter.
Samples with very high dissolved solids (i.e. seawaters, brackish waters) may produce a negative bias by this method. Alternate methods are available for these types of samples.

Arsenic (5+), at elevated levels, is a positive interference on colourimetric phosphate analysis.

PH-PCT-VA	Water	pH by Meter (Automated)	APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

PO4-DO-COL-VA	Water	Diss. Orthophosphate in Water by Colour	APHA 4500-P Phosphorus

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Dissolved Orthophosphate is determined colourimetrically on a sample that has been lab or field filtered through a 0.45 micron membrane filter.
Samples with very high dissolved solids (i.e. seawaters, brackish waters) may produce a negative bias by this method. Alternate methods are available for these types of samples.

Arsenic (5+), at elevated levels, is a positive interference on colourimetric phosphate analysis.

SILICATE-COL-VA	Water	Silicate by Colourimetric analysis	APHA 4500-SiO2 E.

This analysis is carried out using procedures adapted from APHA Method 4500-SiO2 E. "Silica". Silicate (molybdate-reactive silica) is determined by the molybdosilicate-heteropoly blue colourimetric method.

SO4-IC-N-VA	Water	Sulfate in Water by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA	Water	TDS (Calculated)	APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".
The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TKN-F-VA	Water	TKN in Water by Fluorescence	APHA 4500-NORG D.

This analysis is carried out using procedures adapted from APHA Method 4500-Norg D. "Block Digestion and Flow Injection Analysis". Total Kjeldahl Nitrogen is determined using block digestion followed by Flow-injection analysis with fluorescence detection.

TSS-VA	Water	Total Suspended Solids by Gravimetric	APHA 2540 D - GRAVIMETRIC

Reference Information

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius. Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

TURBIDITY-VA Water Turbidity by Meter APHA 2130 Turbidity

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

14-

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Tetra Tech Canada Inc.
ATTN: Danielle MacDonald
14940 - 123 Avenue, NW
Edmonton AB T5V 1B4

Date Received: 18-SEP-17
Report Date: 29-SEP-17 17:24 (MT)
Version: FINAL

Client Phone: 780-886-3055

Certificate of Analysis

Lab Work Order #: L1993110

Project P.O. #: NOT SUBMITTED
Job Reference: VENW03058
C of C Numbers: 14-
Legal Site Desc:

Brent Mack, B.Sc.
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L1993110-6				
Description	Water				
Sampled Date	18-SEP-17				
Sampled Time	13:00				
Client ID	FIELD BLANK				
Grouping **Analyte**					
FILTER					
Plant Pigments Chlorophyll a (ug/L)	<0.010				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1993110-1 Water 18-SEP-17 14:30 HALFWAY RIVER - DOWNSTREAM (HD)	L1993110-2 Water 18-SEP-17 15:30 MIDDLE SITE C RESERVOIR (PR2)	L1993110-3 Water 18-SEP-17 10:45 PEACE CANYON (PC1)	L1993110-4 Water 18-SEP-17 11:50 UPPER CSITE C RESERVOIR (PR1)	L1993110-5 Water 18-SEP-17 16:45 DUPLICATE 2 (DUP 2)
WATER						
Physical Tests	Colour, True (CU)	<5.0	8.6	8.4	8.2	7.4
	Conductivity (uS/cm)	442	177	175	175	178
	Hardness (as CaCO3) (mg/L)	228	84.9	88.5	89.1	89.7
	pH (pH)	8.38	8.10	8.09	8.07	8.11
	Total Suspended Solids (mg/L)	7.8	4.8	<3.0	<3.0	4.8
	TDS (Calculated) (mg/L)	260	94.2	96.2	95.4	96.9
	Turbidity (NTU)	4.70	2.04	2.22	2.16	2.57
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	185	80.2	80.8	79.2	81.0
	Alkalinity, Carbonate (as CaCO3) (mg/L)	7.6	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	192	80.2	80.8	79.2	81.0
	Ammonia, Total (as N) (mg/L)	<0.0050	<0.0050	<0.0050	0.0079	<0.0050
	Bromide (Br) (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Chloride (Cl) (mg/L)	0.57	<0.50	<0.50	<0.50	<0.50
	Fluoride (F) (mg/L)	0.101	0.034	0.034	0.034	0.035
	Nitrate and Nitrite (as N) (mg/L)	<0.0051	0.0490	0.0560	0.0535	0.0511
	Nitrate (as N) (mg/L)	<0.0050	0.0469	0.0535	0.0510	0.0486
	Nitrite (as N) (mg/L)	<0.0010	0.0021	0.0025	0.0026	0.0025
	Total Kjeldahl Nitrogen (mg/L)	0.070	0.076	0.074	0.073	0.079
	Total Nitrogen (mg/L)	0.076	0.130	0.142	0.138	0.132
	Orthophosphate-Dissolved (as P) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Phosphorus (P)-Total Dissolved (mg/L)	<0.0020	<0.0020	<0.0020	0.0028	<0.0020
	Phosphorus (P)-Total (mg/L)	0.0086	0.0069	0.0037	0.0044	0.0061
	Phosphorus (P)-Total Dissolved (mg/L)					
	Silicate (as SiO2) (mg/L)	3.47	4.23	4.26	4.27	4.15
	Sulfate (SO4) (mg/L)	59.6	13.1	13.0	13.0	13.2
	Anion Sum (meq/L)	5.10	1.88	1.89	1.86	1.90
	Cation Sum (meq/L)	4.69	1.70	1.77	1.78	1.79
	Cation - Anion Balance (%)	-4.2	-5.0	-3.4	-2.1	-2.8
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	1.75	2.60	2.54	2.52	2.71
	Total Organic Carbon (mg/L)	1.78	2.61	2.62	2.63	2.74
Bacteriological Tests	E. coli (MPN/100mL)	9	<1		<1	<1
	HPC (CFU/1mL)	128 PEHR	460 PEHR		92 PEHR	596 PEHR
	Coliform Bacteria - Total (MPN/100mL)	101	201		>200.5	165
Total Metals	Aluminum (Al)-Total (mg/L)	0.105	0.0560	0.0457	0.0429	0.0534
	Antimony (Sb)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1993110-6	L1993110-7	L1993110-8	L1993110-9	
	Description	Water	Water	Water	Water	
	Sampled Date	18-SEP-17	18-SEP-17	18-SEP-17	18-SEP-17	
	Sampled Time	13:00	13:15	13:30	15:45	
	Client ID	FIELD BLANK	PC2	PC3	PC4	
Grouping	**Analyte**					
WATER						
Physical Tests	Colour, True (CU)	<5.0				
	Conductivity (uS/cm)	<2.0				
	Hardness (as CaCO3) (mg/L)	0.56				
	pH (pH)	5.44				
	Total Suspended Solids (mg/L)	<3.0				
	TDS (Calculated) (mg/L)	<1.0				
	Turbidity (NTU)	<0.10				
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	<1.0				
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0				
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0				
	Alkalinity, Total (as CaCO3) (mg/L)	<1.0				
	Ammonia, Total (as N) (mg/L)	<0.0050		<0.0050		
	Bromide (Br) (mg/L)	<0.050				
	Chloride (Cl) (mg/L)	<0.50				
	Fluoride (F) (mg/L)	<0.020				
	Nitrate and Nitrite (as N) (mg/L)	0.0166				
	Nitrate (as N) (mg/L)	0.0166 HTD				
	Nitrite (as N) (mg/L)	<0.0010				
	Total Kjeldahl Nitrogen (mg/L)	<0.050		<0.050		
	Total Nitrogen (mg/L)	0.048		<0.030		
	Orthophosphate-Dissolved (as P) (mg/L)	<0.0010 HTD				
	Phosphorus (P)-Total Dissolved (mg/L)	<0.0020				
	Phosphorus (P)-Total (mg/L)	<0.0020		<0.0020		
	Phosphorus (P)-Total Dissolved (mg/L)			<0.0020		
	Silicate (as SiO2) (mg/L)	<0.50				
	Sulfate (SO4) (mg/L)	<0.30				
	Anion Sum (meq/L)	<0.10				
	Cation Sum (meq/L)	<0.10				
	Cation - Anion Balance (%)	90.7				
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	<0.50	0.67	<0.50	<0.50	
	Total Organic Carbon (mg/L)	<0.50		<0.50		
Bacteriological Tests	E. coli (MPN/100mL)	<1				
	HPC (CFU/1mL)	339 PEHR				
	Coliform Bacteria - Total (MPN/100mL)	<1				
Total Metals	Aluminum (Al)-Total (mg/L)	<0.0050				
	Antimony (Sb)-Total (mg/L)	<0.00050				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1993110-1 Water 18-SEP-17 14:30 HALFWAY RIVER - DOWNSTREAM (HD)	L1993110-2 Water 18-SEP-17 15:30 MIDDLE SITE C RESERVOIR (PR2)	L1993110-3 Water 18-SEP-17 10:45 PEACE CANYON (PC1)	L1993110-4 Water 18-SEP-17 11:50 UPPER CSITE C RESERVOIR (PR1)	L1993110-5 Water 18-SEP-17 16:45 DUPLICATE 2 (DUP 2)
WATER						
Total Metals	Arsenic (As)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Barium (Ba)-Total (mg/L)	0.111	0.031	0.033	0.031	0.032
	Beryllium (Be)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Bismuth (Bi)-Total (mg/L)	<0.20	<0.20	<0.20	<0.20	<0.20
	Boron (B)-Total (mg/L)	<0.10	<0.10	<0.10	<0.10	<0.10
	Cadmium (Cd)-Total (mg/L)	0.0000180	0.0000182	0.0000187	0.0000178	0.0000193
	Calcium (Ca)-Total (mg/L)	64.3	25.3	25.3	25.2	25.7
	Chromium (Cr)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Cobalt (Co)-Total (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
	Copper (Cu)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Iron (Fe)-Total (mg/L)	0.163	0.055	0.061	0.055	0.072
	Lead (Pb)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Lithium (Li)-Total (mg/L)	0.0075	0.0011	<0.0010	<0.0010	<0.0010
	Magnesium (Mg)-Total (mg/L)	18.7	5.89	5.73	5.68	5.80
	Manganese (Mn)-Total (mg/L)	0.00956	0.00254	0.00249	0.00248	0.00259
	Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Mercury (Hg)-Total (ug/L)	0.00068	<0.00050	<0.00050	<0.00050	0.00057
	Molybdenum (Mo)-Total (mg/L)	0.0038	<0.0010	<0.0010	<0.0010	<0.0010
	Nickel (Ni)-Total (mg/L)	0.0012	<0.0010	<0.0010	<0.0010	<0.0010
	Phosphorus (P)-Total (mg/L)	<0.30	<0.30	<0.30	<0.30	<0.30
	Potassium (K)-Total (mg/L)	<2.0	<2.0	<2.0	<2.0	<2.0
	Selenium (Se)-Total (mg/L)	0.00130	0.000226	0.000240	0.000226	0.000234
	Silicon (Si)-Total (mg/L)	1.83	2.10	2.11	2.09	2.06
	Silver (Ag)-Total (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Sodium (Na)-Total (mg/L)	3.2	<2.0	<2.0	<2.0	<2.0
	Strontium (Sr)-Total (mg/L)	0.346	0.0962	0.0961	0.0971	0.0972
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Titanium (Ti)-Total (mg/L)	<0.010	<0.010	<0.010	<0.010	<0.010
	Uranium (U)-Total (mg/L)	0.00102	0.00046	0.00044	0.00044	0.00047
	Vanadium (V)-Total (mg/L)	0.00075	0.00051	<0.00050	<0.00050	0.00053
	Zinc (Zn)-Total (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Dissolved Metals	Dissolved Fe2 Filtration Location	FIELD	FIELD			FIELD
	Dissolved MeHg Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	<0.0050	0.0589	<0.0050	0.0066	0.0069

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L1993110-6	L1993110-7	L1993110-8	L1993110-9	
Description	Water	Water	Water	Water	
Sampled Date	18-SEP-17	18-SEP-17	18-SEP-17	18-SEP-17	
Sampled Time	13:00	13:15	13:30	15:45	
Client ID	FIELD BLANK	PC2	PC3	PC4	
Grouping / **Analyte**					
WATER					
Total Metals Arsenic (As)-Total (mg/L)	<0.00050				
Barium (Ba)-Total (mg/L)	<0.020				
Beryllium (Be)-Total (mg/L)	<0.00010				
Bismuth (Bi)-Total (mg/L)	<0.20				
Boron (B)-Total (mg/L)	<0.10				
Cadmium (Cd)-Total (mg/L)	<0.0000050				
Calcium (Ca)-Total (mg/L)	<0.10				
Chromium (Cr)-Total (mg/L)	0.0030				
Cobalt (Co)-Total (mg/L)	<0.00030				
Copper (Cu)-Total (mg/L)	<0.0010				
Iron (Fe)-Total (mg/L)	<0.030				
Lead (Pb)-Total (mg/L)	<0.00050				
Lithium (Li)-Total (mg/L)	<0.0010				
Magnesium (Mg)-Total (mg/L)	<0.10				
Manganese (Mn)-Total (mg/L)	0.00025				
Mercury (Hg)-Total (mg/L)	<0.0000050				
Mercury (Hg)-Total (ug/L)	<0.00050				
Molybdenum (Mo)-Total (mg/L)	<0.0010				
Nickel (Ni)-Total (mg/L)	<0.0010				
Phosphorus (P)-Total (mg/L)	<0.30				
Potassium (K)-Total (mg/L)	<2.0				
Selenium (Se)-Total (mg/L)	<0.000050				
Silicon (Si)-Total (mg/L)	<0.10				
Silver (Ag)-Total (mg/L)	<0.000020				
Sodium (Na)-Total (mg/L)	<2.0				
Strontium (Sr)-Total (mg/L)	<0.0050				
Thallium (Tl)-Total (mg/L)	<0.000010				
Tin (Sn)-Total (mg/L)	<0.00050				
Titanium (Ti)-Total (mg/L)	<0.010				
Uranium (U)-Total (mg/L)	<0.00020				
Vanadium (V)-Total (mg/L)	<0.00050				
Zinc (Zn)-Total (mg/L)	<0.0050				
Dissolved Metals Dissolved Fe2 Filtration Location	FIELD				
Dissolved MeHg Filtration Location	FIELD				
Dissolved Mercury Filtration Location	FIELD				
Dissolved Metals Filtration Location	FIELD				
Aluminum (Al)-Dissolved (mg/L)	0.0868 RRV				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1993110-1 Water 18-SEP-17 14:30 HALFWAY RIVER - DOWNSTREAM (HD)	L1993110-2 Water 18-SEP-17 15:30 MIDDLE SITE C RESERVOIR (PR2)	L1993110-3 Water 18-SEP-17 10:45 PEACE CANYON (PC1)	L1993110-4 Water 18-SEP-17 11:50 UPPER CSITE C RESERVOIR (PR1)	L1993110-5 Water 18-SEP-17 16:45 DUPLICATE 2 (DUP 2)
WATER						
Dissolved Metals	Antimony (Sb)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Arsenic (As)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Barium (Ba)-Dissolved (mg/L)	0.104	0.032	0.031	0.030	0.031
	Beryllium (Be)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Bismuth (Bi)-Dissolved (mg/L)	<0.20	<0.20	<0.20	<0.20	<0.20
	Boron (B)-Dissolved (mg/L)	<0.10	<0.10	<0.10	<0.10	<0.10
	Cadmium (Cd)-Dissolved (mg/L)	0.0000050	0.0000088	0.0000121	0.0000084	0.0000085
	Calcium (Ca)-Dissolved (mg/L)	60.5	24.1	26.1	26.3	26.4
	Chromium (Cr)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Cobalt (Co)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
	Copper (Cu)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Iron (Fe)-Dissolved (mg/L)	<0.030	<0.030	<0.030	<0.030	<0.030
	Ferrous Iron, Dissolved (mg/L)	<0.020	<0.020			<0.020
	Lead (Pb)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Lithium (Li)-Dissolved (mg/L)	0.0083	0.0011	<0.0010	<0.0010	<0.0010
	Magnesium (Mg)-Dissolved (mg/L)	18.6	6.00	5.69	5.70	5.80
	Manganese (Mn)-Dissolved (mg/L)	0.00407	0.00057	0.00062	0.00059	0.00043
	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Mercury (Hg)-Dissolved (ug/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Molybdenum (Mo)-Dissolved (mg/L)	0.0040	<0.0010	<0.0010	<0.0010	<0.0010
	Nickel (Ni)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Phosphorus (P)-Dissolved (mg/L)	<0.30	<0.30	<0.30	<0.30	<0.30
	Potassium (K)-Dissolved (mg/L)	<2.0	<2.0	<2.0	<2.0	<2.0
	Selenium (Se)-Dissolved (mg/L)	0.00116	0.000233	0.000220	0.000289	0.000260
	Silicon (Si)-Dissolved (mg/L)	1.64	2.01	2.08	2.09	2.10
	Silver (Ag)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Sodium (Na)-Dissolved (mg/L)	3.2	<2.0	<2.0	<2.0	<2.0
	Strontium (Sr)-Dissolved (mg/L)	0.348	0.0962	0.0991	0.0984	0.0986
	Thallium (Tl)-Dissolved (mg/L)	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
	Tin (Sn)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Titanium (Ti)-Dissolved (mg/L)	<0.010	<0.010	<0.010	<0.010	<0.010
	Uranium (U)-Dissolved (mg/L)	0.00091	0.00044	0.00037	0.00039	0.00040
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Zinc (Zn)-Dissolved (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Speciated Metals	Methylmercury (as MeHg)-Dissolved (ug/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Methylmercury (as MeHg)-Total (ug/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L1993110-6	L1993110-7	L1993110-8	L1993110-9	
Description	Water	Water	Water	Water	
Sampled Date	18-SEP-17	18-SEP-17	18-SEP-17	18-SEP-17	
Sampled Time	13:00	13:15	13:30	15:45	
Client ID	FIELD BLANK	PC2	PC3	PC4	
Grouping / **Analyte**					
WATER					
Dissolved Metals Antimony (Sb)-Dissolved (mg/L)	<0.00050				
Arsenic (As)-Dissolved (mg/L)	<0.00050				
Barium (Ba)-Dissolved (mg/L)	<0.020				
Beryllium (Be)-Dissolved (mg/L)	<0.00010				
Bismuth (Bi)-Dissolved (mg/L)	<0.20				
Boron (B)-Dissolved (mg/L)	<0.10				
Cadmium (Cd)-Dissolved (mg/L)	<0.0000050				
Calcium (Ca)-Dissolved (mg/L)	0.22 RRV				
Chromium (Cr)-Dissolved (mg/L)	<0.0010				
Cobalt (Co)-Dissolved (mg/L)	<0.00030				
Copper (Cu)-Dissolved (mg/L)	<0.0010				
Iron (Fe)-Dissolved (mg/L)	<0.030				
Ferrous Iron, Dissolved (mg/L)	<0.020				
Lead (Pb)-Dissolved (mg/L)	<0.00050				
Lithium (Li)-Dissolved (mg/L)	<0.0010				
Magnesium (Mg)-Dissolved (mg/L)	<0.10				
Manganese (Mn)-Dissolved (mg/L)	0.00015 RRV				
Mercury (Hg)-Dissolved (mg/L)	<0.0000050				
Mercury (Hg)-Dissolved (ug/L)	<0.00050				
Molybdenum (Mo)-Dissolved (mg/L)	<0.0010				
Nickel (Ni)-Dissolved (mg/L)	<0.0010				
Phosphorus (P)-Dissolved (mg/L)	<0.30				
Potassium (K)-Dissolved (mg/L)	<2.0				
Selenium (Se)-Dissolved (mg/L)	<0.000050				
Silicon (Si)-Dissolved (mg/L)	0.054 RRV				
Silver (Ag)-Dissolved (mg/L)	<0.000020				
Sodium (Na)-Dissolved (mg/L)	<2.0				
Strontium (Sr)-Dissolved (mg/L)	<0.0050				
Thallium (Tl)-Dissolved (mg/L)	<0.00020				
Tin (Sn)-Dissolved (mg/L)	<0.00050				
Titanium (Ti)-Dissolved (mg/L)	<0.010				
Uranium (U)-Dissolved (mg/L)	<0.00020				
Vanadium (V)-Dissolved (mg/L)	<0.00050				
Zinc (Zn)-Dissolved (mg/L)	<0.0050				
Speciated Metals Methylmercury (as MeHg)-Dissolved (ug/L)	<0.000050				
Methylmercury (as MeHg)-Total (ug/L)	<0.000050				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

Qualifiers for Individual Samples Listed:

Sample Numbe	Client Sample ID	Qualifier	Description
L1993110-2	MIDDLE SITE C RESERVOI	WSMD	Water sample(s) for dissolved mercury analysis was not submitted in glass or PTFE container with HCl preservative. Results may be biased low.
		WSMT	Water sample(s) for total mercury analysis was not submitted in glass or PTFE container with HCl preservative. Results may be biased low.
L1993110-3	PEACE CANYON (PC1)	WSMT	Water sample(s) for total mercury analysis was not submitted in glass or PTFE container with HCl preservative. Results may be biased low.
		WSMD	Water sample(s) for dissolved mercury analysis was not submitted in glass or PTFE container with HCl preservative. Results may be biased low.
L1993110-4	UPPER CSITE C RESERVOI	WSMD	Water sample(s) for dissolved mercury analysis was not submitted in glass or PTFE container with HCl preservative. Results may be biased low.
		WSMT	Water sample(s) for total mercury analysis was not submitted in glass or PTFE container with HCl preservative. Results may be biased low.
L1993110-5	DUPLICATE 2 (DUP 2)	WSMT	Water sample(s) for total mercury analysis was not submitted in glass or PTFE container with HCl preservative. Results may be biased low.
		WSMD	Water sample(s) for dissolved mercury analysis was not submitted in glass or PTFE container with HCl preservative. Results may be biased low.

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Duplicate	Selenium (Se)-Dissolved	DUP-H	L1993110-1, -2, -6
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L1993110-1, -2, -6
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L1993110-3, -4, -5
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L1993110-3, -4, -5
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L1993110-1, -2, -6
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L1993110-3, -4, -5
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L1993110-3, -4, -5
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L1993110-1, -2, -6
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L1993110-3, -4, -5
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L1993110-3, -4, -5
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L1993110-1, -2, -6
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1993110-1, -2, -6
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1993110-3, -4, -5
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1993110-3, -4, -5
Matrix Spike	Barium (Ba)-Total	MS-B	L1993110-3, -4, -5
Matrix Spike	Calcium (Ca)-Total	MS-B	L1993110-3, -4, -5
Matrix Spike	Magnesium (Mg)-Total	MS-B	L1993110-3, -4, -5
Matrix Spike	Strontium (Sr)-Total	MS-B	L1993110-3, -4, -5
Matrix Spike	Total Nitrogen	MS-B	L1993110-1, -2, -3, -4, -5, -6, -8
Matrix Spike	Phosphorus (P)-Total	MS-B	L1993110-5, -6, -8
Matrix Spike	Orthophosphate-Dissolved (as P)	MS-B	L1993110-6
Matrix Spike	Orthophosphate-Dissolved (as P)	MS-B	L1993110-6
Matrix Spike	Silicate (as SiO2)	MS-B	L1993110-1, -2, -3, -4, -5, -6

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DUP-H	Duplicate results outside ALS DQO, due to sample heterogeneity.
HTD	Hold time exceeded for re-analysis or dilution, but initial testing was conducted within hold time.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.
PEHR	Parameter Exceeded Recommended Holding Time On Receipt: Proceed With Analysis As Requested.
RRV	Reported Result Verified By Repeat Analysis

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

Reference Information

ANIONS-N+N-CALC-VA	Water	Nitrite & Nitrate in Water (Calculation)	EPA 300.0

Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).

BR-L-IC-N-VA	Water	Bromide in Water by IC (Low Level)	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

CARBONS-DOC-VA	Water	Dissolved organic carbon by combustion	APHA 5310B TOTAL ORGANIC CARBON (TOC)

This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis.

CARBONS-TOC-VA	Water	Total organic carbon by combustion	APHA 5310B TOTAL ORGANIC CARBON (TOC)

This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)".

CHLOROA-F-VA	Filter	Chlorophyll a by Fluorometer (Filter)	EPA 445.0

This analysis is done using procedures modified from EPA Method 445.0. Chlorophyll-a is determined by a routine acetone extraction followed with analysis by fluorometry using the non-acidification procedure. This method is not subject to interferences from chlorophyll b.

CL-IC-N-VA	Water	Chloride in Water by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

COLOUR-TRUE-VA	Water	Colour (True) by Spectrometer	BCMOE Colour Single Wavelength

This analysis is carried out using procedures adapted from British Columbia Environmental Manual "Colour- Single Wavelength." Colour (True Colour) is determined by filtering a sample through a 0.45 micron membrane filter followed by analysis of the filtrate using the platinum-cobalt colourimetric method.
Colour measurements can be highly pH dependent, and apply to the pH of the sample as received (at time of testing), without pH adjustment. Concurrent measurement of sample pH is recommended.

EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510

Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.

ECOLI-COLI-ENV-VA	Water	E.coli by Colilert	APHA METHOD 9223

This analysis is carried out using procedures adapted from APHA Method 9223 "Enzyme Substrate Coliform Test". E. coli and Total Coliform are determined simultaneously. The sample is mixed with a mixture hydrolyzable substrates and then sealed in a multi-well packet. The packet is incubated for 18 or 24 hours and then the number of wells exhibiting a positive response are counted. The final result is obtained by comparing the positive responses to a probability table.

F-IC-N-VA	Water	Fluoride in Water by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

FE2-D-COL-VA	Water	Diss. Ferrous Iron in Water by Colour	APHA 3500-Fe B/James Ball et al (1999)

This analysis is carried out using procedures adapted from APHA 3500-Fe B and "A New Method for the Direct Determination of Dissolved Iron Concentration in Acid Mine Waters" published by James W. Ball et al (1999). The procedure involves preliminary sample filtration, and ferrous iron is determined using the "FerroZine" colourimetric method.

HARDNESS-CALC-VA	Water	Hardness	APHA 2340B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HG-D-CVAA-VA	Water	Diss. Mercury in Water by CVAAS or CVAFS	APHA 3030B/EPA 1631E (mod)

Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

HG-D-U-CVAF-VA	Water	Diss. Mercury in Water by CVAFS (Ultra)	APHA 3030 B / EPA 1631 REV. E

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from Method 1631 Rev. E. by the United States Environmental Protection Agency (EPA). The procedure may involve preliminary sample treatment by filtration (APHA 3030B) and involves a cold-oxidation of the acidified sample using bromine monochloride prior to a purge and trap concentration step and final reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry.

HG-T-CVAA-VA	Water	Total Mercury in Water by CVAAS or CVAFS	EPA 1631E (mod)

Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

HG-T-U-CVAF-VA	Water	Total Mercury in Water by CVAFS (Ultra)	EPA 1631 REV. E

Reference Information

This analysis is carried out using procedures adapted from Method 1631 Rev. E. by the United States Environmental Protection Agency (EPA). The procedure involves a cold-oxidation of the acidified sample using bromine monochloride prior to a purge and trap concentration step and final reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry.

HPC-PP-ENV-VA Water HPC by pour plate APHA METHOD 9215

This analysis is carried out using procedures adapted from APHA Method 9215 "Heterotropic Plate Count". Heterotropic plate count (standard plate count or total plate count) is determined by culturing and colony counting using the pour plate method with a 48 hour incubation period. The test measures colonies formed by heterotropic bacteria.

IONBALANCE-VA Water Ion Balance Calculation APHA 1030E

Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:

Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum]

MEHG-D-GCAF-VA Water Diss. Methylmercury in Water by GCAFS EPA 1630

This method follows Method 1630 of the US EPA. Samples are distilled under an inert gas flow to isolate methylmercury and minimize matrix interferences. The distillate is analyzed by aqueous phase ethylation, purge and trap, desorption and GC separation. The separated species are then pyrolized to elemental Hg and quantified by cold vapour atomic flourescence spectroscopy. Results are reported "as MeHg".

MEHG-T-GCAF-VA Water Total Methylmercury in Water by GCAFS EPA 1630

This method follows Method 1630 of the US EPA. Samples are distilled under an inert gas flow to isolate methylmercury and minimize matrix interferences. The distillate is analyzed by aqueous phase ethylation, purge and trap, desorption and GC separation. THe separated species are then pyrolized to elemental Hg and quantified by cold vapour atomic flourescence spectroscopy. Results are reported "as MeHg".

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

N-T-COL-VA Water Total Nitrogen in water by Colour APHA4500-P(J)/NEMI9171/USGS03-4174

This analysis is carried out using procedures adapted from APHA Method 4500-P (J) "Persulphate Method for Simultaneous Determination of Total Nitrogen and Total Phosphorus" and National Environmental Methods Index - Nemi method 5735.

NH3-F-VA Water Ammonia in Water by Fluorescence APHA 4500 NH3-NITROGEN (AMMONIA)

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-VA Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-VA Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

P-T-PRES-COL-VA Water Total P in Water by Colour APHA 4500-P Phosphorus

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorus is determined colourimetrically after persulphate digestion of the sample.
Samples with very high dissolved solids (i.e. seawaters, brackish waters) may produce a negative bias by this method. Alternate methods are available for these types of samples.

Arsenic (5+), at elevated levels, is a positive interference on colourimetric phosphate analysis.

P-TD-COL-VA Water Total Dissolved P in Water by Colour APHA 4500-P Phosphorous

Reference Information

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Dissolved Phosphorus is determined colourimetrically after persulphate digestion of a sample that has been lab or field filtered through a 0.45 micron membrane filter.
Samples with very high dissolved solids (i.e. seawaters, brackish waters) may produce a negative bias by this method. Alternate methods are available for these types of samples.

Arsenic (5+), at elevated levels, is a positive interference on colourimetric phosphate analysis.

P-TD-PRES-COL-VA Water Total Dissolved P in Water by Colour APHA 4500-P Phosphorous

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Dissolved Phosphorus is determined colourimetrically after persulphate digestion of a sample that has been lab or field filtered through a 0.45 micron membrane filter.
Samples with very high dissolved solids (i.e. seawaters, brackish waters) may produce a negative bias by this method. Alternate methods are available for these types of samples.

Arsenic (5+), at elevated levels, is a positive interference on colourimetric phosphate analysis.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

PO4-DO-COL-VA Water Diss. Orthophosphate in Water by Colour APHA 4500-P Phosphorus

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Dissolved Orthophosphate is determined colourimetrically on a sample that has been lab or field filtered through a 0.45 micron membrane filter.
Samples with very high dissolved solids (i.e. seawaters, brackish waters) may produce a negative bias by this method. Alternate methods are available for these types of samples.

Arsenic (5+), at elevated levels, is a positive interference on colourimetric phosphate analysis.

SILICATE-COL-VA Water Silicate by Colourimetric analysis APHA 4500-SiO2 E.

This analysis is carried out using procedures adapted from APHA Method 4500-SiO2 E. "Silica". Silicate (molybdate-reactive silica) is determined by the molybdosilicate-heteropoly blue colourimetric method.

SO4-IC-N-VA Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TCOLI-COLI-ENV-VA Water Total coliform by Colilert APHA METHOD 9223

This analysis is carried out using procedures adapted from APHA Method 9223 "Enzyme Substrate Coliform Test". E. coli and Total Coliform are determined simultaneously. The sample is mixed with a mixture hydrolyzable substrates and then sealed in a multi-well packet. The packet is incubated for 18 or 24 hours and then the number of wells exhibiting a positive response are counted. The final result is quantified by a statistical estimation of bacteria density (most probable number).

TDS-CALC-VA Water TDS (Calculated) APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".
The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TKN-F-VA Water TKN in Water by Fluorescence APHA 4500-NORG D.

This analysis is carried out using procedures adapted from APHA Method 4500-Norg D. "Block Digestion and Flow Injection Analysis". Total Kjeldahl Nitrogen is determined using block digestion followed by Flow-injection analysis with fluorescence detection.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.
Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

TURBIDITY-VA Water Turbidity by Meter APHA 2130 Turbidity

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

Reference Information

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Tetra Tech Canada Inc.
ATTN: Danielle MacDonald
14940 - 123 Avenue, NW
Edmonton AB T5V 1B4

Date Received: 20-SEP-17
Report Date: 05-OCT-17 13:50 (MT)
Version: FINAL

Client Phone: 780-886-3055

Certificate of Analysis

Lab Work Order #: L1994216

Project P.O. #: NOT SUBMITTED
Job Reference: VENW003060
C of C Numbers:
Legal Site Desc:

Brent Mack, B.Sc.
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1994216-1	L1994216-2	L1994216-3	L1994216-4	L1994216-5
	Description	Water	Water	Water	Water	Water
	Sampled Date	19-SEP-17	19-SEP-17	19-SEP-17	19-SEP-17	19-SEP-17
	Sampled Time	12:30	13:00	13:45	14:00	15:00
	Client ID	PEACE AT BEATTON (PD2)	BEATTON RIVER (BEATTON)	PEACE AT KISKATINAW (PD3)	KISKATINAW RIVER (KR)	PEACE AT POUCE COUPE (PD4)
Grouping	**Analyte**					
WATER						
Physical Tests	Colour, True (CU)	7.5	244	8.0	10.5	8.2
	Conductivity (uS/cm)	186	438	189	480	190
	Hardness (as CaCO3) (mg/L)	89.4	158	89.0	213	92.7
	pH (pH)	8.11	8.26	8.11	8.48	8.19
	Total Suspended Solids (mg/L)	7.5	<3.0	6.3	3.1	11.7
	TDS (Calculated) (mg/L)	100	303	101	286	104
	Turbidity (NTU)	3.74	10.7	4.35	3.30	6.70
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	84.8	146	86.0	206	88.6
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	13.2	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Phenolphthalein (as CaCO3) (mg/L)	<2.0	<2.0	<2.0	6.6	<2.0
	Alkalinity, Total (as CaCO3) (mg/L)	84.8	146	86.0	220	88.6
	Ammonia, Total (as N) (mg/L)	<0.0050	0.0075	<0.0050	<0.0050	<0.0050
	Bromide (Br) (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Chloride (Cl) (mg/L)	<0.50	5.29	<0.50	1.32	<0.50
	Fluoride (F) (mg/L)	0.037	0.153	0.039	0.101	0.038
	Nitrate and Nitrite (as N) (mg/L)	0.0489	<0.0051	0.0472	<0.0051	0.0456
	Nitrate (as N) (mg/L)	0.0473	<0.0050	0.0454	<0.0050	0.0434
	Nitrite (as N) (mg/L)	0.0015	<0.0010	0.0017	<0.0010	0.0021
	Total Kjeldahl Nitrogen (mg/L)	0.087	0.811	0.071	0.275	0.134
	Total Nitrogen (mg/L)	0.133	0.834	0.127	0.265	0.131
	Orthophosphate-Dissolved (as P) (mg/L)	<0.0010	0.0080	<0.0010	<0.0010	<0.0010
	Phosphorus (P)-Total Dissolved (mg/L)	<0.0020	0.024	<0.0020	0.0031	0.0021
	Phosphorus (P)-Total (mg/L)	0.0110	0.0381	0.0090	0.0069	0.0128
	Silicate (as SiO2) (mg/L)	4.18	4.24	4.07	1.67	4.13
	Sulfate (SO4) (mg/L)	14.2	82.7	14.5	50.5	14.7
	Anion Sum (meq/L)	2.00	4.80	2.03	5.48	2.08
	Cation Sum (meq/L)	1.79	4.84	1.78	5.28	1.85
	Cation - Anion Balance (%)	-5.5	0.4	-6.5	-1.9	-5.8
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	2.37	30.3	2.94	6.25	2.48
	Total Organic Carbon (mg/L)	2.89	32.5	2.87	6.69	2.65
Total Metals	Aluminum (Al)-Total (mg/L)	0.126	0.208	0.122	0.0706	0.212
	Antimony (Sb)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Arsenic (As)-Total (mg/L)	<0.00050	0.00153	<0.00050	0.00054	<0.00050
	Barium (Ba)-Total (mg/L)	0.038	0.094	0.040	0.155	0.044
	Beryllium (Be)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1994216-6	L1994216-7			
	Description	Water	Water			
	Sampled Date	19-SEP-17	19-SEP-17			
	Sampled Time	15:30	17:00			
	Client ID	POUCE COUPE (POUCE)	PEACE AT MANY ISLANDS (PD5)			
Grouping	**Analyte**					
WATER						
Physical Tests	Colour, True (CU)	14.7	8.2			
	Conductivity (uS/cm)	852	193			
	Hardness (as CaCO3) (mg/L)	255	92.5			
	pH (pH)	8.37	8.17			
	Total Suspended Solids (mg/L)	39.5	15.7			
	TDS (Calculated) (mg/L)	549	104			
	Turbidity (NTU)	20.6	6.52			
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	165	89.3			
	Alkalinity, Carbonate (as CaCO3) (mg/L)	7.2	<1.0			
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0			
	Alkalinity, Phenolphthalein (as CaCO3) (mg/L)	3.6	<2.0			
	Alkalinity, Total (as CaCO3) (mg/L)	172	89.3			
	Ammonia, Total (as N) (mg/L)	0.0051	<0.0050			
	Bromide (Br) (mg/L)	<0.25 DLDS	<0.050			
	Chloride (Cl) (mg/L)	9.4	<0.50			
	Fluoride (F) (mg/L)	0.14	0.039			
	Nitrate and Nitrite (as N) (mg/L)	<0.025	0.0429			
	Nitrate (as N) (mg/L)	<0.025 DLDS	0.0415			
	Nitrite (as N) (mg/L)	<0.0050 DLDS	0.0014			
	Total Kjeldahl Nitrogen (mg/L)	0.428	0.108			
	Total Nitrogen (mg/L)	0.440	0.131			
	Orthophosphate-Dissolved (as P) (mg/L)	<0.0010	<0.0010			
	Phosphorus (P)-Total Dissolved (mg/L)	0.0045	<0.0020			
	Phosphorus (P)-Total (mg/L)	0.0214	0.0133			
	Silicate (as SiO2) (mg/L)	2.09	4.10			
	Sulfate (SO4) (mg/L)	279	14.7			
	Anion Sum (meq/L)	9.52	2.10			
	Cation Sum (meq/L)	7.61	1.85			
	Cation - Anion Balance (%)	-11.1	-6.2			
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	6.84	2.46			
	Total Organic Carbon (mg/L)	10.2	2.73			
Total Metals	Aluminum (Al)-Total (mg/L)	0.186	0.251			
	Antimony (Sb)-Total (mg/L)	<0.00050	<0.00050			
	Arsenic (As)-Total (mg/L)	<0.00050	<0.00050			
	Barium (Ba)-Total (mg/L)	0.055	0.052			
	Beryllium (Be)-Total (mg/L)	<0.00010	<0.00010			

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L1994216-1	L1994216-2	L1994216-3	L1994216-4	L1994216-5
Description	Water	Water	Water	Water	Water
Sampled Date	19-SEP-17	19-SEP-17	19-SEP-17	19-SEP-17	19-SEP-17
Sampled Time	12:30	13:00	13:45	14:00	15:00
Client ID	PEACE AT BEATTON (PD2)	BEATTON RIVER (BEATTON)	PEACE AT KISKATINAW (PD3)	KISKATINAW RIVER (KR)	PEACE AT POUCE COUPE (PD4)
Grouping / **Analyte**					
WATER					
Total Metals Bismuth (Bi)-Total (mg/L)	<0.20	<0.20	<0.20	<0.20	<0.20
Boron (B)-Total (mg/L)	<0.10	<0.10	<0.10	<0.10	<0.10
Cadmium (Cd)-Total (mg/L)	0.0000286	0.0000747	0.0000221	<0.0000050	0.0000293
Calcium (Ca)-Total (mg/L)	26.9	44.3	27.5	48.0	28.0
Chromium (Cr)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Cobalt (Co)-Total (mg/L)	<0.00030	0.00056	<0.00030	<0.00030	<0.00030
Copper (Cu)-Total (mg/L)	<0.0010	0.0027	<0.0010	0.0013	0.0010
Iron (Fe)-Total (mg/L)	0.204	3.79	0.195	0.074	0.355
Lead (Pb)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Lithium (Li)-Total (mg/L)	0.0013	0.0090	0.0014	0.0059	0.0016
Magnesium (Mg)-Total (mg/L)	6.02	12.1	6.20	21.1	6.30
Manganese (Mn)-Total (mg/L)	0.00569	0.0624	0.00574	0.00762	0.00723
Mercury (Hg)-Total (mg/L)	<0.0000050	<0.000050 DLM	<0.0000050	<0.0000050	<0.0000050
Mercury (Hg)-Total (ug/L)	0.00071	0.00244	0.00057	<0.00050	0.00086
Molybdenum (Mo)-Total (mg/L)	<0.0010	<0.0010	<0.0010	0.0012	<0.0010
Nickel (Ni)-Total (mg/L)	<0.0010	0.0062	<0.0010	0.0014	0.0011
Phosphorus (P)-Total (mg/L)	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)-Total (mg/L)	<2.0	<2.0	<2.0	<2.0	<2.0
Selenium (Se)-Total (mg/L)	0.000253	0.000345	0.000279	0.000266	0.000280
Silicon (Si)-Total (mg/L)	2.30	2.27	2.24	0.87	2.30
Silver (Ag)-Total (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
Sodium (Na)-Total (mg/L)	<2.0	34.9	<2.0	23.2	<2.0
Strontium (Sr)-Total (mg/L)	0.106	0.172	0.108	0.294	0.108
Thallium (Tl)-Total (mg/L)	<0.000010	0.000013	<0.000010	<0.000010	<0.000010
Tin (Sn)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Titanium (Ti)-Total (mg/L)	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium (U)-Total (mg/L)	0.00045	0.00137	0.00046	0.00117	0.00048
Vanadium (V)-Total (mg/L)	0.00073	0.00121	0.00075	<0.00050	0.00107
Zinc (Zn)-Total (mg/L)	<0.0050	0.0056	<0.0050	<0.0050	<0.0050
Dissolved Metals Dissolved MeHg Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
Aluminum (Al)-Dissolved (mg/L)	0.0058	0.0572	0.0075	<0.0050	0.0065
Antimony (Sb)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Arsenic (As)-Dissolved (mg/L)	<0.00050	0.00074	<0.00050	<0.00050	<0.00050
Barium (Ba)-Dissolved (mg/L)	0.036	0.081	0.035	0.160	0.039
Beryllium (Be)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1994216-6	L1994216-7			
	Description	Water	Water			
	Sampled Date	19-SEP-17	19-SEP-17			
	Sampled Time	15:30	17:00			
	Client ID	POUCE COUPE (POUCE)	PEACE AT MANY ISLANDS (PD5)			
Grouping	**Analyte**					
WATER						
Total Metals	Bismuth (Bi)-Total (mg/L)	<0.20	<0.20			
	Boron (B)-Total (mg/L)	<0.10	<0.10			
	Cadmium (Cd)-Total (mg/L)	0.0000219	0.0000374			
	Calcium (Ca)-Total (mg/L)	48.4	28.7			
	Chromium (Cr)-Total (mg/L)	<0.0010	<0.0010			
	Cobalt (Co)-Total (mg/L)	<0.00030	<0.00030			
	Copper (Cu)-Total (mg/L)	0.0014	0.0012			
	Iron (Fe)-Total (mg/L)	0.263	0.469			
	Lead (Pb)-Total (mg/L)	<0.00050	<0.00050			
	Lithium (Li)-Total (mg/L)	0.0091	0.0017			
	Magnesium (Mg)-Total (mg/L)	16.3	6.42			
	Manganese (Mn)-Total (mg/L)	0.0204	0.0106			
	Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050			
	Mercury (Hg)-Total (ug/L)	0.00064	0.00074			
	Molybdenum (Mo)-Total (mg/L)	0.0010	<0.0010			
	Nickel (Ni)-Total (mg/L)	0.0022	0.0012			
	Phosphorus (P)-Total (mg/L)	<0.30	<0.30			
	Potassium (K)-Total (mg/L)	2.9	<2.0			
	Selenium (Se)-Total (mg/L)	0.000394	0.000238			
	Silicon (Si)-Total (mg/L)	1.82	2.35			
	Silver (Ag)-Total (mg/L)	<0.000020	<0.000020			
	Sodium (Na)-Total (mg/L)	36.1	<2.0			
	Strontium (Sr)-Total (mg/L)	0.224	0.111			
	Thallium (Tl)-Total (mg/L)	0.000011	0.000011			
	Tin (Sn)-Total (mg/L)	<0.00050	<0.00050			
	Titanium (Ti)-Total (mg/L)	<0.010	<0.010			
	Uranium (U)-Total (mg/L)	0.00127	0.00050			
	Vanadium (V)-Total (mg/L)	0.00091	0.00127			
	Zinc (Zn)-Total (mg/L)	<0.0050	<0.0050			
Dissolved Metals	Dissolved MeHg Filtration Location	FIELD	FIELD			
	Dissolved Mercury Filtration Location	FIELD	FIELD			
	Dissolved Metals Filtration Location	FIELD	FIELD			
	Aluminum (Al)-Dissolved (mg/L)	0.0052	0.0053			
	Antimony (Sb)-Dissolved (mg/L)	<0.00050	<0.00050			
	Arsenic (As)-Dissolved (mg/L)	<0.00050	<0.00050			
	Barium (Ba)-Dissolved (mg/L)	0.057	0.039			
	Beryllium (Be)-Dissolved (mg/L)	<0.00010	<0.00010			

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1994216-1 Water 19-SEP-17 12:30 PEACE AT BEATTON (PD2)	L1994216-2 Water 19-SEP-17 13:00 BEATTON RIVER (BEATTON)	L1994216-3 Water 19-SEP-17 13:45 PEACE AT KISKATINAW (PD3)	L1994216-4 Water 19-SEP-17 14:00 KISKATINAW RIVER (KR)	L1994216-5 Water 19-SEP-17 15:00 PEACE AT POUCE COUPE (PD4)
WATER						
Dissolved Metals	Bismuth (Bi)-Dissolved (mg/L)	<0.20	<0.20	<0.20	<0.20	<0.20
	Boron (B)-Dissolved (mg/L)	<0.10	<0.10	<0.10	<0.10	<0.10
	Cadmium (Cd)-Dissolved (mg/L)	0.0000125	0.0000251	0.0000129	<0.0000050	0.0000150
	Calcium (Ca)-Dissolved (mg/L)	26.0	42.7	26.4	50.8	27.2
	Chromium (Cr)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Cobalt (Co)-Dissolved (mg/L)	<0.00030	0.00031	<0.00030	<0.00030	<0.00030
	Copper (Cu)-Dissolved (mg/L)	<0.0010	0.0020	<0.0010	0.0010	<0.0010
	Iron (Fe)-Dissolved (mg/L)	<0.030	0.567	<0.030	<0.030	<0.030
	Lead (Pb)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Lithium (Li)-Dissolved (mg/L)	0.0011	0.0088	0.0013	0.0063	0.0013
	Magnesium (Mg)-Dissolved (mg/L)	5.97	12.6	5.59	20.9	6.03
	Manganese (Mn)-Dissolved (mg/L)	0.00144	0.0115	0.00096	0.00181	0.00098
	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Mercury (Hg)-Dissolved (ug/L)	<0.00050	0.00203	<0.00050	<0.00050	<0.00050
	Molybdenum (Mo)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	0.0011	<0.0010
	Nickel (Ni)-Dissolved (mg/L)	<0.0010	0.0052	<0.0010	0.0013	<0.0010
	Phosphorus (P)-Dissolved (mg/L)	<0.30	<0.30	<0.30	<0.30	<0.30
	Potassium (K)-Dissolved (mg/L)	<2.0	2.1	<2.0	<2.0	<2.0
	Selenium (Se)-Dissolved (mg/L)	0.000259	0.000272	0.000237	0.000242	0.000301
	Silicon (Si)-Dissolved (mg/L)	1.99	2.02	1.95	0.683	1.89
	Silver (Ag)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Sodium (Na)-Dissolved (mg/L)	<2.0	36.5	<2.0	23.4	<2.0
	Strontium (Sr)-Dissolved (mg/L)	0.101	0.165	0.103	0.314	0.106
	Thallium (Tl)-Dissolved (mg/L)	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
	Tin (Sn)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Titanium (Ti)-Dissolved (mg/L)	<0.010	<0.010	<0.010	<0.010	<0.010
	Uranium (U)-Dissolved (mg/L)	0.00040	0.00122	0.00040	0.00116	0.00042
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Zinc (Zn)-Dissolved (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Speciated Metals	Methylmercury (as MeHg)-Dissolved (ug/L)	<0.000050	0.000396	<0.000050	<0.000050	<0.000050
	Methylmercury (as MeHg)-Total (ug/L)	<0.000050	0.000488	<0.000050	<0.000050	<0.000050

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1994216-6	L1994216-7			
	Description	Water	Water			
	Sampled Date	19-SEP-17	19-SEP-17			
	Sampled Time	15:30	17:00			
	Client ID	POUCE COUPE (POUCE)	PEACE AT MANY ISLANDS (PD5)			
Grouping	**Analyte**					
WATER						
Dissolved Metals	Bismuth (Bi)-Dissolved (mg/L)	<0.20	<0.20			
	Boron (B)-Dissolved (mg/L)	<0.10	<0.10			
	Cadmium (Cd)-Dissolved (mg/L)	0.0000106	0.0000121			
	Calcium (Ca)-Dissolved (mg/L)	64.3 DTC	27.3			
	Chromium (Cr)-Dissolved (mg/L)	<0.0010	<0.0010			
	Cobalt (Co)-Dissolved (mg/L)	<0.00030	<0.00030			
	Copper (Cu)-Dissolved (mg/L)	0.0012	<0.0010			
	Iron (Fe)-Dissolved (mg/L)	<0.030	<0.030			
	Lead (Pb)-Dissolved (mg/L)	<0.00050	<0.00050			
	Lithium (Li)-Dissolved (mg/L)	0.0121 DTC	0.0013			
	Magnesium (Mg)-Dissolved (mg/L)	22.9 DTC	5.90			
	Manganese (Mn)-Dissolved (mg/L)	0.00817	0.00058			
	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050			
	Mercury (Hg)-Dissolved (ug/L)	0.00051	<0.00050			
	Molybdenum (Mo)-Dissolved (mg/L)	0.0010	<0.0010			
	Nickel (Ni)-Dissolved (mg/L)	0.0025	<0.0010			
	Phosphorus (P)-Dissolved (mg/L)	<0.30	<0.30			
	Potassium (K)-Dissolved (mg/L)	4.1	<2.0			
	Selenium (Se)-Dissolved (mg/L)	0.000336	0.000264			
	Silicon (Si)-Dissolved (mg/L)	1.07	1.88			
	Silver (Ag)-Dissolved (mg/L)	<0.000020	<0.000020			
	Sodium (Na)-Dissolved (mg/L)	55.5 DTC	<2.0			
	Strontium (Sr)-Dissolved (mg/L)	0.285 DTC	0.106			
	Thallium (Tl)-Dissolved (mg/L)	<0.00020	<0.00020			
	Tin (Sn)-Dissolved (mg/L)	<0.00050	<0.00050			
	Titanium (Ti)-Dissolved (mg/L)	<0.010	<0.010			
	Uranium (U)-Dissolved (mg/L)	0.00165	0.00042			
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050			
	Zinc (Zn)-Dissolved (mg/L)	<0.0050	<0.0050			
Speciated Metals	Methylmercury (as MeHg)-Dissolved (ug/L)	0.000057	<0.000050			
	Methylmercury (as MeHg)-Total (ug/L)	<0.000050	<0.000050			

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

Qualifiers for Sample Submission Listed:

Qualifier	Description
WSMT	Water sample(s) for total mercury analysis was not submitted in glass or PTFE container with HCl preservative. Results may be biased low.
WSMD	Water sample(s) for dissolved mercury analysis was not submitted in glass or PTFE container with HCl preservative. Results may be biased low.

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Dissolved Organic Carbon	MS-B	L1994216-1, -3, -5, -6, -7
Matrix Spike	Dissolved Organic Carbon	MS-B	L1994216-2, -4
Matrix Spike	Total Organic Carbon	MS-B	L1994216-1, -3, -4, -5, -6, -7
Matrix Spike	Total Organic Carbon	MS-B	L1994216-2
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L1994216-1, -2, -3
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L1994216-4, -5, -6, -7
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L1994216-1, -2, -3
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L1994216-4, -5, -6, -7
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L1994216-1, -2, -3
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L1994216-4, -5, -6, -7
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L1994216-4, -5, -6, -7
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1994216-1, -2, -3
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1994216-4, -5, -6, -7
Matrix Spike	Barium (Ba)-Total	MS-B	L1994216-6
Matrix Spike	Boron (B)-Total	MS-B	L1994216-6
Matrix Spike	Calcium (Ca)-Total	MS-B	L1994216-6
Matrix Spike	Calcium (Ca)-Total	MS-B	L1994216-6
Matrix Spike	Lithium (Li)-Total	MS-B	L1994216-6
Matrix Spike	Magnesium (Mg)-Total	MS-B	L1994216-6
Matrix Spike	Magnesium (Mg)-Total	MS-B	L1994216-6
Matrix Spike	Manganese (Mn)-Total	MS-B	L1994216-6
Matrix Spike	Potassium (K)-Total	MS-B	L1994216-6
Matrix Spike	Sodium (Na)-Total	MS-B	L1994216-6
Matrix Spike	Sodium (Na)-Total	MS-B	L1994216-6
Matrix Spike	Strontium (Sr)-Total	MS-B	L1994216-6
Matrix Spike	Strontium (Sr)-Total	MS-B	L1994216-6
Matrix Spike	Total Nitrogen	MS-B	L1994216-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Orthophosphate-Dissolved (as P)	MS-B	L1994216-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Orthophosphate-Dissolved (as P)	MS-B	L1994216-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Silicate (as SiO2)	MS-B	L1994216-1, -2, -3, -4, -5, -6, -7

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLDS	Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity.
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
DTC	Dissolved concentration exceeds total. Results were confirmed by re-analysis.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

ANIONS-N+N-CALC-VA	Water	Nitrite & Nitrate in Water (Calculation)	EPA 300.0

Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).

Reference Information

BR-L-IC-N-VA	Water	Bromide in Water by IC (Low Level)	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

CARBONS-DOC-VA	Water	Dissolved organic carbon by combustion	APHA 5310B TOTAL ORGANIC CARBON (TOC)

This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis.

CARBONS-TOC-VA	Water	Total organic carbon by combustion	APHA 5310B TOTAL ORGANIC CARBON (TOC)

This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)".

CL-IC-N-VA	Water	Chloride in Water by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

COLOUR-TRUE-VA	Water	Colour (True) by Spectrometer	BCMOE Colour Single Wavelength

This analysis is carried out using procedures adapted from British Columbia Environmental Manual "Colour- Single Wavelength." Colour (True Colour) is determined by filtering a sample through a 0.45 micron membrane filter followed by analysis of the filtrate using the platinum-cobalt colourimetric method.
Colour measurements can be highly pH dependent, and apply to the pH of the sample as received (at time of testing), without pH adjustment. Concurrent measurement of sample pH is recommended.

EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510

Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.

F-IC-N-VA	Water	Fluoride in Water by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

HARDNESS-CALC-VA	Water	Hardness	APHA 2340B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HG-D-CVAA-VA	Water	Diss. Mercury in Water by CVAAS or CVAFS	APHA 3030B/EPA 1631E (mod)

Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

HG-D-U-CVAF-VA	Water	Diss. Mercury in Water by CVAFS (Ultra)	APHA 3030 B / EPA 1631 REV. E

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from Method 1631 Rev. E. by the United States Environmental Protection Agency (EPA). The procedure may involve preliminary sample treatment by filtration (APHA 3030B) and involves a cold-oxidation of the acidified sample using bromine monochloride prior to a purge and trap concentration step and final reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry.

HG-T-CVAA-VA	Water	Total Mercury in Water by CVAAS or CVAFS	EPA 1631E (mod)

Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

HG-T-U-CVAF-VA	Water	Total Mercury in Water by CVAFS (Ultra)	EPA 1631 REV. E

This analysis is carried out using procedures adapted from Method 1631 Rev. E. by the United States Environmental Protection Agency (EPA). The procedure involves a cold-oxidation of the acidified sample using bromine monochloride prior to a purge and trap concentration step and final reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry.

IONBALANCE-VA	Water	Ion Balance Calculation	APHA 1030E

Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:

Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum]

MEHG-D-GCAF-VA	Water	Diss. Methylmercury in Water by GCAFS	EPA 1630

This method follows Method 1630 of the US EPA. Samples are distilled under an inert gas flow to isolate methylmercury and minimize matrix interferences. The distillate is analyzed by aqueous phase ethylation, purge and trap, desorption and GC separation. The separated species are then pyrolized to elemental Hg and quantified by cold vapour atomic flourescence spectroscopy. Results are reported "as MeHg".

MEHG-T-GCAF-VA	Water	Total Methylmercury in Water by GCAFS	EPA 1630

Reference Information

This method follows Method 1630 of the US EPA. Samples are distilled under an inert gas flow to isolate methylmercury and minimize matrix interferences. The distillate is analyzed by aqueous phase ethylation, purge and trap, desorption and GC separation. THe separated species are then pyrolized to elemental Hg and quantified by cold vapour atomic flourescence spectroscopy. Results are reported "as MeHg".

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

N-T-COL-VA Water Total Nitrogen in water by Colour APHA4500-P(J)/NEMI9171/USGS03-4174

This analysis is carried out using procedures adapted from APHA Method 4500-P (J) "Persulphate Method for Simultaneous Determination of Total Nitrogen and Total Phosphorus" and National Environmental Methods Index - Nemi method 5735.

NH3-F-VA Water Ammonia in Water by Fluorescence APHA 4500 NH3-NITROGEN (AMMONIA)

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-VA Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-VA Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

P-T-PRES-COL-VA Water Total P in Water by Colour APHA 4500-P Phosphorus

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorus is determined colourimetrically after persulphate digestion of the sample.
Samples with very high dissolved solids (i.e. seawaters, brackish waters) may produce a negative bias by this method. Alternate methods are available for these types of samples.

Arsenic (5+), at elevated levels, is a positive interference on colourimetric phosphate analysis.

P-TD-COL-VA Water Total Dissolved P in Water by Colour APHA 4500-P Phosphorous

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Dissolved Phosphorus is determined colourimetrically after persulphate digestion of a sample that has been lab or field filtered through a 0.45 micron membrane filter.
Samples with very high dissolved solids (i.e. seawaters, brackish waters) may produce a negative bias by this method. Alternate methods are available for these types of samples.

Arsenic (5+), at elevated levels, is a positive interference on colourimetric phosphate analysis.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

PO4-DO-COL-VA Water Diss. Orthophosphate in Water by Colour APHA 4500-P Phosphorus

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Dissolved Orthophosphate is determined colourimetrically on a sample that has been lab or field filtered through a 0.45 micron membrane filter.
Samples with very high dissolved solids (i.e. seawaters, brackish waters) may produce a negative bias by this method. Alternate methods are available for these types of samples.

Arsenic (5+), at elevated levels, is a positive interference on colourimetric phosphate analysis.

SILICATE-COL-VA Water Silicate by Colourimetric analysis APHA 4500-SiO2 E.

This analysis is carried out using procedures adapted from APHA Method 4500-SiO2 E. "Silica". Silicate (molybdate-reactive silica) is determined by the molybdosilicate-heteropoly blue colourimetric method.

SO4-IC-N-VA Water Sulfate in Water by IC EPA 300.1 (mod)

Reference Information

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA	Water	TDS (Calculated)	APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".
The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TKN-F-VA	Water	TKN in Water by Fluorescence	APHA 4500-NORG D.

This analysis is carried out using procedures adapted from APHA Method 4500-Norg D. "Block Digestion and Flow Injection Analysis". Total Kjeldahl Nitrogen is determined using block digestion followed by Flow-injection analysis with fluorescence detection.

TSS-VA	Water	Total Suspended Solids by Gravimetric	APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius. Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

TURBIDITY-VA	Water	Turbidity by Meter	APHA 2130 Turbidity

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Tetra Tech Canada Inc.
ATTN: Danielle MacDonald
14940 - 123 Avenue, NW
Edmonton AB T5V 1B4

Date Received: 20-SEP-17
Report Date: 05-OCT-17 16:50 (MT)
Version: FINAL

Client Phone: 780-886-3055

Certificate of Analysis

Lab Work Order #: L1994687

Project P.O. #: NOT SUBMITTED
Job Reference: VENW03058
C of C Numbers: 14-
Legal Site Desc:

Comments:

Brent Mack, B.Sc.
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1994687-1	L1994687-2	L1994687-3	L1994687-4	L1994687-5
	Description	Water	Water	Water	Water	Water
	Sampled Date	20-SEP-17	20-SEP-17	20-SEP-17	20-SEP-17	
	Sampled Time	12:15	11:00	12:45	13:05	
	Client ID	MOBERLY RIVER DOWNSTREAM (MD)	LOWER SITE C RESERVOIR (PR3)	PEACE AT PINE (PD1)	PINE RIVER(PINE)	TRIP BLANK
Grouping	**Analyte**					
WATER						
Physical Tests	Colour, True (CU)	8.6	7.9	8.3	7.2	<5.0
	Conductivity (uS/cm)	369	187	185	286	<2.0
	Hardness (as CaCO3) (mg/L)	205	104	103	164	<0.50 HTC
	pH (pH)	8.25	8.03	8.03	8.27	5.42
	Total Suspended Solids (mg/L)	17.3	7.9	15.5	8.7	<3.0
	TDS (Calculated) (mg/L)	219	105	105	170	<1.0
	Turbidity (NTU)	10.9	4.02	6.12	6.70	<0.10
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	181	83.0	84.0	135	<1.0
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Phenolphthalein (as CaCO3) (mg/L)	<2.0	<2.0	<2.0	<2.0	<2.0
	Alkalinity, Total (as CaCO3) (mg/L)	181	83.0	84.0	135	<1.0
	Ammonia, Total (as N) (mg/L)	<0.0050	<0.0050	0.0070	<0.0050	<0.025 RRV
	Bromide (Br) (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Chloride (Cl) (mg/L)	0.61	<0.50	<0.50	1.02	<0.50
	Fluoride (F) (mg/L)	0.098	0.038	0.039	0.064	<0.020
	Nitrate and Nitrite (as N) (mg/L)	<0.0051	0.0584	0.0592	0.0300	<0.0051
	Nitrate (as N) (mg/L)	<0.0050	0.0572 HTD	0.0592	0.0300	<0.0050
	Nitrite (as N) (mg/L)	<0.0010	0.0012	<0.0010	<0.0010	<0.0010 HTD
	Total Kjeldahl Nitrogen (mg/L)	0.139	0.119	0.139	0.073	<0.050
	Total Nitrogen (mg/L)	0.116	0.144	0.154	0.101	<0.030
	Orthophosphate-Dissolved (as P) (mg/L)	0.0015	<0.0010	<0.0010	<0.0010	<0.0010
	Phosphorus (P)-Total Dissolved (mg/L)	0.0022	<0.0020	0.0021	<0.0020	<0.0020
	Phosphorus (P)-Total (mg/L)	0.0202	0.0069	0.0062	0.0102	<0.0020
	Silicate (as SiO2) (mg/L)	4.07	4.21	4.14	2.11	<0.50
	Sulfate (SO4) (mg/L)	27.1	14.4	14.7	24.6	<0.30
	Anion Sum (meq/L)	4.20	1.96	1.99	3.25	<0.10
	Cation Sum (meq/L)	4.39	2.08	2.06	3.42	<0.10
	Cation - Anion Balance (%)	2.2	2.8	1.7	2.5	0.0
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	3.20	2.57	2.49	1.41	
	Total Organic Carbon (mg/L)	3.35	2.99	2.97	1.67	<0.50
Bacteriological Tests	E. coli (MPN/100mL)	23	5	10	5	<1
	HPC (CFU/1mL)	268	95	162	89	<1
	Coliform Bacteria - Total (MPN/100mL)	1990	488	727	39	<1
Total Metals	Aluminum (Al)-Total (mg/L)	0.192	0.107	0.164	0.182	<0.0050

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1994687-1	L1994687-2	L1994687-3	L1994687-4	L1994687-5
	Description	Water	Water	Water	Water	Water
	Sampled Date	20-SEP-17	20-SEP-17	20-SEP-17	20-SEP-17	
	Sampled Time	12:15	11:00	12:45	13:05	
	Client ID	MOBERLY RIVER DOWNSTREAM (MD)	LOWER SITE C RESERVOIR (PR3)	PEACE AT PINE (PD1)	PINE RIVER(PINE)	TRIP BLANK
Grouping	**Analyte**					
WATER						
Total Metals	Antimony (Sb)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Arsenic (As)-Total (mg/L)	0.00055	<0.00050	<0.00050	<0.00050	<0.00050
	Barium (Ba)-Total (mg/L)	0.180	0.035	0.040	0.093	<0.020
	Beryllium (Be)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Bismuth (Bi)-Total (mg/L)	<0.20	<0.20	<0.20	<0.20	<0.20
	Boron (B)-Total (mg/L)	<0.10	<0.10	<0.10	<0.10	<0.10
	Cadmium (Cd)-Total (mg/L)	0.0000483	0.0000221	0.0000353	0.0000199	<0.0000050
	Calcium (Ca)-Total (mg/L)	52.8	26.8	26.7	41.4	<0.10
	Chromium (Cr)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Cobalt (Co)-Total (mg/L)	0.00041	<0.00030	<0.00030	<0.00030	<0.00030
	Copper (Cu)-Total (mg/L)	0.0014	<0.0010	0.0011	<0.0010	<0.0010
	Iron (Fe)-Total (mg/L)	0.455	0.141	0.280	0.397	<0.030
	Lead (Pb)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Lithium (Li)-Total (mg/L)	0.0058	0.0011	0.0012	0.0064	<0.0010
	Magnesium (Mg)-Total (mg/L)	13.0	5.79	6.16	10.3	<0.10
	Manganese (Mn)-Total (mg/L)	0.0573	0.00467	0.00790	0.00992	<0.00010
	Mercury (Hg)-Total (ug/L)	0.00118	0.00056	0.00083	0.00089	
	Molybdenum (Mo)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Nickel (Ni)-Total (mg/L)	0.0023	<0.0010	0.0011	0.0012	<0.0010
	Phosphorus (P)-Total (mg/L)	<0.30	<0.30	<0.30	<0.30	<0.30
	Potassium (K)-Total (mg/L)	<2.0	<2.0	<2.0	<2.0	<2.0
	Selenium (Se)-Total (mg/L)	0.000266	0.000295	0.000278	0.000425	<0.000050
	Silicon (Si)-Total (mg/L)	2.22	2.13	2.33	1.27	<0.10
	Silver (Ag)-Total (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Sodium (Na)-Total (mg/L)	5.8	<2.0	<2.0	2.9	<2.0
	Strontium (Sr)-Total (mg/L)	0.139	0.106	0.105	0.151	<0.0050
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Titanium (Ti)-Total (mg/L)	<0.010	<0.010	<0.010	<0.010	<0.010
	Uranium (U)-Total (mg/L)	0.00071	0.00043	0.00046	0.00038	<0.00020
	Vanadium (V)-Total (mg/L)	0.00078	0.00064	0.00096	0.00070	<0.00050
	Zinc (Zn)-Total (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Dissolved Metals	Dissolved Fe2 Filtration Location	FIELD	FIELD	FIELD	FIELD	
	Dissolved MeHg Filtration Location	FIELD	FIELD	FIELD	FIELD	
	Dissolved Mercury Filtration Location	FIELD	LAB	FIELD	LAB	
		LAB	FIELD	LAB	FIELD	
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L1994687-1	L1994687-2	L1994687-3	L1994687-4	L1994687-5
Description	Water	Water	Water	Water	Water
Sampled Date	20-SEP-17	20-SEP-17	20-SEP-17	20-SEP-17	
Sampled Time	12:15	11:00	12:45	13:05	
Client ID	MOBERLY RIVER DOWNSTREAM (MD)	LOWER SITE C RESERVOIR (PR3)	PEACE AT PINE (PD1)	PINE RIVER(PINE)	TRIP BLANK
Grouping / **Analyte**					
WATER					
Dissolved Metals Aluminum (Al)-Dissolved (mg/L)	0.0357	0.0089	0.0105	0.0207	
Antimony (Sb)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
Arsenic (As)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
Barium (Ba)-Dissolved (mg/L)	0.190	0.038	0.039	0.101	
Beryllium (Be)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
Bismuth (Bi)-Dissolved (mg/L)	<0.20	<0.20	<0.20	<0.20	
Boron (B)-Dissolved (mg/L)	<0.10	<0.10	<0.10	<0.10	
Cadmium (Cd)-Dissolved (mg/L)	0.0000186	0.0000097	0.0000116	0.0000104	
Calcium (Ca)-Dissolved (mg/L)	58.2	30.5	30.3	46.1	
Chromium (Cr)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	
Cobalt (Co)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	
Copper (Cu)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	
Iron (Fe)-Dissolved (mg/L)	<0.030	<0.030	<0.030	<0.030	
Ferrous Iron, Dissolved (mg/L)	<0.020	<0.020	<0.020	<0.020	
Lead (Pb)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
Lithium (Li)-Dissolved (mg/L)	0.0061	0.0013	0.0013	0.0068	
Magnesium (Mg)-Dissolved (mg/L)	14.6	6.77	6.66	11.8	
Manganese (Mn)-Dissolved (mg/L)	0.0475	0.00201	0.00276	0.00570	
Mercury (Hg)-Dissolved (ug/L)	<0.00050	<0.00050	<0.00050	<0.00050	
Molybdenum (Mo)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	
Nickel (Ni)-Dissolved (mg/L)	0.0018	<0.0010	<0.0010	<0.0010	
Phosphorus (P)-Dissolved (mg/L)	<0.30	<0.30	<0.30	<0.30	
Potassium (K)-Dissolved (mg/L)	<2.0	<2.0	<2.0	<2.0	
Selenium (Se)-Dissolved (mg/L)	0.000234	0.000269	0.000242	0.000444	
Silicon (Si)-Dissolved (mg/L)	2.18	2.22	2.22	1.13	
Silver (Ag)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	
Sodium (Na)-Dissolved (mg/L)	6.5	<2.0	<2.0	3.3	
Strontium (Sr)-Dissolved (mg/L)	0.146	0.116	0.112	0.159	
Thallium (Tl)-Dissolved (mg/L)	<0.00020	<0.00020	<0.00020	<0.00020	
Tin (Sn)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
Titanium (Ti)-Dissolved (mg/L)	<0.010	<0.010	<0.010	<0.010	
Uranium (U)-Dissolved (mg/L)	0.00066	0.00043	0.00043	0.00033	
Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
Zinc (Zn)-Dissolved (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	
Speciated Metals Methylmercury (as MeHg)-Dissolved (ug/L)	<0.000050	<0.000050	<0.000050	<0.000050	
Methylmercury (as MeHg)-Total (ug/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

Qualifiers for Individual Samples Listed:

Sample Number	Client Sample ID	Qualifier	Description
L1994687-1	MOBERLY RIVER DOWNST	WSMT	Water sample(s) for total mercury analysis was not submitted in glass or PTFE container with HCl preservative. Results may be biased low.
		WSMD	Water sample(s) for dissolved mercury analysis was not submitted in glass or PTFE container with HCl preservative. Results may be biased low.
L1994687-2	LOWER SITE C RESERVOIF	WSMT	Water sample(s) for total mercury analysis was not submitted in glass or PTFE container with HCl preservative. Results may be biased low.
		WSMD	Water sample(s) for dissolved mercury analysis was not submitted in glass or PTFE container with HCl preservative. Results may be biased low.
L1994687-3	PEACE AT PINE (PD1)	WSMT	Water sample(s) for total mercury analysis was not submitted in glass or PTFE container with HCl preservative. Results may be biased low.
		WSMD	Water sample(s) for dissolved mercury analysis was not submitted in glass or PTFE container with HCl preservative. Results may be biased low.
L1994687-4	PINE RIVER(PINE)	WSMD	Water sample(s) for dissolved mercury analysis was not submitted in glass or PTFE container with HCl preservative. Results may be biased low.
		WSMT	Water sample(s) for total mercury analysis was not submitted in glass or PTFE container with HCl preservative. Results may be biased low.

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Laboratory Control Sample	Methylmercury (as MeHg)-Dissolved	LCS-ND	L1994687-2, -3
Laboratory Control Sample	Methylmercury (as MeHg)-Total	LCS-ND	L1994687-2, -3
Matrix Spike	Dissolved Organic Carbon	MS-B	L1994687-4
Matrix Spike	Dissolved Organic Carbon	MS-B	L1994687-3
Matrix Spike	Total Organic Carbon	MS-B	L1994687-3, -4, -5
Matrix Spike	Barium (Ba)-Total	MS-B	L1994687-1, -2, -3, -4, -5
Matrix Spike	Calcium (Ca)-Total	MS-B	L1994687-1, -2, -3, -4, -5
Matrix Spike	Magnesium (Mg)-Total	MS-B	L1994687-1, -2, -3, -4, -5
Matrix Spike	Strontium (Sr)-Total	MS-B	L1994687-1, -2, -3, -4, -5
Matrix Spike	Orthophosphate-Dissolved (as P)	MS-B	L1994687-1, -2, -3, -4, -5
Matrix Spike	Orthophosphate-Dissolved (as P)	MS-B	L1994687-1, -2, -3, -4, -5
Matrix Spike	Sulfate (SO4)	MS-B	L1994687-1, -2, -3, -4, -5

Qualifiers for Individual Parameters Listed:

Qualifier	Description
HTC	Hardness was calculated from Total Ca and/or Mg concentrations and may be biased high (dissolved Ca/Mg results unavailable).
HTD	Hold time exceeded for re-analysis or dilution, but initial testing was conducted within hold time.
LCS-ND	Lab Control Sample recovery was slightly outside ALS DQO. Reported non-detect results for associated samples were unaffected.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.
RRV	Reported Result Verified By Repeat Analysis

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
ANIONS-N+N-CALC-VA	Water	Nitrite & Nitrate in Water (Calculation)	EPA 300.0
Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).			
BR-L-IC-N-VA	Water	Bromide in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
CARBONS-DOC-VA	Water	Dissolved organic carbon by combustion	APHA 5310B TOTAL ORGANIC CARBON (TOC)
This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis.			
CARBONS-TOC-VA	Water	Total organic carbon by combustion	APHA 5310B TOTAL ORGANIC CARBON (TOC)
This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)".			
CL-IC-N-VA	Water	Chloride in Water by IC	EPA 300.1 (mod)

Reference Information

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

COLOUR-TRUE-VA Water Colour (True) by Spectrometer BCMOE Colour Single Wavelength

This analysis is carried out using procedures adapted from British Columbia Environmental Manual "Colour- Single Wavelength." Colour (True Colour) is determined by filtering a sample through a 0.45 micron membrane filter followed by analysis of the filtrate using the platinum-cobalt colourimetric method.
Colour measurements can be highly pH dependent, and apply to the pH of the sample as received (at time of testing), without pH adjustment. Concurrent measurement of sample pH is recommended.

EC-PCT-VA Water Conductivity (Automated) APHA 2510 Auto. Conduc.

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

EC-SCREEN-VA Water Conductivity Screen (Internal Use Only) APHA 2510

Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.

ECOLI-COLI-ENV-VA Water E.coli by Colilert APHA METHOD 9223

This analysis is carried out using procedures adapted from APHA Method 9223 "Enzyme Substrate Coliform Test". E. coli and Total Coliform are determined simultaneously. The sample is mixed with a mixture hydrolyzable substrates and then sealed in a multi-well packet. The packet is incubated for 18 or 24 hours and then the number of wells exhibiting a positive response are counted. The final result is obtained by comparing the positive responses to a probability table.

F-IC-N-VA Water Fluoride in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

FE2-D-COL-VA Water Diss. Ferrous Iron in Water by Colour APHA 3500-Fe B/James Ball et al (1999)

This analysis is carried out using procedures adapted from APHA 3500-Fe B and "A New Method for the Direct Determination of Dissolved Iron Concentration in Acid Mine Waters" published by James W. Ball et al (1999). The procedure involves preliminary sample filtration, and ferrous iron is determined using the "FerroZine" colourimetric method.

HARDNESS-CALC-VA Water Hardness APHA 2340B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HG-D-U-CVAF-VA Water Diss. Mercury in Water by CVAFS (Ultra) APHA 3030 B / EPA 1631 REV. E

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from Method 1631 Rev. E. by the United States Environmental Protection Agency (EPA). The procedure may involve preliminary sample treatment by filtration (APHA 3030B) and involves a cold-oxidation of the acidified sample using bromine monochloride prior to a purge and trap concentration step and final reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry.

HG-T-U-CVAF-VA Water Total Mercury in Water by CVAFS (Ultra) EPA 1631 REV. E

This analysis is carried out using procedures adapted from Method 1631 Rev. E. by the United States Environmental Protection Agency (EPA). The procedure involves a cold-oxidation of the acidified sample using bromine monochloride prior to a purge and trap concentration step and final reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry.

HPC-PP-ENV-VA Water HPC by pour plate APHA METHOD 9215

This analysis is carried out using procedures adapted from APHA Method 9215 "Heterotropic Plate Count". Heterotropic plate count (standard plate count or total plate count) is determined by culturing and colony counting using the pour plate method with a 48 hour incubation period. The test measures colonies formed by heterotropic bacteria.

IONBALANCE-VA Water Ion Balance Calculation APHA 1030E

Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:

Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum]

MEHG-D-GCAF-VA Water Diss. Methylmercury in Water by GCAFS EPA 1630

This method follows Method 1630 of the US EPA. Samples are distilled under an inert gas flow to isolate methylmercury and minimize matrix interferences. The distillate is analyzed by aqueous phase ethylation, purge and trap, desorption and GC separation. The separated species are then pyrolized to elemental Hg and quantified by cold vapour atomic flourescence spectroscopy. Results are reported "as MeHg".

MEHG-T-GCAF-VA Water Total Methylmercury in Water by GCAFS EPA 1630

This method follows Method 1630 of the US EPA. Samples are distilled under an inert gas flow to isolate methylmercury and minimize matrix interferences. The distillate is analyzed by aqueous phase ethylation, purge and trap, desorption and GC separation. THe separated species are then

Reference Information

pyrolized to elemental Hg and quantified by cold vapour atomic flourescence spectroscopy. Results are reported "as MeHg".

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

N-T-COL-VA Water Total Nitrogen in water by Colour APHA4500-P(J)/NEMI9171/USGS03-4174

This analysis is carried out using procedures adapted from APHA Method 4500-P (J) "Persulphate Method for Simultaneous Determination of Total Nitrogen and Total Phosphorus" and National Environmental Methods Index - Nemi method 5735.

NH3-F-VA Water Ammonia in Water by Fluorescence APHA 4500 NH3-NITROGEN (AMMONIA)

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-VA Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-VA Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

P-T-PRES-COL-VA Water Total P in Water by Colour APHA 4500-P Phosphorus

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorus is determined colourimetrically after persulphate digestion of the sample.
Samples with very high dissolved solids (i.e. seawaters, brackish waters) may produce a negative bias by this method. Alternate methods are available for these types of samples.

Arsenic (5+), at elevated levels, is a positive interference on colourimetric phosphate analysis.

P-TD-COL-VA Water Total Dissolved P in Water by Colour APHA 4500-P Phosphorous

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Dissolved Phosphorus is determined colourimetrically after persulphate digestion of a sample that has been lab or field filtered through a 0.45 micron membrane filter.
Samples with very high dissolved solids (i.e. seawaters, brackish waters) may produce a negative bias by this method. Alternate methods are available for these types of samples.

Arsenic (5+), at elevated levels, is a positive interference on colourimetric phosphate analysis.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

PO4-DO-COL-VA Water Diss. Orthophosphate in Water by Colour APHA 4500-P Phosphorus

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Dissolved Orthophosphate is determined colourimetrically on a sample that has been lab or field filtered through a 0.45 micron membrane filter.
Samples with very high dissolved solids (i.e. seawaters, brackish waters) may produce a negative bias by this method. Alternate methods are available for these types of samples.

Arsenic (5+), at elevated levels, is a positive interference on colourimetric phosphate analysis.

SILICATE-COL-VA Water Silicate by Colourimetric analysis APHA 4500-SiO2 E.

This analysis is carried out using procedures adapted from APHA Method 4500-SiO2 E. "Silica". Silicate (molybdate-reactive silica) is determined by the molybdosilicate-heteropoly blue colourimetric method.

SO4-IC-N-VA Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

Reference Information

TCOLI-COLI-ENV-VA	Water	Total coliform by Colilert	APHA METHOD 9223

This analysis is carried out using procedures adapted from APHA Method 9223 "Enzyme Substrate Coliform Test". E. coli and Total Coliform are determined simultaneously. The sample is mixed with a mixture hydrolyzable substrates and then sealed in a multi-well packet. The packet is incubated for 18 or 24 hours and then the number of wells exhibiting a positive response are counted. The final result is quantified by a statistical estimation of bacteria density (most probable number).

TDS-CALC-VA	Water	TDS (Calculated)	APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".
The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TKN-F-VA	Water	TKN in Water by Fluorescence	APHA 4500-NORG D.

This analysis is carried out using procedures adapted from APHA Method 4500-Norg D. "Block Digestion and Flow Injection Analysis". Total Kjeldahl Nitrogen is determined using block digestion followed by Flow-injection analysis with fluorescence detection.

TSS-VA	Water	Total Suspended Solids by Gravimetric	APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.
Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

TURBIDITY-VA	Water	Turbidity by Meter	APHA 2130 Turbidity

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

14-

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Tetra Tech Canada Inc.
ATTN: Danielle MacDonald
14940 - 123 Avenue, NW
Edmonton AB T5V 1B4

Date Received: 18-OCT-17
Report Date: 01-NOV-17 15:58 (MT)
Version: FINAL

Client Phone: 780-886-3055

Certificate of Analysis

Lab Work Order #: L2009107

Project P.O. #: NOT SUBMITTED
Job Reference: VENW03060
C of C Numbers:
Legal Site Desc:

Brent Mack, B.Sc.
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2009107-1 Water 17-OCT-17 15:10 MOBERLY RIVER - DOWNSTREAM (MD)	L2009107-2 Water 17-OCT-17 13:20 LOWER SITE C RESERVOIR (PR3)	L2009107-3 Water 17-OCT-17 16:10 PEACE AT PINE (PD1)	L2009107-4 Water 17-OCT-17 17:00 PINE RIVER (PINE)	
WATER						
Physical Tests	Colour, True (CU)	14.9	<5.0	7.0	5.2	
	Conductivity (uS/cm)	274	172	179	286	
	Hardness (as CaCO3) (mg/L)	141	85.0	87.1	152	
	pH (pH)	8.34	8.13	8.15	8.37	
	Total Suspended Solids (mg/L)	7.7	6.1	15.5	50.7	
	TDS (Calculated) (mg/L)	160	95.0	97.4	169	
	Turbidity (NTU)	8.78	1.70	3.05	20.4	
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	138	80.9	82.1	140	
	Alkalinity, Carbonate (as CaCO3) (mg/L)	4.6	<1.0	<1.0	5.0	
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	
	Alkalinity, Total (as CaCO3) (mg/L)	142	80.9	82.1	145	
	Ammonia, Total (as N) (mg/L)	<0.0050	<0.0050	0.0051	<0.0050	
	Bromide (Br) (mg/L)	<0.050	<0.050	<0.050	<0.050	
	Chloride (Cl) (mg/L)	0.61	<0.50	<0.50	0.97	
	Fluoride (F) (mg/L)	0.081	0.036	0.037	0.067	
	Nitrate and Nitrite (as N) (mg/L)	<0.0051	0.0468	0.0457	0.0630	
	Nitrate (as N) (mg/L)	<0.0050	0.0468	0.0457	0.0630	
	Nitrite (as N) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	
	Total Kjeldahl Nitrogen (mg/L)	0.159	0.096	0.097	0.155	
	Total Nitrogen (mg/L)	0.155	0.129	0.142	0.175	
	Orthophosphate-Dissolved (as P) (mg/L)	0.0016	0.0010	0.0012	<0.0010	
	Phosphorus (P)-Total Dissolved (mg/L)	0.0026	<0.0020	<0.0020	<0.0020	
	Phosphorus (P)-Total (mg/L)	0.0125	0.0075	0.0159	0.0490	
	Silicate (as SiO2) (mg/L)	3.41	4.11	4.23	2.43	
	Sulfate (SO4) (mg/L)	15.2	13.0	13.8	20.5	
	Anion Sum (meq/L)	3.18	1.89	1.93	3.36	
	Cation Sum (meq/L)	3.00	1.70	1.74	3.17	
	Cation - Anion Balance (%)	-2.9	-5.4	-5.3	-3.0	
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	4.57 M	2.67 M	2.59 M	1.88 M	
	Total Organic Carbon (mg/L)	4.94 M	2.85 M	2.96 M	2.78 M	
Total Metals	Aluminum (Al)-Total (mg/L)	0.170	0.0875	0.115	0.668	
	Antimony (Sb)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Arsenic (As)-Total (mg/L)	<0.00050	<0.00050	<0.00050	0.00061	
	Barium (Ba)-Total (mg/L)	0.155	0.032	0.038	0.128	
	Beryllium (Be)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
	Bismuth (Bi)-Total (mg/L)	<0.20	<0.20	<0.20	<0.20	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2009107-1 Water 17-OCT-17 15:10 MOBERLY RIVER - DOWNSTREAM (MD)	L2009107-2 Water 17-OCT-17 13:20 LOWER SITE C RESERVOIR (PR3)	L2009107-3 Water 17-OCT-17 16:10 PEACE AT PINE (PD1)	L2009107-4 Water 17-OCT-17 17:00 PINE RIVER (PINE)	
WATER						
Total Metals	Boron (B)-Total (mg/L)	<0.10	<0.10	<0.10	<0.10	
	Cadmium (Cd)-Total (mg/L)	0.0000195	0.0000167	0.0000328	0.0000661	
	Calcium (Ca)-Total (mg/L)	39.3	24.4	25.7	44.6	
	Chromium (Cr)-Total (mg/L)	<0.0010	<0.0010	<0.0010	0.0011	
	Cobalt (Co)-Total (mg/L)	<0.00030	<0.00030	<0.00030	0.00062	
	Copper (Cu)-Total (mg/L)	0.0011	<0.0010	<0.0010	0.0016	
	Iron (Fe)-Total (mg/L)	0.369	0.104	0.220	1.34	
	Lead (Pb)-Total (mg/L)	<0.00050	<0.00050	<0.00050	0.00073	
	Lithium (Li)-Total (mg/L)	0.0041	0.0016	0.0014	0.0071	
	Magnesium (Mg)-Total (mg/L)	10.8	5.85	6.25	11.2	
	Manganese (Mn)-Total (mg/L)	0.0256	0.00276	0.00680	0.0313	
	Mercury (Hg)-Total (ug/L)	0.0147	0.00067	0.00099	0.0040	
	Molybdenum (Mo)-Total (mg/L)	<0.0010	<0.0010	<0.0010	0.0010	
	Nickel (Ni)-Total (mg/L)	0.0016	<0.0010	<0.0010	0.0022	
	Phosphorus (P)-Total (mg/L)	<0.30	<0.30	<0.30	<0.30	
	Potassium (K)-Total (mg/L)	<2.0	<2.0	<2.0	<2.0	
	Selenium (Se)-Total (mg/L)	0.000181	0.000250	0.000262	0.000531	
	Silicon (Si)-Total (mg/L)	1.89	2.13	2.21	2.02	
	Silver (Ag)-Total (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	
	Sodium (Na)-Total (mg/L)	4.0	<2.0	<2.0	3.0	
	Strontium (Sr)-Total (mg/L)	0.103	0.102	0.105	0.166	
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010	0.000023	
	Tin (Sn)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Titanium (Ti)-Total (mg/L)	<0.010	<0.010	<0.010	<0.010	
	Uranium (U)-Total (mg/L)	0.00042	0.00040	0.00048	0.00045	
	Vanadium (V)-Total (mg/L)	0.00076	0.00060	0.00082	0.00257	
	Zinc (Zn)-Total (mg/L)	<0.0050	<0.0050	<0.0050	0.0092	
Dissolved Metals	Dissolved MeHg Filtration Location	FIELD	FIELD	FIELD	FIELD	
	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	
	Aluminum (Al)-Dissolved (mg/L)	0.0340	0.0116	<0.0050	0.0058	
	Antimony (Sb)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Arsenic (As)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Barium (Ba)-Dissolved (mg/L)	0.135	0.032	0.032	0.104	
	Beryllium (Be)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
	Bismuth (Bi)-Dissolved (mg/L)	<0.20	<0.20	<0.20	<0.20	
	Boron (B)-Dissolved (mg/L)	<0.10	<0.10	<0.10	<0.10	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2009107-1	L2009107-2	L2009107-3	L2009107-4	
	Description	Water	Water	Water	Water	
	Sampled Date	17-OCT-17	17-OCT-17	17-OCT-17	17-OCT-17	
	Sampled Time	15:10	13:20	16:10	17:00	
	Client ID	MOBERLY RIVER - DOWNSTREAM (MD)	LOWER SITE C RESERVOIR (PR3)	PEACE AT PINE (PD1)	PINE RIVER (PINE)	
Grouping	**Analyte**					
WATER						
Dissolved Metals	Cadmium (Cd)-Dissolved (mg/L)	0.0000187	0.0000099	0.0000066	0.0000095	
	Calcium (Ca)-Dissolved (mg/L)	39.5	24.5	25.2	43.4	
	Chromium (Cr)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	
	Cobalt (Co)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	
	Copper (Cu)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	
	Iron (Fe)-Dissolved (mg/L)	0.070	<0.030	<0.030	<0.030	
	Lead (Pb)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Lithium (Li)-Dissolved (mg/L)	0.0042	0.0013	0.0014	0.0066	
	Magnesium (Mg)-Dissolved (mg/L)	10.4	5.79	5.89	10.6	
	Manganese (Mn)-Dissolved (mg/L)	0.0503 DTMF	0.00101	0.00070	0.00336	
	Mercury (Hg)-Dissolved (ug/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Molybdenum (Mo)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	
	Nickel (Ni)-Dissolved (mg/L)	0.0013	<0.0010	<0.0010	<0.0010	
	Phosphorus (P)-Dissolved (mg/L)	<0.30	<0.30	<0.30	<0.30	
	Potassium (K)-Dissolved (mg/L)	<2.0	<2.0	<2.0	<2.0	
	Selenium (Se)-Dissolved (mg/L)	0.000190	0.000231	0.000229	0.000467	
	Silicon (Si)-Dissolved (mg/L)	1.64	2.04	2.00	1.10	
	Silver (Ag)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	
	Sodium (Na)-Dissolved (mg/L)	3.8	<2.0	<2.0	2.8	
	Strontium (Sr)-Dissolved (mg/L)	0.0996	0.0955	0.102	0.160	
	Thallium (Tl)-Dissolved (mg/L)	<0.00020	<0.00020	<0.00020	<0.00020	
	Tin (Sn)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Titanium (Ti)-Dissolved (mg/L)	<0.010	<0.010	<0.010	<0.010	
	Uranium (U)-Dissolved (mg/L)	0.00041	0.00044	0.00044	0.00038	
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Zinc (Zn)-Dissolved (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	
Speciated Metals	Methylmercury (as MeHg)-Dissolved (ug/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Methylmercury (as MeHg)-Total (ug/L)	0.000256	<0.000050	<0.000050	<0.000050	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

Qualifiers for Individual Samples Listed:

Sample Number	Client Sample ID	Qualifier	Description
L2009107-2	LOWER SITE C RESERVOI	LPMB	Lab-Preserved for Total Metals. Sample received with pH > 2 and preserved at the lab. Total Metals results may be biased low.

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Method Blank	Aluminum (Al)-Total	MB-LOR	L2009107-1, -3, -4
Method Blank	Molybdenum (Mo)-Total	MB-LOR	L2009107-1, -3, -4
Method Blank	Zinc (Zn)-Total	MB-LOR	L2009107-1, -3, -4
Matrix Spike	Barium (Ba)-Total	MS-B	L2009107-1, -3, -4
Matrix Spike	Calcium (Ca)-Total	MS-B	L2009107-1, -3, -4
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2009107-1, -3, -4
Matrix Spike	Strontium (Sr)-Total	MS-B	L2009107-1, -3, -4
Matrix Spike	Phosphorus (P)-Total	MS-B	L2009107-1, -2, -3, -4
Matrix Spike	Orthophosphate-Dissolved (as P)	MS-B	L2009107-1, -2, -3, -4

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DTMF	Dissolved concentration exceeds total for field-filtered metals sample. Metallic contaminants were likely introduced to dissolved sample during field filtration.
M	A peak has been manually integrated.
MB-LOR	Method Blank exceeds ALS DQO. Limits of Reporting have been adjusted for samples with positive hits below 5x blank level.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
ANIONS-N+N-CALC-VA	Water	Nitrite & Nitrate in Water (Calculation)	EPA 300.0
Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).			
BR-L-IC-N-VA	Water	Bromide in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
CARBONS-DOC-VA	Water	Dissolved organic carbon by combustion	APHA 5310B TOTAL ORGANIC CARBON (TOC)
This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis.			
CARBONS-TOC-VA	Water	Total organic carbon by combustion	APHA 5310B TOTAL ORGANIC CARBON (TOC)
This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)".			
CL-IC-N-VA	Water	Chloride in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
COLOUR-TRUE-VA	Water	Colour (True) by Spectrometer	BCMOE Colour Single Wavelength
This analysis is carried out using procedures adapted from British Columbia Environmental Manual "Colour- Single Wavelength." Colour (True Colour) is determined by filtering a sample through a 0.45 micron membrane filter followed by analysis of the filtrate using the platinum-cobalt colourimetric method. Colour measurements can be highly pH dependent, and apply to the pH of the sample as received (at time of testing), without pH adjustment. Concurrent measurement of sample pH is recommended.			
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510
Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.			
F-IC-N-VA	Water	Fluoride in Water by IC	EPA 300.1 (mod)

Reference Information

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

HARDNESS-CALC-VA Water Hardness APHA 2340B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HG-D-U-CVAF-VA Water Diss. Mercury in Water by CVAFS (Ultra) APHA 3030 B / EPA 1631 REV. E

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from Method 1631 Rev. E. by the United States Environmental Protection Agency (EPA). The procedure may involve preliminary sample treatment by filtration (APHA 3030B) and involves a cold-oxidation of the acidified sample using bromine monochloride prior to a purge and trap concentration step and final reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry.

HG-T-U-CVAF-VA Water Total Mercury in Water by CVAFS (Ultra) EPA 1631 REV. E

This analysis is carried out using procedures adapted from Method 1631 Rev. E. by the United States Environmental Protection Agency (EPA). The procedure involves a cold-oxidation of the acidified sample using bromine monochloride prior to a purge and trap concentration step and final reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry.

IONBALANCE-VA Water Ion Balance Calculation APHA 1030E

Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:

Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum]

MEHG-D-GCAF-VA Water Diss. Methylmercury in Water by GCAFS EPA 1630

This method follows Method 1630 of the US EPA. Samples are distilled under an inert gas flow to isolate methylmercury and minimize matrix interferences. The distillate is analyzed by aqueous phase ethylation, purge and trap, desorption and GC separation. The separated species are then pyrolized to elemental Hg and quantified by cold vapour atomic flourescence spectroscopy. Results are reported "as MeHg".

MEHG-T-GCAF-VA Water Total Methylmercury in Water by GCAFS EPA 1630

This method follows Method 1630 of the US EPA. Samples are distilled under an inert gas flow to isolate methylmercury and minimize matrix interferences. The distillate is analyzed by aqueous phase ethylation, purge and trap, desorption and GC separation. THe separated species are then pyrolized to elemental Hg and quantified by cold vapour atomic flourescence spectroscopy. Results are reported "as MeHg".

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

N-T-COL-VA Water Total Nitrogen in water by Colour APHA4500-P(J)/NEMI9171/USGS03-4174

This analysis is carried out using procedures adapted from APHA Method 4500-P (J) "Persulphate Method for Simultaneous Determination of Total Nitrogen and Total Phosphorus" and National Environmental Methods Index - Nemi method 5735.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-VA Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-VA Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

P-T-PRES-COL-VA Water Total P in Water by Colour APHA 4500-P Phosphorus

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorus is determined colourimetrically after persulphate digestion of the sample.
Samples with very high dissolved solids (i.e. seawaters, brackish waters) may produce a negative bias by this method. Alternate methods are available for these types of samples.

Reference Information

Arsenic (5+), at elevated levels, is a positive interference on colourimetric phosphate analysis.

P-TD-COL-VA Water Total Dissolved P in Water by Colour APHA 4500-P Phosphorous

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Dissolved Phosphorus is determined colourimetrically after persulphate digestion of a sample that has been lab or field filtered through a 0.45 micron membrane filter.
Samples with very high dissolved solids (i.e. seawaters, brackish waters) may produce a negative bias by this method. Alternate methods are available for these types of samples.

Arsenic (5+), at elevated levels, is a positive interference on colourimetric phosphate analysis.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

PO4-DO-COL-VA Water Diss. Orthophosphate in Water by Colour APHA 4500-P Phosphorus

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Dissolved Orthophosphate is determined colourimetrically on a sample that has been lab or field filtered through a 0.45 micron membrane filter.
Samples with very high dissolved solids (i.e. seawaters, brackish waters) may produce a negative bias by this method. Alternate methods are available for these types of samples.

Arsenic (5+), at elevated levels, is a positive interference on colourimetric phosphate analysis.

SILICATE-COL-VA Water Silicate by Colourimetric analysis APHA 4500-SiO2 E.

This analysis is carried out using procedures adapted from APHA Method 4500-SiO2 E. "Silica". Silicate (molybdate-reactive silica) is determined by the molybdosilicate-heteropoly blue colourimetric method.

SO4-IC-N-VA Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA Water TDS (Calculated) APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".
The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TKN-F-VA Water TKN in Water by Fluorescence APHA 4500-NORG D.

This analysis is carried out using procedures adapted from APHA Method 4500-Norg D. "Block Digestion and Flow Injection Analysis". Total Kjeldahl Nitrogen is determined using block digestion followed by Flow-injection analysis with fluorescence detection.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.
Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

TURBIDITY-VA Water Turbidity by Meter APHA 2130 Turbidity

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

Reference Information

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Tetra Tech Canada Inc.
ATTN: Danielle MacDonald
14940 - 123 Avenue, NW
Edmonton AB T5V 1B4

Date Received: 18-OCT-17
Report Date: 06-NOV-17 17:39 (MT)
Version: FINAL

Client Phone: 780-886-3055

Certificate of Analysis

Lab Work Order #: L2009110

Project P.O. #: NOT SUBMITTED
Job Reference: VENW03060
C of C Numbers:
Legal Site Desc:

Brent Mack, B.Sc.
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2009110-1	L2009110-2	L2009110-3	L2009110-4	
Description	Soil	Soil	Soil	Soil	
Sampled Date	17-OCT-17	17-OCT-17	17-OCT-17	17-OCT-17	
Sampled Time	15:10	13:20	16:10	17:00	
Client ID	MOBERLY RIVER - DOWNSTREAM (MD)	LOWER SITE C RESERVOIR (PR3)	PEACE AT PINE (PD1)	PINE RIVER (PINE)	
Grouping / **Analyte**					
SOIL					
Physical Tests pH (1:2 soil:water) (pH)	7.99	7.98	8.09	8.24	
Particle Size % Gravel (>2mm) (%)	<1.0	<1.0	<1.0	<1.0	
% Sand (2.00mm - 1.00mm) (%)	<1.0	<1.0	<1.0	<1.0	
% Sand (1.00mm - 0.50mm) (%)	<1.0	<1.0	<1.0	<1.0	
% Sand (0.50mm - 0.25mm) (%)	3.5	<1.0	<1.0	<1.0	
% Sand (0.25mm - 0.125mm) (%)	20.9	1.9	3.5	22.3	
% Sand (0.125mm - 0.063mm) (%)	32.5	17.0	29.1	33.3	
% Silt (0.063mm - 0.0312mm) (%)	21.3	34.7	30.8	17.9	
% Silt (0.0312mm - 0.004mm) (%)	17.5	38.1	30.0	18.5	
% Clay (<4um) (%)	4.3	8.2	6.2	7.3	
Texture	Sandy loam	Silt loam	Silt loam	Sandy loam	
Leachable Anions & Nutrients Total Kjeldahl Nitrogen (%)	0.070	0.097	0.071	0.076	
Anions and Nutrients Total Nitrogen by LECO (%)	0.085	0.119	0.086	0.090	
Organic / Inorganic Carbon Total Organic Carbon (%)	1.25	1.74	1.25	1.23	
Plant Available Nutrients Available Ammonium-N (mg/kg)	2.3	9.0	4.4	2.6	
Nitrate+Nitrite-N (mg/kg)	<2.0	<2.0 DLM	<2.0 DLM	<2.0 DLM	
Nitrate-N (mg/kg)	<2.0	<2.0 DLM	<2.0 DLM	<2.0 DLM	
Nitrite-N (mg/kg)	0.45	<0.80 DLM	<0.80 DLM	<0.80 DLM	
Available Phosphate-P (mg/kg)	<2.0	<2.0	<2.0	<2.0	
Metals Aluminum (Al) (mg/kg)	5860	7280	5960	4700	
Antimony (Sb) (mg/kg)	0.70	0.82	0.70	0.63	
Arsenic (As) (mg/kg)	6.87	8.08	7.09	7.08	
Barium (Ba) (mg/kg)	400	524	449	284	
Beryllium (Be) (mg/kg)	0.41	0.50	0.40	0.39	
Bismuth (Bi) (mg/kg)	<0.20	<0.20	<0.20	<0.20	
Boron (B) (mg/kg)	6.6	7.9	6.3	<5.0	
Cadmium (Cd) (mg/kg)	0.664	0.871	0.674	0.429	
Calcium (Ca) (mg/kg)	23200	25000	24500	16400	
Chromium (Cr) (mg/kg)	13.1	16.2	13.9	9.19	
Cobalt (Co) (mg/kg)	6.50	7.71	6.65	6.06	
Copper (Cu) (mg/kg)	15.3	19.1	14.8	11.2	
Iron (Fe) (mg/kg)	15700	18500	16400	16400	
Lead (Pb) (mg/kg)	7.90	9.41	8.01	7.28	
Lithium (Li) (mg/kg)	8.5	10.5	9.1	8.1	
Magnesium (Mg) (mg/kg)	6860	7740	7660	4390	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2009110-1	L2009110-2	L2009110-3	L2009110-4	
	Description	Soil	Soil	Soil	Soil	
	Sampled Date	17-OCT-17	17-OCT-17	17-OCT-17	17-OCT-17	
	Sampled Time	15:10	13:20	16:10	17:00	
	Client ID	MOBERLY RIVER - DOWNSTREAM (MD)	LOWER SITE C RESERVOIR (PR3)	PEACE AT PINE (PD1)	PINE RIVER (PINE)	
Grouping	**Analyte**					
SOIL						
Metals	Manganese (Mn) (mg/kg)	217	230	208	219	
	Mercury (Hg) (mg/kg)	0.0516	0.0704	0.0517	0.0441	
	Molybdenum (Mo) (mg/kg)	1.36	1.77	1.47	1.13	
	Nickel (Ni) (mg/kg)	20.9	25.9	21.5	19.2	
	Phosphorus (P) (mg/kg)	883	987	909	764	
	Potassium (K) (mg/kg)	1210	1450	1140	910	
	Selenium (Se) (mg/kg)	0.64	0.91	0.64	0.55	
	Silver (Ag) (mg/kg)	0.19	0.25	0.18	0.13	
	Sodium (Na) (mg/kg)	85	105	84	60	
	Strontium (Sr) (mg/kg)	59.1	67.9	61.7	41.5	
	Sulfur (S) (mg/kg)	<1000	1600	1000	<1000	
	Thallium (Tl) (mg/kg)	0.152	0.207	0.160	0.115	
	Tin (Sn) (mg/kg)	<2.0	<2.0	<2.0	<2.0	
	Titanium (Ti) (mg/kg)	46.1	43.5	40.6	15.4	
	Tungsten (W) (mg/kg)	<0.50	<0.50	<0.50	<0.50	
	Uranium (U) (mg/kg)	0.890	1.10	0.969	0.718	
	Vanadium (V) (mg/kg)	30.1	36.1	30.1	21.0	
	Zinc (Zn) (mg/kg)	69.6	90.5	75.0	65.4	
	Zirconium (Zr) (mg/kg)	1.9	2.0	2.0	1.8	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
C-TIC-PCT-SK	Soil	Total Inorganic Carbon in Soil	CSSS (2008) P216-217

A known quantity of acetic acid is consumed by reaction with carbonates in the soil. The pH of the resulting solution is measured and compared against a standard curve relating pH to weight of carbonate.

C-TOC-CALC-SK	Soil	Total Organic Carbon Calculation	CSSS (2008) 21.2

Total Organic Carbon (TOC) is calculated by the difference between total carbon (TC) and total inorganic carbon. (TIC)

C-TOT-LECO-SK	Soil	Total Carbon by combustion method	CSSS (2008) 21.2

The sample is ignited in a combustion analyzer where carbon in the reduced CO2 gas is determined using a thermal conductivity detector.

HG-200.2-CVAF-VA	Soil	Mercury in Soil by CVAFS	EPA 200.2/1631E (mod)

Soil samples are digested with nitric and hydrochloric acids, followed by analysis by CVAFS.

IC-CACO3-CALC-SK	Soil	Inorganic Carbon as CaCO3 Equivalent	Calculation
MET-200.2-CCMS-VA	Soil	Metals in Soil by CRC ICPMS	EPA 200.2/6020A (mod)

This method uses a heated strong acid digestion with HNO3 and HCl and is intended to liberate metals that may be environmentally available. Silicate minerals are not solubilized. Dependent on sample matrix, some metals may be only partially recovered, including Al, Ba, Be, Cr, Sr, Ti, Tl, V, W, and Zr. Volatile forms of sulfur (including sulfide) may not be captured, as they may be lost during sampling, storage, or digestion. Analysis is by Collision/Reaction Cell ICPMS.

N-TOT-LECO-SK	Soil	Total Nitrogen by combustion method	CSSS (2008) 22.4

The sample is ignited in a combustion analyzer where nitrogen in the reduced nitrous oxide gas is determined using a thermal conductivity detector.

N-TOTKJ-COL-SK	Soil	Total Kjeldahl Nitrogen	CSSS (2008) 22.2.3

The soil is digested with sulfuric acid in the presence of CuSO4 and K2SO4 catalysts. Ammonia in the soil extract is determined colrimetrically at 660 nm.

N2/N3-AVAIL-SK	Soil	Nitrate, Nitrite and Nitrate+Nitrite-N	APHA 4500 NO3F

Available Nitrate and Nitrite are extracted from the soil using a dilute calcium chloride solution. Nitrate plus Nitrite is quantitatively reduced to nitrite by passage of the sample through a copperized cadmium column. The nitrite (reduced nitrate plus original nitrite) is then determined by diazotizing with sulfanilamide followed by coupling with N-(1-naphthyl) ethylenediamine dihydrochloride. The resulting water soluble dye has a magenta color which is measured at colorimetrically at 520nm. Nitrite is determined on the same extract by following the same instrumental procedure without a cadmium column.
Reference: Recommended Methods of Soil Analysis for Canadian Prairie Agricultural Soils. Alberta Agriculture (1988) p. 19 and 28

NH4-AVAIL-SK	Soil	Available Ammonium-N	Comm Soil Sci 19(6)

Ammonium (NH4-N) is extracted from the soil using 2 N KCl. Ammonium in the extract is mixed with hypochlorite and salicylate to form indophenol blue, which is determined colorimetrically by auto analysis at 660 nm.

PH-1:2-VA	Soil	pH in Soil (1:2 Soil:Water Extraction)	BC WLAP METHOD: PH, ELECTROMETRIC, SOIL

This analysis is carried out in accordance with procedures described in the pH, Electrometric in Soil and Sediment method - Section B Physical/Inorganic and Misc. Constituents, BC Environmental Laboratory Manual 2007. The procedure involves mixing the dried (at <60°C) and sieved (No. 10 / 2mm) sample with deionized/distilled water at a 1:2 ratio of sediment to water. The pH of the solution is then measured using a standard pH probe.

PO4-AVAIL-SK	Soil	Available Phosphate-P	Comm. Soil Sci. Plant Anal. 25 (5&6)

Plant available phosphorus is extracted from the soil using Modified Kelowna solution. Phosphorous in the soil extract is determined colorimetrically at 880 nm.

PSA-PIPET-DETAIL-SK	Soil	Particle size - Sieve and Pipette	SSIR-51 METHOD 3.2.1

Particle size distribution is determined by a combination of techniques. Dry sieving is performed for coarse particles, wet sieving for sand particles and the pipette sedimentation method for clay particles.

Reference:

Reference Information

Burt, R. (2009). Soil Survey Field and Laboratory Methods Manual. Soil Survey Investigations Report No. 5. Method 3.2.1.2.2. United States Department of Agriculture Natural Resources Conservation Service.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
SK	ALS ENVIRONMENTAL - SASKATOON, SASKATCHEWAN, CANADA
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Tetra Tech Canada Inc.
ATTN: Danielle MacDonald
14940 - 123 Avenue, NW
Edmonton AB T5V 1B4

Date Received: 19-OCT-17
Report Date: 06-NOV-17 10:55 (MT)
Version: FINAL

Client Phone: 780-886-3055

Certificate of Analysis

Lab Work Order #: L2009935

Project P.O. #: NOT SUBMITTED
Job Reference: VENW03060
C of C Numbers: 14-
Legal Site Desc:

Brent Mack, B.Sc.
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2009935-1 Water 18-OCT-17 19:00 HALFWAY RIVER - DOWNSTREAM (HD)	L2009935-2 Water 18-OCT-17 16:40 MIDDLE SITE C RESERVOIR (PR2)	L2009935-3 Water 18-OCT-17 11:50 PEACE CANYON (PC1)	L2009935-4 Water 18-OCT-17 13:40 UPPER SITE C RESEVOIR (PR1)	
WATER						
Physical Tests	Colour, True (CU)	<5.0	8.9	7.6	7.9	
	Conductivity (uS/cm)	452	172	166	165	
	Hardness (as CaCO3) (mg/L)	255	86.5	87.5	86.9	
	pH (pH)	8.34	8.04	8.05	8.06	
	Total Suspended Solids (mg/L)	6.3	5.5	3.8	5.3	
	TDS (Calculated) (mg/L)	276	92.4	93.7	93.0	
	Turbidity (NTU)	3.24	1.35	1.50	1.48	
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	190	76.7	77.9	76.8	
	Alkalinity, Carbonate (as CaCO3) (mg/L)	5.4	<1.0	<1.0	<1.0	
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	
	Alkalinity, Total (as CaCO3) (mg/L)	195	76.7	77.9	76.8	
	Ammonia, Total (as N) (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	
	Bromide (Br) (mg/L)	<0.050	<0.050	<0.050	<0.050	
	Chloride (Cl) (mg/L)	0.61	<0.50	<0.50	<0.50	
	Fluoride (F) (mg/L)	0.103	0.035	0.036	0.036	
	Nitrate and Nitrite (as N) (mg/L)	<0.0051	0.0465	0.0490	0.0482	
	Nitrate (as N) (mg/L)	<0.0050	0.0465	0.0490	0.0482	
	Nitrite (as N) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	
	Total Kjeldahl Nitrogen (mg/L)	0.086	0.100	0.118	0.088	
	Total Nitrogen (mg/L)	0.066	0.129	0.138	0.132	
	Orthophosphate-Dissolved (as P) (mg/L)	0.0010	<0.0010	<0.0010	<0.0010	
	Phosphorus (P)-Total Dissolved (mg/L)	<0.0020	<0.0020	<0.0020	<0.0020	
	Phosphorus (P)-Total (mg/L)	0.0070	0.0043	0.0225	0.0049	
	Silicate (as SiO2) (mg/L)	3.57	4.20	4.48	4.40	
	Sulfate (SO4) (mg/L)	63.3	12.6	12.6	12.5	
	Anion Sum (meq/L)	5.23	1.80	1.82	1.80	
	Cation Sum (meq/L)	5.26	1.73	1.75	1.74	
	Cation - Anion Balance (%)	0.2	-2.0	-2.1	-1.7	
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	1.36	2.66	2.49	2.88	
	Total Organic Carbon (mg/L)	1.57	2.73	2.81	3.04	
Total Metals	Aluminum (Al)-Total (mg/L)	0.0767	0.0377	0.0456	0.0409	
	Antimony (Sb)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Arsenic (As)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Barium (Ba)-Total (mg/L)	0.101	0.031	0.029	0.030	
	Beryllium (Be)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
	Bismuth (Bi)-Total (mg/L)	<0.20	<0.20	<0.20	<0.20	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2009935-1 Water 18-OCT-17 19:00 HALFWAY RIVER - DOWNSTREAM (HD)	L2009935-2 Water 18-OCT-17 16:40 MIDDLE SITE C RESERVOIR (PR2)	L2009935-3 Water 18-OCT-17 11:50 PEACE CANYON (PC1)	L2009935-4 Water 18-OCT-17 13:40 UPPER SITE C RESEVOIR (PR1)	
WATER						
Total Metals	Boron (B)-Total (mg/L)	<0.10	<0.10	<0.10	<0.10	
	Cadmium (Cd)-Total (mg/L)	0.0000178	0.0000131	0.0000223	0.0000138	
	Calcium (Ca)-Total (mg/L)	68.8	26.1	26.2	25.9	
	Chromium (Cr)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	
	Cobalt (Co)-Total (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	
	Copper (Cu)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	
	Iron (Fe)-Total (mg/L)	0.126	0.049	0.065	0.053	
	Lead (Pb)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Lithium (Li)-Total (mg/L)	0.0085	<0.0010	<0.0010	<0.0010	
	Magnesium (Mg)-Total (mg/L)	19.7	5.96	5.95	5.82	
	Manganese (Mn)-Total (mg/L)	0.00900	0.00220	0.00278	0.00226	
	Mercury (Hg)-Total (ug/L)	0.00057	0.00067	<0.00050	0.00051	
	Molybdenum (Mo)-Total (mg/L)	0.0037	<0.0010	<0.0010	<0.0010	
	Nickel (Ni)-Total (mg/L)	0.0013	<0.0010	<0.0010	<0.0010	
	Phosphorus (P)-Total (mg/L)	<0.30	<0.30	<0.30	<0.30	
	Potassium (K)-Total (mg/L)	<2.0	<2.0	<2.0	<2.0	
	Selenium (Se)-Total (mg/L)	0.00146	0.000206	0.000239	0.000241	
	Silicon (Si)-Total (mg/L)	1.88	2.20	2.21	2.23	
	Silver (Ag)-Total (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	
	Sodium (Na)-Total (mg/L)	3.4	<2.0	<2.0	<2.0	
	Strontium (Sr)-Total (mg/L)	0.346	0.0950	0.0930	0.0968	
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	
	Tin (Sn)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Titanium (Ti)-Total (mg/L)	<0.010	<0.010	<0.010	<0.010	
	Uranium (U)-Total (mg/L)	0.00091	0.00041	0.00041	0.00042	
	Vanadium (V)-Total (mg/L)	0.00072	0.00058	0.00056	0.00054	
	Zinc (Zn)-Total (mg/L)	<0.0050	<0.0050	0.0054	<0.0050	
Dissolved Metals	Dissolved MeHg Filtration Location	FIELD	FIELD	FIELD	FIELD	
	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	
	Aluminum (Al)-Dissolved (mg/L)	0.142	<0.0050	<0.0050	0.0184	
	Antimony (Sb)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Arsenic (As)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Barium (Ba)-Dissolved (mg/L)	0.097	0.029	0.028	0.030	
	Beryllium (Be)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
	Bismuth (Bi)-Dissolved (mg/L)	<0.20	<0.20	<0.20	<0.20	
	Boron (B)-Dissolved (mg/L)	<0.10	<0.10	<0.10	<0.10	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2009935-1 Water 18-OCT-17 19:00 HALFWAY RIVER - DOWNSTREAM (HD)	L2009935-2 Water 18-OCT-17 16:40 MIDDLE SITE C RESERVOIR (PR2)	L2009935-3 Water 18-OCT-17 11:50 PEACE CANYON (PC1)	L2009935-4 Water 18-OCT-17 13:40 UPPER SITE C RESEVOIR (PR1)	
WATER						
Dissolved Metals	Cadmium (Cd)-Dissolved (mg/L)	0.0000126	0.0000077	0.0000076	0.0000122	
	Calcium (Ca)-Dissolved (mg/L)	70.5	25.1	25.6	25.3	
	Chromium (Cr)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	
	Cobalt (Co)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	
	Copper (Cu)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	
	Iron (Fe)-Dissolved (mg/L)	<0.030	<0.030	<0.030	<0.030	
	Lead (Pb)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Lithium (Li)-Dissolved (mg/L)	0.0088	<0.0010	<0.0010	<0.0010	
	Magnesium (Mg)-Dissolved (mg/L)	19.2	5.79	5.73	5.76	
	Manganese (Mn)-Dissolved (mg/L)	0.00584	0.00039	0.00035	0.00148	
	Mercury (Hg)-Dissolved (ug/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Molybdenum (Mo)-Dissolved (mg/L)	0.0036	<0.0010	<0.0010	<0.0010	
	Nickel (Ni)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	
	Phosphorus (P)-Dissolved (mg/L)	<0.30	<0.30	<0.30	<0.30	
	Potassium (K)-Dissolved (mg/L)	<2.0	<2.0	<2.0	<2.0	
	Selenium (Se)-Dissolved (mg/L)	0.00121	0.000225	0.000200	0.000202	
	Silicon (Si)-Dissolved (mg/L)	1.68	2.10	2.06	2.14	
	Silver (Ag)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	
	Sodium (Na)-Dissolved (mg/L)	3.3	<2.0	<2.0	<2.0	
	Strontium (Sr)-Dissolved (mg/L)	0.346	0.0922	0.0926	0.0903	
	Thallium (Tl)-Dissolved (mg/L)	<0.00020	<0.00020	<0.00020	<0.00020	
	Tin (Sn)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Titanium (Ti)-Dissolved (mg/L)	<0.010	<0.010	<0.010	<0.010	
	Uranium (U)-Dissolved (mg/L)	0.00084	0.00036	0.00037	0.00035	
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Zinc (Zn)-Dissolved (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	
Speciated Metals	Methylmercury (as MeHg)-Dissolved (ug/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Methylmercury (as MeHg)-Total (ug/L)	<0.000050	<0.000050	<0.000050	<0.000050	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Dissolved Organic Carbon	MS-B	L2009935-2, -3, -4
Matrix Spike	Dissolved Organic Carbon	MS-B	L2009935-2, -3, -4
Matrix Spike	Dissolved Organic Carbon	MS-B	L2009935-1
Matrix Spike	Dissolved Organic Carbon	MS-B	L2009935-1
Matrix Spike	Total Organic Carbon	MS-B	L2009935-2, -3, -4
Matrix Spike	Total Organic Carbon	MS-B	L2009935-2, -3, -4
Matrix Spike	Total Organic Carbon	MS-B	L2009935-1
Matrix Spike	Total Organic Carbon	MS-B	L2009935-1
Matrix Spike	Total Organic Carbon	MS-B	L2009935-1
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2009935-1, -2, -3, -4
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2009935-1, -2, -3, -4
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2009935-1, -2, -3, -4
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2009935-1, -2, -3, -4
Matrix Spike	Barium (Ba)-Total	MS-B	L2009935-1, -2, -3, -4
Matrix Spike	Calcium (Ca)-Total	MS-B	L2009935-1, -2, -3, -4
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2009935-1, -2, -3, -4
Matrix Spike	Strontium (Sr)-Total	MS-B	L2009935-1, -2, -3, -4

Qualifiers for Individual Parameters Listed:

Qualifier	Description
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

ANIONS-N+N-CALC-VA	Water	Nitrite & Nitrate in Water (Calculation)	EPA 300.0

Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).

BR-L-IC-N-VA	Water	Bromide in Water by IC (Low Level)	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

CARBONS-DOC-VA	Water	Dissolved organic carbon by combustion	APHA 5310B TOTAL ORGANIC CARBON (TOC)

This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis.

CARBONS-TOC-VA	Water	Total organic carbon by combustion	APHA 5310B TOTAL ORGANIC CARBON (TOC)

This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)".

CL-IC-N-VA	Water	Chloride in Water by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

COLOUR-TRUE-VA	Water	Colour (True) by Spectrometer	BCMOE Colour Single Wavelength

This analysis is carried out using procedures adapted from British Columbia Environmental Manual "Colour- Single Wavelength." Colour (True Colour) is determined by filtering a sample through a 0.45 micron membrane filter followed by analysis of the filtrate using the platinum-cobalt colourimetric method.
Colour measurements can be highly pH dependent, and apply to the pH of the sample as received (at time of testing), without pH adjustment. Concurrent measurement of sample pH is recommended.

EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510

Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.

F-IC-N-VA	Water	Fluoride in Water by IC	EPA 300.1 (mod)

Reference Information

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

HARDNESS-CALC-VA Water Hardness APHA 2340B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HG-D-U-CVAF-VA Water Diss. Mercury in Water by CVAFS (Ultra) APHA 3030 B / EPA 1631 REV. E

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from Method 1631 Rev. E. by the United States Environmental Protection Agency (EPA). The procedure may involve preliminary sample treatment by filtration (APHA 3030B) and involves a cold-oxidation of the acidified sample using bromine monochloride prior to a purge and trap concentration step and final reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry.

HG-T-U-CVAF-VA Water Total Mercury in Water by CVAFS (Ultra) EPA 1631 REV. E

This analysis is carried out using procedures adapted from Method 1631 Rev. E. by the United States Environmental Protection Agency (EPA). The procedure involves a cold-oxidation of the acidified sample using bromine monochloride prior to a purge and trap concentration step and final reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry.

IONBALANCE-VA Water Ion Balance Calculation APHA 1030E

Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:

Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum]

MEHG-D-GCAF-VA Water Diss. Methylmercury in Water by GCAFS EPA 1630

This method follows Method 1630 of the US EPA. Samples are distilled under an inert gas flow to isolate methylmercury and minimize matrix interferences. The distillate is analyzed by aqueous phase ethylation, purge and trap, desorption and GC separation. The separated species are then pyrolized to elemental Hg and quantified by cold vapour atomic flourescence spectroscopy. Results are reported "as MeHg".

MEHG-T-GCAF-VA Water Total Methylmercury in Water by GCAFS EPA 1630

This method follows Method 1630 of the US EPA. Samples are distilled under an inert gas flow to isolate methylmercury and minimize matrix interferences. The distillate is analyzed by aqueous phase ethylation, purge and trap, desorption and GC separation. THe separated species are then pyrolized to elemental Hg and quantified by cold vapour atomic flourescence spectroscopy. Results are reported "as MeHg".

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

N-T-COL-VA Water Total Nitrogen in water by Colour APHA4500-P(J)/NEMI9171/USGS03-4174

This analysis is carried out using procedures adapted from APHA Method 4500-P (J) "Persulphate Method for Simultaneous Determination of Total Nitrogen and Total Phosphorus" and National Environmental Methods Index - Nemi method 5735.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-VA Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-VA Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

P-T-PRES-COL-VA Water Total P in Water by Colour APHA 4500-P Phosphorus

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorus is determined colourimetrically after persulphate digestion of the sample.
Samples with very high dissolved solids (i.e. seawaters, brackish waters) may produce a negative bias by this method. Alternate methods are available for these types of samples.

Reference Information

Arsenic (5+), at elevated levels, is a positive interference on colourimetric phosphate analysis.

P-TD-COL-VA Water Total Dissolved P in Water by Colour APHA 4500-P Phosphorous

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Dissolved Phosphorus is determined colourimetrically after persulphate digestion of a sample that has been lab or field filtered through a 0.45 micron membrane filter.
Samples with very high dissolved solids (i.e. seawaters, brackish waters) may produce a negative bias by this method. Alternate methods are available for these types of samples.

Arsenic (5+), at elevated levels, is a positive interference on colourimetric phosphate analysis.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

PO4-DO-COL-VA Water Diss. Orthophosphate in Water by Colour APHA 4500-P Phosphorus

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Dissolved Orthophosphate is determined colourimetrically on a sample that has been lab or field filtered through a 0.45 micron membrane filter.
Samples with very high dissolved solids (i.e. seawaters, brackish waters) may produce a negative bias by this method. Alternate methods are available for these types of samples.

Arsenic (5+), at elevated levels, is a positive interference on colourimetric phosphate analysis.

SILICATE-COL-VA Water Silicate by Colourimetric analysis APHA 4500-SiO2 E.

This analysis is carried out using procedures adapted from APHA Method 4500-SiO2 E. "Silica". Silicate (molybdate-reactive silica) is determined by the molybdosilicate-heteropoly blue colourimetric method.

SO4-IC-N-VA Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA Water TDS (Calculated) APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".
The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TKN-F-VA Water TKN in Water by Fluorescence APHA 4500-NORG D.

This analysis is carried out using procedures adapted from APHA Method 4500-Norg D. "Block Digestion and Flow Injection Analysis". Total Kjeldahl Nitrogen is determined using block digestion followed by Flow-injection analysis with fluorescence detection.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.
Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

TURBIDITY-VA Water Turbidity by Meter APHA 2130 Turbidity

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

Reference Information

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Tetra Tech Canada Inc.
ATTN: Danielle MacDonald
14940 - 123 Avenue, NW
Edmonton AB T5V 1B4

Date Received: 19-OCT-17
Report Date: 06-NOV-17 17:40 (MT)
Version: FINAL

Client Phone: 780-886-3055

Certificate of Analysis

Lab Work Order #: L2009937

Project P.O. #: NOT SUBMITTED
Job Reference: VENW03060
C of C Numbers: 14-
Legal Site Desc:

Brent Mack, B.Sc.
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2009937-1	L2009937-2	L2009937-3	L2009937-4	
	Description	Soil	Soil	Soil	Soil	
	Sampled Date	18-OCT-17	18-OCT-17	18-OCT-17	18-OCT-17	
	Sampled Time	17:30	16:00	11:00	13:00	
	Client ID	HALFWAY RIVER - DOWNSTREAM (HD)	MIDDLE SITE C RESERVOIR (PR2)	PEACE CANYON (PC1)	UPPER SITE C RESERVOIR (PR1)	
Grouping	**Analyte**					
SOIL						
Physical Tests	pH (1:2 soil:water) (pH)	8.32	8.42	8.06	8.02	
Particle Size	% Gravel (>2mm) (%)	1.3	<1.0	<1.0	15.4	
	% Sand (2.00mm - 1.00mm) (%)	1.6	<1.0	<1.0	15.7	
	% Sand (1.00mm - 0.50mm) (%)	2.2	<1.0	<1.0	18.3	
	% Sand (0.50mm - 0.25mm) (%)	10.0	<1.0	2.1	19.2	
	% Sand (0.25mm - 0.125mm) (%)	27.3	30.5	13.5	9.0	
	% Sand (0.125mm - 0.063mm) (%)	27.9	34.8	13.6	7.9	
	% Silt (0.063mm - 0.0312mm) (%)	14.2	18.8	26.2	5.7	
	% Silt (0.0312mm - 0.004mm) (%)	11.4	13.0	36.7	6.5	
	% Clay (<4um) (%)	4.1	2.6	7.5	2.3	
	Texture	Loamy sand	Sandy loam / Loamy sand	Silt loam	Loamy sand	
Leachable Anions & Nutrients	Total Kjeldahl Nitrogen (%)	0.051	0.035	0.160	0.060	
Anions and Nutrients	Total Nitrogen by LECO (%)	0.069	0.055	0.188	0.079	
Organic / Inorganic Carbon	Total Organic Carbon (%)	0.88	1.11	2.68	1.13	
Plant Available Nutrients	Available Ammonium-N (mg/kg)	1.6	2.5	6.3	2.6	
	Nitrate+Nitrite-N (mg/kg)	<2.0	<2.0	<2.0	<2.0	
	Nitrate-N (mg/kg)	<2.0	<2.0	<2.0	<2.0	
	Nitrite-N (mg/kg)	<0.40	<0.40	<0.40	<0.40	
	Available Phosphate-P (mg/kg)	<2.0	<2.0	<2.0	<2.0	
Metals	Aluminum (Al) (mg/kg)	4980	4220	5360	5890	
	Antimony (Sb) (mg/kg)	0.60	0.55	0.56	0.48	
	Arsenic (As) (mg/kg)	7.37	5.03	5.67	5.57	
	Barium (Ba) (mg/kg)	388	250	204	129	
	Beryllium (Be) (mg/kg)	0.38	0.23	0.29	0.30	
	Bismuth (Bi) (mg/kg)	<0.20	<0.20	<0.20	<0.20	
	Boron (B) (mg/kg)	6.5	<5.0	<5.0	<5.0	
	Cadmium (Cd) (mg/kg)	0.570	0.629	0.629	0.582	
	Calcium (Ca) (mg/kg)	24400	39500	17300	23700	
	Chromium (Cr) (mg/kg)	11.2	12.5	14.5	15.7	
	Cobalt (Co) (mg/kg)	5.59	4.57	5.89	5.72	
	Copper (Cu) (mg/kg)	16.8	11.4	14.7	14.8	
	Iron (Fe) (mg/kg)	16300	12300	15600	16300	
	Lead (Pb) (mg/kg)	7.11	4.99	6.91	7.37	
	Lithium (Li) (mg/kg)	6.7	5.8	8.3	9.4	
	Magnesium (Mg) (mg/kg)	5660	11600	8250	9900	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2009937-1	L2009937-2	L2009937-3	L2009937-4	
	Description	Soil	Soil	Soil	Soil	
	Sampled Date	18-OCT-17	18-OCT-17	18-OCT-17	18-OCT-17	
	Sampled Time	17:30	16:00	11:00	13:00	
	Client ID	HALFWAY RIVER - DOWNSTREAM (HD)	MIDDLE SITE C RESERVOIR (PR2)	PEACE CANYON (PC1)	UPPER SITE C RESERVOIR (PR1)	
Grouping	**Analyte**					
SOIL						
Metals	Manganese (Mn) (mg/kg)	172	181	172	232	
	Mercury (Hg) (mg/kg)	0.0322	0.0284	0.0470	0.0433	
	Molybdenum (Mo) (mg/kg)	1.48	0.97	0.74	0.66	
	Nickel (Ni) (mg/kg)	18.7	15.4	20.3	20.7	
	Phosphorus (P) (mg/kg)	1150	849	828	750	
	Potassium (K) (mg/kg)	1140	720	870	780	
	Selenium (Se) (mg/kg)	0.60	0.35	0.50	0.44	
	Silver (Ag) (mg/kg)	0.13	0.11	0.14	0.13	
	Sodium (Na) (mg/kg)	85	77	86	83	
	Strontium (Sr) (mg/kg)	62.6	75.0	42.6	50.6	
	Sulfur (S) (mg/kg)	1500	<1000	<1000	1100	
	Thallium (Tl) (mg/kg)	0.120	0.090	0.114	0.104	
	Tin (Sn) (mg/kg)	<2.0	<2.0	<2.0	<2.0	
	Titanium (Ti) (mg/kg)	<35 DLM	134	104	157	
	Tungsten (W) (mg/kg)	<0.50	<0.50	<0.50	<0.50	
	Uranium (U) (mg/kg)	0.897	0.719	0.671	0.642	
	Vanadium (V) (mg/kg)	27.5	29.2	28.5	32.4	
	Zinc (Zn) (mg/kg)	76.0	49.7	66.8	62.2	
	Zirconium (Zr) (mg/kg)	1.8	2.2	1.3	1.7	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
C-TIC-PCT-SK	Soil	Total Inorganic Carbon in Soil	CSSS (2008) P216-217

A known quantity of acetic acid is consumed by reaction with carbonates in the soil. The pH of the resulting solution is measured and compared against a standard curve relating pH to weight of carbonate.

C-TOC-CALC-SK	Soil	Total Organic Carbon Calculation	CSSS (2008) 21.2

Total Organic Carbon (TOC) is calculated by the difference between total carbon (TC) and total inorganic carbon. (TIC)

C-TOT-LECO-SK	Soil	Total Carbon by combustion method	CSSS (2008) 21.2

The sample is ignited in a combustion analyzer where carbon in the reduced CO2 gas is determined using a thermal conductivity detector.

HG-200.2-CVAF-VA	Soil	Mercury in Soil by CVAFS	EPA 200.2/1631E (mod)

Soil samples are digested with nitric and hydrochloric acids, followed by analysis by CVAFS.

IC-CACO3-CALC-SK	Soil	Inorganic Carbon as CaCO3 Equivalent	Calculation
MET-200.2-CCMS-VA	Soil	Metals in Soil by CRC ICPMS	EPA 200.2/6020A (mod)

This method uses a heated strong acid digestion with HNO3 and HCl and is intended to liberate metals that may be environmentally available. Silicate minerals are not solubilized. Dependent on sample matrix, some metals may be only partially recovered, including Al, Ba, Be, Cr, Sr, Ti, Tl, V, W, and Zr. Volatile forms of sulfur (including sulfide) may not be captured, as they may be lost during sampling, storage, or digestion. Analysis is by Collision/Reaction Cell ICPMS.

N-TOT-LECO-SK	Soil	Total Nitrogen by combustion method	CSSS (2008) 22.4

The sample is ignited in a combustion analyzer where nitrogen in the reduced nitrous oxide gas is determined using a thermal conductivity detector.

N-TOTKJ-COL-SK	Soil	Total Kjeldahl Nitrogen	CSSS (2008) 22.2.3

The soil is digested with sulfuric acid in the presence of CuSO4 and K2SO4 catalysts. Ammonia in the soil extract is determined colrimetrically at 660 nm.

N2/N3-AVAIL-SK	Soil	Nitrate, Nitrite and Nitrate+Nitrite-N	APHA 4500 NO3F

Available Nitrate and Nitrite are extracted from the soil using a dilute calcium chloride solution. Nitrate plus Nitrite is quantitatively reduced to nitrite by passage of the sample through a copperized cadmium column. The nitrite (reduced nitrate plus original nitrite) is then determined by diazotizing with sulfanilamide followed by coupling with N-(1-naphthyl) ethylenediamine dihydrochloride. The resulting water soluble dye has a magenta color which is measured at colorimetrically at 520nm. Nitrite is determined on the same extract by following the same instrumental procedure without a cadmium column.
Reference: Recommended Methods of Soil Analysis for Canadian Prairie Agricultural Soils. Alberta Agriculture (1988) p. 19 and 28

NH4-AVAIL-SK	Soil	Available Ammonium-N	Comm Soil Sci 19(6)

Ammonium (NH4-N) is extracted from the soil using 2 N KCl. Ammonium in the extract is mixed with hypochlorite and salicylate to form indophenol blue, which is determined colorimetrically by auto analysis at 660 nm.

PH-1:2-VA	Soil	pH in Soil (1:2 Soil:Water Extraction)	BC WLAP METHOD: PH, ELECTROMETRIC, SOIL

This analysis is carried out in accordance with procedures described in the pH, Electrometric in Soil and Sediment method - Section B Physical/Inorganic and Misc. Constituents, BC Environmental Laboratory Manual 2007. The procedure involves mixing the dried (at <60°C) and sieved (No. 10 / 2mm) sample with deionized/distilled water at a 1:2 ratio of sediment to water. The pH of the solution is then measured using a standard pH probe.

PO4-AVAIL-SK	Soil	Available Phosphate-P	Comm. Soil Sci. Plant Anal. 25 (5&6)

Plant available phosphorus is extracted from the soil using Modified Kelowna solution. Phosphorous in the soil extract is determined colorimetrically at 880 nm.

PSA-PIPET-DETAIL-SK	Soil	Particle size - Sieve and Pipette	SSIR-51 METHOD 3.2.1

Particle size distribution is determined by a combination of techniques. Dry sieving is performed for coarse particles, wet sieving for sand particles and the pipette sedimentation method for clay particles.

Reference:

Reference Information

Burt, R. (2009). Soil Survey Field and Laboratory Methods Manual. Soil Survey Investigations Report No. 5. Method 3.2.1.2.2. United States Department of Agriculture Natural Resources Conservation Service.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
SK	ALS ENVIRONMENTAL - SASKATOON, SASKATCHEWAN, CANADA
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

14-

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Tetra Tech Canada Inc.
ATTN: Danielle MacDonald
14940 - 123 Avenue, NW
Edmonton AB T5V 1B4

Date Received: 19-OCT-17
Report Date: 09-NOV-17 11:38 (MT)
Version: FINAL

Client Phone: 780-886-3055

Certificate of Analysis

Lab Work Order #: L2010676

Project P.O. #: NOT SUBMITTED
Job Reference: VENW003060
C of C Numbers: 14-
Legal Site Desc:

Brent Mack, B.Sc.
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2010676-1 Water 19-OCT-17 16:50 PEACE AT BEATTON (PD2)	L2010676-2 Water 19-OCT-17 16:30 BEATTON RIVER (BEATTON)	L2010676-3 Water DUPLICATE 2 (DUP 2)	L2010676-4 Water 19-OCT-17 15:40 PEACE AT KISKATINAW (PD3)	L2010676-5 Water 19-OCT-17 14:45 KISKATINAW RIVER (KR)
WATER						
Physical Tests	Colour, True (CU)	13.4	145	9.7	12.9	16.8
	Conductivity (uS/cm)	182	516	319	180	346
	Hardness (as CaCO3) (mg/L)	94.6	197	149	87.3	164
	pH (pH)	8.03	8.27	8.16	7.95	8.36
	Total Suspended Solids (mg/L)	106	3.5	21.1	123	148
	TDS (Calculated) (mg/L)	104	360	214	100	210
	Turbidity (NTU)	65.2	9.28	23.9	77.2	48.1
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	86.5	186	110	85.0	179
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	9.2
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	86.5	186	110	85.0	188
	Ammonia, Total (as N) (mg/L)	<0.0050	0.0088	<0.0050	<0.0050	<0.0050
	Bromide (Br) (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Chloride (Cl) (mg/L)	<0.50	4.51	4.23	<0.50	0.75
	Fluoride (F) (mg/L)	0.039	0.148	0.069	0.034	0.072
	Nitrate and Nitrite (as N) (mg/L)	0.0595	0.0509	0.0733	0.0602	0.0260
	Nitrate (as N) (mg/L)	0.0595	0.0509	0.0733	0.0602	0.0260
	Nitrite (as N) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Total Kjeldahl Nitrogen (mg/L)	0.311	0.782	0.209	0.334	0.306
	Total Nitrogen (mg/L)	0.234	0.683	0.243	0.269	0.296
	Orthophosphate-Dissolved (as P) (mg/L)	0.0011	0.0027	0.0010	0.0013	0.0011
	Phosphorus (P)-Total Dissolved (mg/L)	0.0036	0.0135	0.0037	0.0034	0.0048
	Phosphorus (P)-Total (mg/L)	0.0997	0.0281	0.0239	0.134	0.0550
	Silicate (as SiO2) (mg/L)	3.75	2.56	3.20	3.91	2.84
	Sulfate (SO4) (mg/L)	12.9	99.8	70.5	12.8	22.6
	Anion Sum (meq/L)	2.00	5.93	3.80	1.97	4.25
	Cation Sum (meq/L)	1.89	6.01	3.74	1.74	3.65
	Cation - Anion Balance (%)	-2.9	0.7	-0.7	-6.1	-7.5
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	3.43	26.3	3.59	3.80	7.47
	Total Organic Carbon (mg/L)	5.52	27.6	4.62 M	5.94	8.23
Total Metals	Aluminum (Al)-Total (mg/L)	1.57	0.132	0.420	1.86	1.81
	Antimony (Sb)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Arsenic (As)-Total (mg/L)	0.00114	0.00101	0.00051	0.00144	0.00136
	Barium (Ba)-Total (mg/L)	0.084	0.085	0.060	0.099	0.207
	Beryllium (Be)-Total (mg/L)	<0.00010	<0.00010	<0.00010	0.00011	0.00012
	Bismuth (Bi)-Total (mg/L)	<0.20	<0.20	<0.20	<0.20	<0.20

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2010676-6 Water 19-OCT-17 13:30 PEACE AT POUCE COUPE (PD4)	L2010676-7 Water 19-OCT-17 13:00 POUCE COUPE (POUCE)	L2010676-8 Water 19-OCT-17 11:30 PEACE AT MANY ISLANDS (PD5)		
WATER						
Physical Tests	Colour, True (CU)	11.6	11.6	9.8		
	Conductivity (uS/cm)	173	329	182		
	Hardness (as CaCO3) (mg/L)	85.8	152	108		
	pH (pH)	8.03	8.14	8.06		
	Total Suspended Solids (mg/L)	151	21.9	161		
	TDS (Calculated) (mg/L)	100	216	113		
	Turbidity (NTU)	67.1	28.7	80.6		
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	84.7	111	89.0		
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0		
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0		
	Alkalinity, Total (as CaCO3) (mg/L)	84.7	111	89.0		
	Ammonia, Total (as N) (mg/L)	<0.0050	<0.0050	<0.0050		
	Bromide (Br) (mg/L)	<0.050	<0.050	<0.050		
	Chloride (Cl) (mg/L)	<0.50	4.24	<0.50		
	Fluoride (F) (mg/L)	0.039	0.069	0.042		
	Nitrate and Nitrite (as N) (mg/L)	0.0580	0.0746	0.0625		
	Nitrate (as N) (mg/L)	0.0580	0.0746	0.0625		
	Nitrite (as N) (mg/L)	<0.0010	<0.0010	<0.0010		
	Total Kjeldahl Nitrogen (mg/L)	0.304	0.236	0.342		
	Total Nitrogen (mg/L)	0.244	0.252	0.244		
	Orthophosphate-Dissolved (as P) (mg/L)	0.0015	<0.0010	0.0011		
	Phosphorus (P)-Total Dissolved (mg/L)	0.0034	0.0035	0.0033		
	Phosphorus (P)-Total (mg/L)	0.133	0.0308	0.158		
	Silicate (as SiO2) (mg/L)	3.86	3.22	4.02		
	Sulfate (SO4) (mg/L)	13.6	70.7	15.0		
	Anion Sum (meq/L)	1.98	3.82	2.10		
	Cation Sum (meq/L)	1.72	3.77	2.23		
	Cation - Anion Balance (%)	-7.2	-0.6	3.1		
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	3.07	3.64	2.76 M		
	Total Organic Carbon (mg/L)	5.53	4.80	5.22		
Total Metals	Aluminum (Al)-Total (mg/L)	1.63	0.475	2.04		
	Antimony (Sb)-Total (mg/L)	<0.00050	<0.00050	<0.00050		
	Arsenic (As)-Total (mg/L)	0.00145	0.00059	0.00183		
	Barium (Ba)-Total (mg/L)	0.113	0.064	0.125		
	Beryllium (Be)-Total (mg/L)	0.00011	<0.00010	0.00014		
	Bismuth (Bi)-Total (mg/L)	<0.20	<0.20	<0.20		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2010676-1 Water 19-OCT-17 16:50 PEACE AT BEATTON (PD2)	L2010676-2 Water 19-OCT-17 16:30 BEATTON RIVER (BEATTON)	L2010676-3 Water DUPLICATE 2 (DUP 2)	L2010676-4 Water 19-OCT-17 15:40 PEACE AT KISKATINAW (PD3)	L2010676-5 Water 19-OCT-17 14:45 KISKATINAW RIVER (KR)
WATER						
Total Metals	Boron (B)-Total (mg/L)	<0.10	<0.10	<0.10	<0.10	<0.10
	Cadmium (Cd)-Total (mg/L)	0.000101	0.0000420	0.0000380	0.000122	0.0000986
	Calcium (Ca)-Total (mg/L)	29.7	51.5	40.0	31.0	55.0
	Chromium (Cr)-Total (mg/L)	0.0025	<0.0010	<0.0010	0.0031	0.0033
	Cobalt (Co)-Total (mg/L)	0.00110	0.00048	0.00037	0.00146	0.00121
	Copper (Cu)-Total (mg/L)	0.0032	0.0018	0.0016	0.0038	0.0117
	Iron (Fe)-Total (mg/L)	2.70	2.27	0.691	3.10	2.17
	Lead (Pb)-Total (mg/L)	0.00134	<0.00050	<0.00050	0.00167	0.00139
	Lithium (Li)-Total (mg/L)	0.0039	0.0095	0.0057	0.0043	0.0059
	Magnesium (Mg)-Total (mg/L)	8.16	15.9	12.7	8.76	18.0
	Manganese (Mn)-Total (mg/L)	0.0493	0.0759	0.0237	0.0626	0.0370
	Mercury (Hg)-Total (ug/L)	0.0070	0.0035	0.00217	0.0077	0.00165
	Molybdenum (Mo)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Nickel (Ni)-Total (mg/L)	0.0039	0.0046	0.0017	0.0046	0.0059
	Phosphorus (P)-Total (mg/L)	<0.30	<0.30	<0.30	<0.30	<0.30
	Potassium (K)-Total (mg/L)	<2.0	<2.0	<2.0	<2.0	<2.0
	Selenium (Se)-Total (mg/L)	0.000304	0.000290	0.000391	0.000392	0.000305
	Silicon (Si)-Total (mg/L)	4.43	1.48	2.27	4.46	4.22
	Silver (Ag)-Total (mg/L)	0.000024	<0.000020	<0.000020	0.000030	0.000034
	Sodium (Na)-Total (mg/L)	<2.0	43.4	16.0	<2.0	13.4
	Strontium (Sr)-Total (mg/L)	0.106	0.203	0.158	0.111	0.229
	Thallium (Tl)-Total (mg/L)	0.000047	0.000011	0.000014	0.000050	0.000056
	Tin (Sn)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Titanium (Ti)-Total (mg/L)	0.011	<0.010	<0.010	0.011	<0.010
	Uranium (U)-Total (mg/L)	0.00045	0.00163	0.00071	0.00047	0.00080
	Vanadium (V)-Total (mg/L)	0.00613	0.00086	0.00173	0.00725	0.00721
	Zinc (Zn)-Total (mg/L)	0.0138	0.0068	<0.0050	0.0175	0.0162
Dissolved Metals	Dissolved MeHg Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0066	0.0385	0.0587	0.0083	0.160
	Antimony (Sb)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Arsenic (As)-Dissolved (mg/L)	<0.00050	0.00066	<0.00050	<0.00050	<0.00050
	Barium (Ba)-Dissolved (mg/L)	0.042	0.089	0.056	0.044	0.123
	Beryllium (Be)-Dissolved (mg/L)	<0.00020 DLA	<0.00010	<0.00010	<0.00010	<0.00010
	Bismuth (Bi)-Dissolved (mg/L)	<0.20	<0.20	<0.20	<0.20	<0.20
	Boron (B)-Dissolved (mg/L)	<0.10	<0.10	<0.10	<0.10	<0.10

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2010676-6	L2010676-7	L2010676-8		
	Description	Water	Water	Water		
	Sampled Date	19-OCT-17	19-OCT-17	19-OCT-17		
	Sampled Time	13:30	13:00	11:30		
	Client ID	PEACE AT POUCE COUPE (PD4)	POUCE COUPE (POUCE)	PEACE AT MANY ISLANDS (PD5)		
Grouping	**Analyte**					
WATER						
Total Metals	Boron (B)-Total (mg/L)	<0.10	<0.10	<0.10		
	Cadmium (Cd)-Total (mg/L)	0.000136	0.0000374	0.000173		
	Calcium (Ca)-Total (mg/L)	30.3	42.1	33.4		
	Chromium (Cr)-Total (mg/L)	0.0028	<0.0010	0.0034		
	Cobalt (Co)-Total (mg/L)	0.00136	0.00044	0.00184		
	Copper (Cu)-Total (mg/L)	0.0037	0.0018	0.0047		
	Iron (Fe)-Total (mg/L)	3.26	0.829	3.90		
	Lead (Pb)-Total (mg/L)	0.00161	0.00051	0.00224		
	Lithium (Li)-Total (mg/L)	0.0039	0.0059	0.0051		
	Magnesium (Mg)-Total (mg/L)	7.49	14.0	9.44		
	Manganese (Mn)-Total (mg/L)	0.0607	0.0260	0.0760		
	Mercury (Hg)-Total (ug/L)	0.0081	0.00214	0.0098		
	Molybdenum (Mo)-Total (mg/L)	<0.0010	<0.0010	<0.0010		
	Nickel (Ni)-Total (mg/L)	0.0048	0.0021	0.0054		
	Phosphorus (P)-Total (mg/L)	<0.30	<0.30	<0.30		
	Potassium (K)-Total (mg/L)	<2.0	<2.0	<2.0		
	Selenium (Se)-Total (mg/L)	0.000395	0.000440	0.000415		
	Silicon (Si)-Total (mg/L)	4.09	2.34	4.89		
	Silver (Ag)-Total (mg/L)	0.000032	<0.000020	0.000043		
	Sodium (Na)-Total (mg/L)	<2.0	16.9	<2.0		
	Strontium (Sr)-Total (mg/L)	0.107	0.158	0.122		
	Thallium (Tl)-Total (mg/L)	0.000047	0.000017	0.000071		
	Tin (Sn)-Total (mg/L)	<0.00050	<0.00050	<0.00050		
	Titanium (Ti)-Total (mg/L)	0.014	<0.010	0.013		
	Uranium (U)-Total (mg/L)	0.00062	0.00073	0.00058		
	Vanadium (V)-Total (mg/L)	0.00661	0.00197	0.00791		
	Zinc (Zn)-Total (mg/L)	0.0168	0.0056	0.0222		
Dissolved Metals	Dissolved MeHg Filtration Location	FIELD	FIELD	FIELD		
	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD		
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD		
	Aluminum (Al)-Dissolved (mg/L)	0.0057	0.0664	0.277		
	Antimony (Sb)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050		
	Arsenic (As)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050		
	Barium (Ba)-Dissolved (mg/L)	0.041	0.054	0.081		
	Beryllium (Be)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010		
	Bismuth (Bi)-Dissolved (mg/L)	<0.20	<0.20	<0.20		
	Boron (B)-Dissolved (mg/L)	<0.10	<0.10	<0.10		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2010676-1 Water 19-OCT-17 16:50 PEACE AT BEATTON (PD2)	L2010676-2 Water 19-OCT-17 16:30 BEATTON RIVER (BEATTON)	L2010676-3 Water DUPLICATE 2 (DUP 2)	L2010676-4 Water 19-OCT-17 15:40 PEACE AT KISKATINAW (PD3)	L2010676-5 Water 19-OCT-17 14:45 KISKATINAW RIVER (KR)
WATER						
Dissolved Metals	Cadmium (Cd)-Dissolved (mg/L)	0.000012	0.0000187	0.0000216	0.0000149	0.0000479
	Calcium (Ca)-Dissolved (mg/L)	27.1	50.3	37.6	23.3	43.5
	Chromium (Cr)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Cobalt (Co)-Dissolved (mg/L)	<0.00030	0.00036	<0.00030	<0.00030	0.00039
	Copper (Cu)-Dissolved (mg/L)	<0.0010	0.0016	0.0010	<0.0010	0.0027
	Iron (Fe)-Dissolved (mg/L)	<0.030	0.673	0.117	<0.030	0.351
	Lead (Pb)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Lithium (Li)-Dissolved (mg/L)	<0.0020 DLA	0.0100	0.0050	0.0018	0.0033
	Magnesium (Mg)-Dissolved (mg/L)	6.54	17.3	13.3	7.08	13.4
	Manganese (Mn)-Dissolved (mg/L)	0.00256	0.0171	0.0151	0.00261	0.0191
	Mercury (Hg)-Dissolved (ug/L)	0.00100	0.00240	0.00140	0.00080	0.00419 DTC
	Molybdenum (Mo)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Nickel (Ni)-Dissolved (mg/L)	<0.0010	0.0045	0.0012	<0.0010	0.0017
	Phosphorus (P)-Dissolved (mg/L)	<0.30	<0.30	<0.30	<0.30	<0.30
	Potassium (K)-Dissolved (mg/L)	<2.0	2.3	<2.0	<2.0	<2.0
	Selenium (Se)-Dissolved (mg/L)	0.00027	0.000229	0.000338	0.000253	0.000242
	Silicon (Si)-Dissolved (mg/L)	1.86	1.17	1.65	1.72	1.59
	Silver (Ag)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Sodium (Na)-Dissolved (mg/L)	<2.0	45.5	17.5	<2.0	7.9
	Strontium (Sr)-Dissolved (mg/L)	0.0944	0.189	0.156	0.0820	0.174
	Thallium (Tl)-Dissolved (mg/L)	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
	Tin (Sn)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Titanium (Ti)-Dissolved (mg/L)	<0.010	<0.010	<0.010	<0.010	<0.010
	Uranium (U)-Dissolved (mg/L)	0.00038	0.00151	0.00064	0.00029	0.00051
	Vanadium (V)-Dissolved (mg/L)	<0.0010 DLA	<0.00050	<0.00050	<0.00050	0.00072
	Zinc (Zn)-Dissolved (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Speciated Metals	Methylmercury (as MeHg)-Dissolved (ug/L)	<0.000050	0.000273	<0.000050	<0.000050	<0.000050
	Methylmercury (as MeHg)-Total (ug/L)	0.000067	0.000315	<0.000050	<0.000050	<0.000050

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2010676-6	L2010676-7	L2010676-8		
	Description	Water	Water	Water		
	Sampled Date	19-OCT-17	19-OCT-17	19-OCT-17		
	Sampled Time	13:30	13:00	11:30		
	Client ID	PEACE AT POUCE COUPE (PD4)	POUCE COUPE (POUCE)	PEACE AT MANY ISLANDS (PD5)		
Grouping	**Analyte**					
WATER						
Dissolved Metals	Cadmium (Cd)-Dissolved (mg/L)	0.0000196	0.0000215	0.0000793		
	Calcium (Ca)-Dissolved (mg/L)	23.8	38.9	29.9		
	Chromium (Cr)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010		
	Cobalt (Co)-Dissolved (mg/L)	<0.00030	<0.00030	0.00059		
	Copper (Cu)-Dissolved (mg/L)	<0.0010	0.0010	0.0018		
	Iron (Fe)-Dissolved (mg/L)	<0.030	0.117	0.676		
	Lead (Pb)-Dissolved (mg/L)	<0.00050	<0.00050	0.00073		
	Lithium (Li)-Dissolved (mg/L)	0.0012	0.0051	0.0026		
	Magnesium (Mg)-Dissolved (mg/L)	6.43	13.3	8.16		
	Manganese (Mn)-Dissolved (mg/L)	0.00459	0.0145	0.0342		
	Mercury (Hg)-Dissolved (ug/L)	<0.00050	0.00135	0.00209		
	Molybdenum (Mo)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010		
	Nickel (Ni)-Dissolved (mg/L)	<0.0010	0.0011	0.0016		
	Phosphorus (P)-Dissolved (mg/L)	<0.30	<0.30	<0.30		
	Potassium (K)-Dissolved (mg/L)	<2.0	<2.0	<2.0		
	Selenium (Se)-Dissolved (mg/L)	0.000293	0.000375	0.000362		
	Silicon (Si)-Dissolved (mg/L)	1.89	1.68	2.20		
	Silver (Ag)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020		
	Sodium (Na)-Dissolved (mg/L)	<2.0	16.6	<2.0		
	Strontium (Sr)-Dissolved (mg/L)	0.0907	0.156	0.117		
	Thallium (Tl)-Dissolved (mg/L)	<0.00020	<0.00020	<0.00020		
	Tin (Sn)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050		
	Titanium (Ti)-Dissolved (mg/L)	<0.010	<0.010	<0.010		
	Uranium (U)-Dissolved (mg/L)	0.00037	0.00065	0.00044		
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	0.00120		
	Zinc (Zn)-Dissolved (mg/L)	<0.0050	<0.0050	0.0054		
Speciated Metals	Methylmercury (as MeHg)-Dissolved (ug/L)	0.000057	<0.000050	<0.000050		
	Methylmercury (as MeHg)-Total (ug/L)	0.000097	<0.000050	0.000136		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Method Blank	Aluminum (Al)-Dissolved	MB-LOR	L2010676-2
Method Blank	Barium (Ba)-Dissolved	MB-LOR	L2010676-1, -3, -4, -5, -7, -8
Method Blank	Manganese (Mn)-Dissolved	MB-LOR	L2010676-6
Method Blank	Nickel (Ni)-Dissolved	MB-LOR	L2010676-2
Matrix Spike	Dissolved Organic Carbon	MS-B	L2010676-1, -2
Matrix Spike	Dissolved Organic Carbon	MS-B	L2010676-3, -4, -5, -6, -7, -8
Matrix Spike	Total Organic Carbon	MS-B	L2010676-1, -2
Matrix Spike	Total Organic Carbon	MS-B	L2010676-3, -4, -5, -6, -7, -8
Matrix Spike	Total Organic Carbon	MS-B	L2010676-3, -4, -5, -6, -7, -8
Matrix Spike	Total Organic Carbon	MS-B	L2010676-3, -4, -5, -6, -7, -8
Matrix Spike	Aluminum (Al)-Total	MS-B	L2010676-2, -3, -4, -5, -7, -8
Matrix Spike	Barium (Ba)-Total	MS-B	L2010676-2, -3, -4, -5, -7, -8
Matrix Spike	Barium (Ba)-Total	MS-B	L2010676-1, -6
Matrix Spike	Boron (B)-Total	MS-B	L2010676-2, -3, -4, -5, -7, -8
Matrix Spike	Calcium (Ca)-Total	MS-B	L2010676-2, -3, -4, -5, -7, -8
Matrix Spike	Calcium (Ca)-Total	MS-B	L2010676-1, -6
Matrix Spike	Copper (Cu)-Total	MS-B	L2010676-2, -3, -4, -5, -7, -8
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2010676-2, -3, -4, -5, -7, -8
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2010676-1, -6
Matrix Spike	Manganese (Mn)-Total	MS-B	L2010676-2, -3, -4, -5, -7, -8
Matrix Spike	Molybdenum (Mo)-Total	MS-B	L2010676-2, -3, -4, -5, -7, -8
Matrix Spike	Potassium (K)-Total	MS-B	L2010676-2, -3, -4, -5, -7, -8
Matrix Spike	Selenium (Se)-Total	MS-B	L2010676-1, -6
Matrix Spike	Sodium (Na)-Total	MS-B	L2010676-2, -3, -4, -5, -7, -8
Matrix Spike	Strontium (Sr)-Total	MS-B	L2010676-2, -3, -4, -5, -7, -8
Matrix Spike	Strontium (Sr)-Total	MS-B	L2010676-1, -6
Matrix Spike	Total Nitrogen	MS-B	L2010676-1, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Total Nitrogen	MS-B	L2010676-1, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Nitrate (as N)	MS-B	L2010676-1, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Nitrate (as N)	MS-B	L2010676-1, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Orthophosphate-Dissolved (as P)	MS-B	L2010676-1, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Sulfate (SO4)	MS-B	L2010676-1, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Sulfate (SO4)	MS-B	L2010676-1, -2, -3, -4, -5, -6, -7, -8

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLA	Detection Limit adjusted for required dilution
DTC	Dissolved concentration exceeds total. Results were confirmed by re-analysis.
M	A peak has been manually integrated.
MB-LOR	Method Blank exceeds ALS DQO. Limits of Reporting have been adjusted for samples with positive hits below 5x blank level.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

ANIONS-N+N-CALC-VA	Water	Nitrite & Nitrate in Water (Calculation)	EPA 300.0

Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).

BR-L-IC-N-VA	Water	Bromide in Water by IC (Low Level)	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

Reference Information

CARBONS-DOC-VA	Water	Dissolved organic carbon by combustion	APHA 5310B TOTAL ORGANIC CARBON (TOC)

This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis.

CARBONS-TOC-VA	Water	Total organic carbon by combustion	APHA 5310B TOTAL ORGANIC CARBON (TOC)

This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)".

CL-IC-N-VA	Water	Chloride in Water by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

COLOUR-TRUE-VA	Water	Colour (True) by Spectrometer	BCMOE Colour Single Wavelength

This analysis is carried out using procedures adapted from British Columbia Environmental Manual "Colour- Single Wavelength." Colour (True Colour) is determined by filtering a sample through a 0.45 micron membrane filter followed by analysis of the filtrate using the platinum-cobalt colourimetric method.
Colour measurements can be highly pH dependent, and apply to the pH of the sample as received (at time of testing), without pH adjustment. Concurrent measurement of sample pH is recommended.

EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510

Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.

F-IC-N-VA	Water	Fluoride in Water by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

HARDNESS-CALC-VA	Water	Hardness	APHA 2340B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HG-D-U-CVAF-VA	Water	Diss. Mercury in Water by CVAFS (Ultra)	APHA 3030 B / EPA 1631 REV. E

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from Method 1631 Rev. E. by the United States Environmental Protection Agency (EPA). The procedure may involve preliminary sample treatment by filtration (APHA 3030B) and involves a cold-oxidation of the acidified sample using bromine monochloride prior to a purge and trap concentration step and final reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry.

HG-T-U-CVAF-VA	Water	Total Mercury in Water by CVAFS (Ultra)	EPA 1631 REV. E

This analysis is carried out using procedures adapted from Method 1631 Rev. E. by the United States Environmental Protection Agency (EPA). The procedure involves a cold-oxidation of the acidified sample using bromine monochloride prior to a purge and trap concentration step and final reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry.

IONBALANCE-VA	Water	Ion Balance Calculation	APHA 1030E

Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:

Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum]

MEHG-D-GCAF-VA	Water	Diss. Methylmercury in Water by GCAFS	EPA 1630

This method follows Method 1630 of the US EPA. Samples are distilled under an inert gas flow to isolate methylmercury and minimize matrix interferences. The distillate is analyzed by aqueous phase ethylation, purge and trap, desorption and GC separation. The separated species are then pyrolized to elemental Hg and quantified by cold vapour atomic flourescence spectroscopy. Results are reported "as MeHg".

MEHG-T-GCAF-VA	Water	Total Methylmercury in Water by GCAFS	EPA 1630

This method follows Method 1630 of the US EPA. Samples are distilled under an inert gas flow to isolate methylmercury and minimize matrix interferences. The distillate is analyzed by aqueous phase ethylation, purge and trap, desorption and GC separation. THe separated species are then pyrolized to elemental Hg and quantified by cold vapour atomic flourescence spectroscopy. Results are reported "as MeHg".

MET-D-CCMS-VA	Water	Dissolved Metals in Water by CRC ICPMS	APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA	Water	Total Metals in Water by CRC ICPMS	EPA 200.2/6020A (mod)

Reference Information

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

N-T-COL-VA	Water	Total Nitrogen in water by Colour	APHA4500-P(J)/NEMI9171/USGS03-4174

This analysis is carried out using procedures adapted from APHA Method 4500-P (J) "Persulphate Method for Simultaneous Determination of Total Nitrogen and Total Phosphorus" and National Environmental Methods Index - Nemi method 5735.

NH3-F-VA	Water	Ammonia in Water by Fluorescence	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-VA	Water	Nitrite in Water by IC (Low Level)	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-VA	Water	Nitrate in Water by IC (Low Level)	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

P-T-PRES-COL-VA	Water	Total P in Water by Colour	APHA 4500-P Phosphorus

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorus is determined colourimetrically after persulphate digestion of the sample.
Samples with very high dissolved solids (i.e. seawaters, brackish waters) may produce a negative bias by this method. Alternate methods are available for these types of samples.

Arsenic (5+), at elevated levels, is a positive interference on colourimetric phosphate analysis.

P-TD-COL-VA	Water	Total Dissolved P in Water by Colour	APHA 4500-P Phosphorous

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Dissolved Phosphorus is determined colourimetrically after persulphate digestion of a sample that has been lab or field filtered through a 0.45 micron membrane filter.
Samples with very high dissolved solids (i.e. seawaters, brackish waters) may produce a negative bias by this method. Alternate methods are available for these types of samples.

Arsenic (5+), at elevated levels, is a positive interference on colourimetric phosphate analysis.

PH-PCT-VA	Water	pH by Meter (Automated)	APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

PO4-DO-COL-VA	Water	Diss. Orthophosphate in Water by Colour	APHA 4500-P Phosphorus

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Dissolved Orthophosphate is determined colourimetrically on a sample that has been lab or field filtered through a 0.45 micron membrane filter.
Samples with very high dissolved solids (i.e. seawaters, brackish waters) may produce a negative bias by this method. Alternate methods are available for these types of samples.

Arsenic (5+), at elevated levels, is a positive interference on colourimetric phosphate analysis.

SILICATE-COL-VA	Water	Silicate by Colourimetric analysis	APHA 4500-SiO2 E.

This analysis is carried out using procedures adapted from APHA Method 4500-SiO2 E. "Silica". Silicate (molybdate-reactive silica) is determined by the molybdosilicate-heteropoly blue colourimetric method.

SO4-IC-N-VA	Water	Sulfate in Water by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA	Water	TDS (Calculated)	APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".
The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TKN-F-VA	Water	TKN in Water by Fluorescence	APHA 4500-NORG D.

This analysis is carried out using procedures adapted from APHA Method 4500-Norg D. "Block Digestion and Flow Injection Analysis". Total Kjeldahl Nitrogen is determined using block digestion followed by Flow-injection analysis with fluorescence detection.

TSS-VA	Water	Total Suspended Solids by Gravimetric	APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.
Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

Reference Information

TURBIDITY-VA	Water	Turbidity by Meter	APHA 2130 Turbidity

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

14-

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Tetra Tech Canada Inc.
ATTN: Danielle MacDonald
14940 - 123 Avenue, NW
Edmonton AB T5V 1B4

Date Received: 19-OCT-17
Report Date: 03-NOV-17 12:57 (MT)
Version: FINAL

Client Phone: 780-886-3055

Certificate of Analysis

Lab Work Order #: L2010677

Project P.O. #: NOT SUBMITTED
Job Reference: VENW003060
C of C Numbers:
Legal Site Desc:

Brent Mack, B.Sc.
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2010677-1 Soil 19-OCT-17 17:00 PEACE AT BEATTON (PD2)	L2010677-2 Soil 19-OCT-17 16:00 BEATTON RIVER (BEATTON)	L2010677-3 Soil 19-OCT-17 15:00 PEACE AT KISKATINAW (PD3)	L2010677-4 Soil 19-OCT-17 14:30 KISKATINAW RIVER (KR)	L2010677-5 Soil 19-OCT-17 16:00 PEACE AT POUCE COUPE (PD4)
SOIL						
Physical Tests	pH (1:2 soil:water) (pH)	8.12	8.19	8.21	8.26	8.16
Particle Size	% Gravel (>2mm) (%)	<1.0	3.1	<1.0	2.3	<1.0
	% Sand (2.00mm - 1.00mm) (%)	<1.0	<1.0	<1.0	<1.0	<1.0
	% Sand (1.00mm - 0.50mm) (%)	<1.0	<1.0	<1.0	<1.0	<1.0
	% Sand (0.50mm - 0.25mm) (%)	<1.0	7.3	3.3	1.6	<1.0
	% Sand (0.25mm - 0.125mm) (%)	7.3	14.5	27.5	32.1	9.6
	% Sand (0.125mm - 0.063mm) (%)	36.7	25.8	25.1	25.3	40.9
	% Silt (0.063mm - 0.0312mm) (%)	27.3	21.0	20.8	13.0	25.5
	% Silt (0.0312mm - 0.004mm) (%)	23.7	20.7	18.9	14.3	19.6
	% Clay (<4um) (%)	4.8	7.0	4.4	11.1	4.1
	Texture	Sandy loam	Sandy loam	Sandy loam	Sandy loam	Sandy loam
Leachable Anions & Nutrients	Total Kjeldahl Nitrogen (%)	0.076	0.071	0.065	0.058	0.060
Anions and Nutrients	Total Nitrogen by LECO (%)	0.091	0.089	0.072	0.064	0.078
Organic / Inorganic Carbon	Total Organic Carbon (%)	1.13	1.04	0.95	0.59	0.92
Plant Available Nutrients	Available Ammonium-N (mg/kg)	2.0	1.9	1.5	2.4	1.4
	Nitrate+Nitrite-N (mg/kg)	<2.0 DLM	<2.0 DLM	<2.0 DLM	<2.0	<2.0
	Nitrate-N (mg/kg)	<2.0 DLM	<2.0 DLM	<2.0 DLM	<2.0	<2.0
	Nitrite-N (mg/kg)	<0.80 DLM	<0.80 DLM	<0.80 DLM	<0.40	0.41
	Available Phosphate-P (mg/kg)	<2.0	2.9	<2.0	<2.0	<2.0
Metals	Aluminum (Al) (mg/kg)	4650	5550	4600	7390	7550
	Antimony (Sb) (mg/kg)	0.51	0.79	0.65	0.52	0.71
	Arsenic (As) (mg/kg)	6.43	9.26	8.28	7.87	8.20
	Barium (Ba) (mg/kg)	310	440	375	316	375
	Beryllium (Be) (mg/kg)	0.36	0.43	0.37	0.45	0.53
	Bismuth (Bi) (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
	Boron (B) (mg/kg)	<5.0	<5.0	<5.0	5.9	8.1
	Cadmium (Cd) (mg/kg)	0.472	0.558	0.477	0.335	0.680
	Calcium (Ca) (mg/kg)	18400	5850	13800	13400	19700
	Chromium (Cr) (mg/kg)	10.7	13.0	10.6	16.0	16.2
	Cobalt (Co) (mg/kg)	5.67	8.55	6.78	7.29	7.78
	Copper (Cu) (mg/kg)	11.7	14.4	10.7	14.2	18.0
	Iron (Fe) (mg/kg)	15300	20700	18300	17800	19500
	Lead (Pb) (mg/kg)	6.95	8.32	7.12	8.14	9.94
	Lithium (Li) (mg/kg)	7.8	8.2	6.7	11.5	11.8
	Magnesium (Mg) (mg/kg)	6120	3070	4430	4910	6500

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2010677-6	L2010677-7	L2010677-8		
	Description	Soil	Soil	Soil		
	Sampled Date	19-OCT-17	19-OCT-17	19-OCT-17		
	Sampled Time	12:30	11:00			
	Client ID	POUCE COUPE (POUCE)	PEACE AT MANY ISLANDS (PD5)	DUPLICATE 2 (DUP 2)		
Grouping	**Analyte**					
SOIL						
Physical Tests	pH (1:2 soil:water) (pH)	8.38	8.07	8.18		
Particle Size	% Gravel (>2mm) (%)	<1.0	<1.0	<1.0		
	% Sand (2.00mm - 1.00mm) (%)	<1.0	<1.0	<1.0		
	% Sand (1.00mm - 0.50mm) (%)	<1.0	<1.0	<1.0		
	% Sand (0.50mm - 0.25mm) (%)	<1.0	<1.0	<1.0		
	% Sand (0.25mm - 0.125mm) (%)	41.7	8.5	36.7		
	% Sand (0.125mm - 0.063mm) (%)	30.4	32.9	25.5		
	% Silt (0.063mm - 0.0312mm) (%)	12.4	27.9	11.7		
	% Silt (0.0312mm - 0.004mm) (%)	9.4	25.2	15.9		
	% Clay (<4um) (%)	5.3	5.2	9.2		
	Texture	Loamy sand	Sandy loam	Sandy loam		
Leachable Anions & Nutrients	Total Kjeldahl Nitrogen (%)	0.039	0.068	0.057		
Anions and Nutrients	Total Nitrogen by LECO (%)	0.050	0.079	0.069		
Organic / Inorganic Carbon	Total Organic Carbon (%)	0.443	0.86	0.672		
Plant Available Nutrients	Available Ammonium-N (mg/kg)	1.4	2.3	1.9		
	Nitrate+Nitrite-N (mg/kg)	<2.0	<2.0	<2.0		
	Nitrate-N (mg/kg)	<2.0	<2.0	<2.0		
	Nitrite-N (mg/kg)	<0.40	<0.40	<0.40		
	Available Phosphate-P (mg/kg)	<2.0	<2.0	2.1		
Metals	Aluminum (Al) (mg/kg)	4180	5730	6800		
	Antimony (Sb) (mg/kg)	0.38	0.59	0.63		
	Arsenic (As) (mg/kg)	9.20	7.29	12.5		
	Barium (Ba) (mg/kg)	326	394	297		
	Beryllium (Be) (mg/kg)	0.33	0.39	0.52		
	Bismuth (Bi) (mg/kg)	<0.20	<0.20	<0.20		
	Boron (B) (mg/kg)	<5.0	5.6	7.2		
	Cadmium (Cd) (mg/kg)	0.179	0.517	0.445		
	Calcium (Ca) (mg/kg)	6140	17600	9810		
	Chromium (Cr) (mg/kg)	9.84	12.7	14.6		
	Cobalt (Co) (mg/kg)	6.67	6.45	10.3		
	Copper (Cu) (mg/kg)	6.91	13.2	15.4		
	Iron (Fe) (mg/kg)	15300	17300	20200		
	Lead (Pb) (mg/kg)	5.71	7.59	9.17		
	Lithium (Li) (mg/kg)	6.4	8.5	10.7		
	Magnesium (Mg) (mg/kg)	2510	6260	3540		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2010677-1 Soil 19-OCT-17 17:00 PEACE AT BEATTON (PD2)	L2010677-2 Soil 19-OCT-17 16:00 BEATTON RIVER (BEATTON)	L2010677-3 Soil 19-OCT-17 15:00 PEACE AT KISKATINAW (PD3)	L2010677-4 Soil 19-OCT-17 14:30 KISKATINAW RIVER (KR)	L2010677-5 Soil 19-OCT-17 16:00 PEACE AT POUCE COUPE (PD4)
SOIL						
Metals	Manganese (Mn) (mg/kg)	196	298	247	231	301
	Mercury (Hg) (mg/kg)	0.0436	0.0640	0.0374	0.0631	0.0829
	Molybdenum (Mo) (mg/kg)	1.04	1.20	1.28	0.80	1.40
	Nickel (Ni) (mg/kg)	18.9	24.2	20.5	22.7	26.6
	Phosphorus (P) (mg/kg)	829	658	833	646	892
	Potassium (K) (mg/kg)	910	940	890	1230	1540
	Selenium (Se) (mg/kg)	0.45	0.63	0.48	0.53	0.80
	Silver (Ag) (mg/kg)	0.15	0.16	0.11	0.14	0.22
	Sodium (Na) (mg/kg)	61	102	61	96	84
	Strontium (Sr) (mg/kg)	44.1	29.6	40.7	44.0	54.4
	Sulfur (S) (mg/kg)	1100	<1000	<1000	1100	1400
	Thallium (Tl) (mg/kg)	0.106	0.127	0.101	0.116	0.175
	Tin (Sn) (mg/kg)	<2.0	<2.0	<2.0	<2.0	<2.0
	Titanium (Ti) (mg/kg)	26.1	52.1	35.8	38.0	<39 DLM
	Tungsten (W) (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
	Uranium (U) (mg/kg)	0.788	0.914	0.922	0.838	0.991
	Vanadium (V) (mg/kg)	22.7	26.8	24.6	27.8	35.8
	Zinc (Zn) (mg/kg)	65.5	85.8	69.0	71.7	86.2
	Zirconium (Zr) (mg/kg)	1.4	2.2	2.0	2.6	1.5

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2010677-6	L2010677-7	L2010677-8		
	Description	Soil	Soil	Soil		
	Sampled Date	19-OCT-17	19-OCT-17	19-OCT-17		
	Sampled Time	12:30	11:00			
	Client ID	POUCE COUPE (POUCE)	PEACE AT MANY ISLANDS (PD5)	DUPLICATE 2 (DUP 2)		
Grouping	**Analyte**					
SOIL						
Metals	Manganese (Mn) (mg/kg)	214	225	336		
	Mercury (Hg) (mg/kg)	0.0272	0.0483	0.0547		
	Molybdenum (Mo) (mg/kg)	0.63	1.14	1.07		
	Nickel (Ni) (mg/kg)	17.0	21.0	26.6		
	Phosphorus (P) (mg/kg)	521	852	622		
	Potassium (K) (mg/kg)	740	1090	1230		
	Selenium (Se) (mg/kg)	0.29	0.55	0.56		
	Silver (Ag) (mg/kg)	<0.10	0.15	0.14		
	Sodium (Na) (mg/kg)	76	71	103		
	Strontium (Sr) (mg/kg)	26.1	46.7	39.1		
	Sulfur (S) (mg/kg)	<1000	1300	1200		
	Thallium (Tl) (mg/kg)	0.072	0.128	0.141		
	Tin (Sn) (mg/kg)	<2.0	<2.0	<2.0		
	Titanium (Ti) (mg/kg)	<46 DLM	<45 DLM	46.0		
	Tungsten (W) (mg/kg)	<0.50	<0.50	<0.50		
	Uranium (U) (mg/kg)	0.542	0.832	1.04		
	Vanadium (V) (mg/kg)	23.3	27.9	31.6		
	Zinc (Zn) (mg/kg)	50.9	71.5	79.3		
	Zirconium (Zr) (mg/kg)	2.2	2.0	2.8		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
C-TIC-PCT-SK	Soil	Total Inorganic Carbon in Soil	CSSS (2008) P216-217

A known quantity of acetic acid is consumed by reaction with carbonates in the soil. The pH of the resulting solution is measured and compared against a standard curve relating pH to weight of carbonate.

C-TOC-CALC-SK	Soil	Total Organic Carbon Calculation	CSSS (2008) 21.2

Total Organic Carbon (TOC) is calculated by the difference between total carbon (TC) and total inorganic carbon. (TIC)

C-TOT-LECO-SK	Soil	Total Carbon by combustion method	CSSS (2008) 21.2

The sample is ignited in a combustion analyzer where carbon in the reduced CO2 gas is determined using a thermal conductivity detector.

HG-200.2-CVAF-VA	Soil	Mercury in Soil by CVAFS	EPA 200.2/1631E (mod)

Soil samples are digested with nitric and hydrochloric acids, followed by analysis by CVAFS.

IC-CACO3-CALC-SK	Soil	Inorganic Carbon as CaCO3 Equivalent	Calculation
MET-200.2-CCMS-VA	Soil	Metals in Soil by CRC ICPMS	EPA 200.2/6020A (mod)

This method uses a heated strong acid digestion with HNO3 and HCl and is intended to liberate metals that may be environmentally available. Silicate minerals are not solubilized. Dependent on sample matrix, some metals may be only partially recovered, including Al, Ba, Be, Cr, Sr, Ti, Tl, V, W, and Zr. Volatile forms of sulfur (including sulfide) may not be captured, as they may be lost during sampling, storage, or digestion. Analysis is by Collision/Reaction Cell ICPMS.

N-TOT-LECO-SK	Soil	Total Nitrogen by combustion method	CSSS (2008) 22.4

The sample is ignited in a combustion analyzer where nitrogen in the reduced nitrous oxide gas is determined using a thermal conductivity detector.

N-TOTKJ-COL-SK	Soil	Total Kjeldahl Nitrogen	CSSS (2008) 22.2.3

The soil is digested with sulfuric acid in the presence of CuSO4 and K2SO4 catalysts. Ammonia in the soil extract is determined colrimetrically at 660 nm.

N2/N3-AVAIL-SK	Soil	Nitrate, Nitrite and Nitrate+Nitrite-N	APHA 4500 NO3F

Available Nitrate and Nitrite are extracted from the soil using a dilute calcium chloride solution. Nitrate plus Nitrite is quantitatively reduced to nitrite by passage of the sample through a copperized cadmium column. The nitrite (reduced nitrate plus original nitrite) is then determined by diazotizing with sulfanilamide followed by coupling with N-(1-naphthyl) ethylenediamine dihydrochloride. The resulting water soluble dye has a magenta color which is measured at colorimetrically at 520nm. Nitrite is determined on the same extract by following the same instrumental procedure without a cadmium column.
Reference: Recommended Methods of Soil Analysis for Canadian Prairie Agricultural Soils. Alberta Agriculture (1988) p. 19 and 28

NH4-AVAIL-SK	Soil	Available Ammonium-N	Comm Soil Sci 19(6)

Ammonium (NH4-N) is extracted from the soil using 2 N KCl. Ammonium in the extract is mixed with hypochlorite and salicylate to form indophenol blue, which is determined colorimetrically by auto analysis at 660 nm.

PH-1:2-VA	Soil	pH in Soil (1:2 Soil:Water Extraction)	BC WLAP METHOD: PH, ELECTROMETRIC, SOIL

This analysis is carried out in accordance with procedures described in the pH, Electrometric in Soil and Sediment method - Section B Physical/Inorganic and Misc. Constituents, BC Environmental Laboratory Manual 2007. The procedure involves mixing the dried (at <60°C) and sieved (No. 10 / 2mm) sample with deionized/distilled water at a 1:2 ratio of sediment to water. The pH of the solution is then measured using a standard pH probe.

PO4-AVAIL-SK	Soil	Available Phosphate-P	Comm. Soil Sci. Plant Anal. 25 (5&6)

Plant available phosphorus is extracted from the soil using Modified Kelowna solution. Phosphorous in the soil extract is determined colorimetrically at 880 nm.

PSA-PIPET-DETAIL-SK	Soil	Particle size - Sieve and Pipette	SSIR-51 METHOD 3.2.1

Particle size distribution is determined by a combination of techniques. Dry sieving is performed for coarse particles, wet sieving for sand particles and the pipette sedimentation method for clay particles.

Reference:

Reference Information

Burt, R. (2009). Soil Survey Field and Laboratory Methods Manual. Soil Survey Investigations Report No. 5. Method 3.2.1.2.2. United States Department of Agriculture Natural Resources Conservation Service.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
SK	ALS ENVIRONMENTAL - SASKATOON, SASKATCHEWAN, CANADA
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Tetra Tech Canada Inc.
ATTN: Danielle MacDonald
14940 - 123 Avenue, NW
Edmonton AB T5V 1B4

Date Received: 22-OCT-17
Report Date: 09-NOV-17 12:06 (MT)
Version: FINAL

Client Phone: 780-886-3055

Certificate of Analysis

Lab Work Order #: L2011209

Project P.O. #: NOT SUBMITTED
Job Reference: VENW03060
C of C Numbers:
Legal Site Desc:

Brent Mack, B.Sc.
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2011209-1	L2011209-2	L2011209-3	L2011209-4	L2011209-5
Description	Water	Water	Water	Water	Water
Sampled Date	20-OCT-17	20-OCT-17	20-OCT-17	20-OCT-17	20-OCT-17
Sampled Time	14:20	14:50	17:45	17:10	
Client ID	WILLISTON SHALLOW (W1 - SHALLOW)	WILLISTON DEEP (W1 - DEEP)	DINOSAUR SHALLOW (D1 - SHALLOW)	DINOSAUR DEEP (D1 - DEEP)	DUPLICATE 1 (DUP 1)
Grouping **Analyte**					
FILTER					
Plant Pigments Chlorophyll a (ug/L)	0.556	1.86	1.15	1.55	0.906

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2011209-6				
Description	Water				
Sampled Date	20-OCT-17				
Sampled Time					
Client ID	FIELD BLANK				
Grouping **Analyte**					
FILTER					
Plant Pigments Chlorophyll a (ug/L)	<0.010				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2011209-1 Water 20-OCT-17 14:20 WILLISTON SHALLOW (W1 - SHALLOW)	L2011209-2 Water 20-OCT-17 14:50 WILLISTON DEEP (W1 - DEEP)	L2011209-3 Water 20-OCT-17 17:45 DINOSAUR SHALLOW (D1 - SHALLOW)	L2011209-4 Water 20-OCT-17 17:10 DINOSAUR DEEP (D1 - DEEP)	L2011209-5 Water 20-OCT-17 DUPLICATE 1 (DUP 1)
WATER						
Physical Tests	Colour, True (CU)	6.6	7.5	6.8	9.0	<5.0
	Conductivity (uS/cm)	169	165	167	165	161
	Hardness (as CaCO3) (mg/L)	79.0	85.1	87.7	86.9	89.0
	pH (pH)	8.14	8.11	8.14	8.14	7.88
	Total Suspended Solids (mg/L)	<3.0	<3.0	<3.0	<3.0	<3.0
	TDS (Calculated) (mg/L)	90.9	93.0	94.2	93.3	93.9
	Turbidity (NTU)	0.73	0.83	1.25	1.20	1.24
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	80.1	79.6	79.9	79.1	78.7
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	80.1	79.6	79.9	79.1	78.7
	Ammonia, Total (as N) (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Bromide (Br) (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Chloride (Cl) (mg/L)	<0.50	<0.50	<0.50	<0.50	<0.50
	Fluoride (F) (mg/L)	0.047	0.046	0.046	0.044	0.044
	Nitrate and Nitrite (as N) (mg/L)	0.0464	0.0464	0.0506	0.0513	0.0484
	Nitrate (as N) (mg/L)	0.0464	0.0464	0.0506	0.0513	0.0484
	Nitrite (as N) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Total Kjeldahl Nitrogen (mg/L)	0.068	0.062	0.061	0.062	0.098
	Total Nitrogen (mg/L)	0.118	0.120	0.130	0.125	0.111
	Orthophosphate-Dissolved (as P) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Phosphorus (P)-Total Dissolved (mg/L)	<0.0020	0.0021	<0.0020	<0.0020	<0.0020
	Phosphorus (P)-Total (mg/L)	0.0031	0.0029	0.0036	0.0036	0.0041
	Silicate (as SiO2) (mg/L)	4.06	4.13	4.40	4.18	4.19
	Sulfate (SO4) (mg/L)	11.7	11.8	11.9	11.8	11.8
	Anion Sum (meq/L)	1.85	1.84	1.85	1.83	1.82
	Cation Sum (meq/L)	1.58	1.70	1.75	1.74	1.78
	Cation - Anion Balance (%)	-7.9	-4.0	-2.7	-2.7	-1.2
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	2.57	2.62	2.55	2.50	2.60
	Total Organic Carbon (mg/L)	2.85	2.71	2.60	2.62	2.63
Total Metals	Aluminum (Al)-Total (mg/L)	0.0185	0.0190	0.0324	0.0309	0.0296
	Antimony (Sb)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Arsenic (As)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Barium (Ba)-Total (mg/L)	0.030	0.030	0.030	0.030	0.030
	Beryllium (Be)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Bismuth (Bi)-Total (mg/L)	<0.20	<0.20	<0.20	<0.20	<0.20

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2011209-6	L2011209-7			
	Description	Water	Water			
	Sampled Date	20-OCT-17	20-OCT-17			
	Sampled Time					
	Client ID	FIELD BLANK	TRAVEL BLANK			
Grouping	**Analyte**					
WATER						
Physical Tests	Colour, True (CU)	<5.0	<5.0			
	Conductivity (uS/cm)	<2.0	<2.0			
	Hardness (as CaCO3) (mg/L)	<0.50	<0.50 HTC			
	pH (pH)	5.52	5.46			
	Total Suspended Solids (mg/L)	<3.0	<3.0			
	TDS (Calculated) (mg/L)	<1.0	<1.0			
	Turbidity (NTU)	<0.10	<0.10			
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	<1.0	<1.0			
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0			
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0			
	Alkalinity, Total (as CaCO3) (mg/L)	<1.0	<1.0			
	Ammonia, Total (as N) (mg/L)	<0.0050	<0.011 RRV			
	Bromide (Br) (mg/L)	<0.050	<0.050			
	Chloride (Cl) (mg/L)	<0.50	<0.50			
	Fluoride (F) (mg/L)	<0.020	<0.020			
	Nitrate and Nitrite (as N) (mg/L)	<0.0051	<0.0051			
	Nitrate (as N) (mg/L)	<0.0050	<0.0050			
	Nitrite (as N) (mg/L)	<0.0010	<0.0010			
	Total Kjeldahl Nitrogen (mg/L)	<0.050	<0.050			
	Total Nitrogen (mg/L)	<0.030	<0.030			
	Orthophosphate-Dissolved (as P) (mg/L)	<0.0010	<0.0010			
	Phosphorus (P)-Total Dissolved (mg/L)	<0.0020	<0.0020			
	Phosphorus (P)-Total (mg/L)	<0.0020	<0.0020			
	Silicate (as SiO2) (mg/L)	<0.50	<0.50			
	Sulfate (SO4) (mg/L)	<0.30	<0.30			
	Anion Sum (meq/L)	<0.10	<0.10			
	Cation Sum (meq/L)	<0.10	<0.10			
	Cation - Anion Balance (%)	0.0	0.0			
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	<0.50				
	Total Organic Carbon (mg/L)	<0.50	<0.50			
Total Metals	Aluminum (Al)-Total (mg/L)	<0.0050	<0.0050			
	Antimony (Sb)-Total (mg/L)	<0.00050	<0.00050			
	Arsenic (As)-Total (mg/L)	<0.00050	<0.00050			
	Barium (Ba)-Total (mg/L)	<0.020	<0.020			
	Beryllium (Be)-Total (mg/L)	<0.00010	<0.00010			
	Bismuth (Bi)-Total (mg/L)	<0.20	<0.20			

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2011209-1	L2011209-2	L2011209-3	L2011209-4	L2011209-5
	Description	Water	Water	Water	Water	Water
	Sampled Date	20-OCT-17	20-OCT-17	20-OCT-17	20-OCT-17	20-OCT-17
	Sampled Time	14:20	14:50	17:45	17:10	
	Client ID	WILLISTON SHALLOW (W1 - SHALLOW)	WILLISTON DEEP (W1 - DEEP)	DINOSAUR SHALLOW (D1 - SHALLOW)	DINOSAUR DEEP (D1 - DEEP)	DUPLICATE 1 (DUP 1)
Grouping	**Analyte**					
WATER						
Total Metals	Boron (B)-Total (mg/L)	<0.10	<0.10	<0.10	<0.10	<0.10
	Cadmium (Cd)-Total (mg/L)	0.0000123	0.0000140	0.0000174	0.0000152	0.0000131
	Calcium (Ca)-Total (mg/L)	24.3	24.5	25.1	25.2	25.6
	Chromium (Cr)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Cobalt (Co)-Total (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
	Copper (Cu)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Iron (Fe)-Total (mg/L)	<0.030	<0.030	0.048	0.046	0.038
	Lead (Pb)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Lithium (Li)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Magnesium (Mg)-Total (mg/L)	5.66	5.67	5.66	5.63	5.72
	Manganese (Mn)-Total (mg/L)	0.00154	0.00151	0.00229	0.00209	0.00205
	Mercury (Hg)-Total (ug/L)	<0.00050	<0.00050	<0.00050	0.00054	<0.00050
	Molybdenum (Mo)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Nickel (Ni)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Phosphorus (P)-Total (mg/L)	<0.30	<0.30	<0.30	<0.30	<0.30
	Potassium (K)-Total (mg/L)	<2.0	<2.0	<2.0	<2.0	<2.0
	Selenium (Se)-Total (mg/L)	0.000246	0.000233	0.000249	0.000267	0.000240
	Silicon (Si)-Total (mg/L)	2.07	2.05	2.11	2.10	2.11
	Silver (Ag)-Total (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Sodium (Na)-Total (mg/L)	<2.0	<2.0	<2.0	<2.0	<2.0
	Strontium (Sr)-Total (mg/L)	0.0921	0.0937	0.0956	0.0952	0.0972
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Titanium (Ti)-Total (mg/L)	<0.010	<0.010	<0.010	<0.010	<0.010
	Uranium (U)-Total (mg/L)	0.00041	0.00046	0.00048	0.00047	0.00048
	Vanadium (V)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Zinc (Zn)-Total (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Dissolved Metals	Dissolved MeHg Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0053	0.0076	0.0057	0.0074	0.0056
	Antimony (Sb)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Arsenic (As)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Barium (Ba)-Dissolved (mg/L)	0.030	0.029	0.029	0.030	0.030
	Beryllium (Be)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Bismuth (Bi)-Dissolved (mg/L)	<0.20	<0.20	<0.20	<0.20	<0.20
	Boron (B)-Dissolved (mg/L)	<0.10	<0.10	<0.10	<0.10	<0.10

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2011209-6	L2011209-7			
	Description	Water	Water			
	Sampled Date	20-OCT-17	20-OCT-17			
	Sampled Time					
	Client ID	FIELD BLANK	TRAVEL BLANK			
Grouping	**Analyte**					
WATER						
Total Metals	Boron (B)-Total (mg/L)	<0.10	<0.10			
	Cadmium (Cd)-Total (mg/L)	<0.0000050	<0.0000050			
	Calcium (Ca)-Total (mg/L)	<0.10	<0.10			
	Chromium (Cr)-Total (mg/L)	<0.0010	<0.0010			
	Cobalt (Co)-Total (mg/L)	<0.00030	<0.00030			
	Copper (Cu)-Total (mg/L)	<0.0010	<0.0010			
	Iron (Fe)-Total (mg/L)	<0.030	<0.030			
	Lead (Pb)-Total (mg/L)	<0.00050	<0.00050			
	Lithium (Li)-Total (mg/L)	<0.0010	<0.0010			
	Magnesium (Mg)-Total (mg/L)	<0.10	<0.10			
	Manganese (Mn)-Total (mg/L)	0.00014	<0.00010			
	Mercury (Hg)-Total (ug/L)	<0.00050				
	Molybdenum (Mo)-Total (mg/L)	<0.0010	<0.0010			
	Nickel (Ni)-Total (mg/L)	<0.0010	<0.0010			
	Phosphorus (P)-Total (mg/L)	<0.30	<0.30			
	Potassium (K)-Total (mg/L)	<2.0	<2.0			
	Selenium (Se)-Total (mg/L)	<0.000050	<0.000050			
	Silicon (Si)-Total (mg/L)	<0.10	<0.10			
	Silver (Ag)-Total (mg/L)	<0.000020	<0.000020			
	Sodium (Na)-Total (mg/L)	<2.0	<2.0			
	Strontium (Sr)-Total (mg/L)	<0.0050	<0.0050			
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010			
	Tin (Sn)-Total (mg/L)	<0.00050	<0.00050			
	Titanium (Ti)-Total (mg/L)	<0.010	<0.010			
	Uranium (U)-Total (mg/L)	<0.00020	<0.00020			
	Vanadium (V)-Total (mg/L)	<0.00050	<0.00050			
	Zinc (Zn)-Total (mg/L)	<0.0050	<0.0050			
Dissolved Metals	Dissolved MeHg Filtration Location	FIELD				
	Dissolved Mercury Filtration Location	FIELD				
	Dissolved Metals Filtration Location	FIELD				
	Aluminum (Al)-Dissolved (mg/L)	<0.0050				
	Antimony (Sb)-Dissolved (mg/L)	<0.00050				
	Arsenic (As)-Dissolved (mg/L)	<0.00050				
	Barium (Ba)-Dissolved (mg/L)	<0.020				
	Beryllium (Be)-Dissolved (mg/L)	<0.00010				
	Bismuth (Bi)-Dissolved (mg/L)	<0.20				
	Boron (B)-Dissolved (mg/L)	<0.10				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2011209-1 Water 20-OCT-17 14:20 WILLISTON SHALLOW (W1 - SHALLOW)	L2011209-2 Water 20-OCT-17 14:50 WILLISTON DEEP (W1 - DEEP)	L2011209-3 Water 20-OCT-17 17:45 DINOSAUR SHALLOW (D1 - SHALLOW)	L2011209-4 Water 20-OCT-17 17:10 DINOSAUR DEEP (D1 - DEEP)	L2011209-5 Water 20-OCT-17 DUPLICATE 1 (DUP 1)
WATER						
Dissolved Metals	Cadmium (Cd)-Dissolved (mg/L)	0.0000079	0.0000099	0.0000084	0.0000079	0.0000072
	Calcium (Ca)-Dissolved (mg/L)	22.5	24.8	26.0	25.5	26.3
	Chromium (Cr)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Cobalt (Co)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
	Copper (Cu)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Iron (Fe)-Dissolved (mg/L)	<0.030	<0.030	<0.030	<0.030	<0.030
	Lead (Pb)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Lithium (Li)-Dissolved (mg/L)	0.0011	0.0010	0.0010	0.0011	0.0012
	Magnesium (Mg)-Dissolved (mg/L)	5.52	5.66	5.56	5.62	5.68
	Manganese (Mn)-Dissolved (mg/L)	0.00035	0.00060	0.00058	0.00063	0.00055
	Mercury (Hg)-Dissolved (ug/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Molybdenum (Mo)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Nickel (Ni)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Phosphorus (P)-Dissolved (mg/L)	<0.30	<0.30	<0.30	<0.30	<0.30
	Potassium (K)-Dissolved (mg/L)	<2.0	<2.0	<2.0	<2.0	<2.0
	Selenium (Se)-Dissolved (mg/L)	0.000246	0.000216	0.000242	0.000224	0.000209
	Silicon (Si)-Dissolved (mg/L)	1.99	2.00	1.99	2.03	2.03
	Silver (Ag)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Sodium (Na)-Dissolved (mg/L)	<2.0	<2.0	<2.0	<2.0	<2.0
	Strontium (Sr)-Dissolved (mg/L)	0.0856	0.0936	0.0960	0.0961	0.0970
	Thallium (Tl)-Dissolved (mg/L)	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
	Tin (Sn)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Titanium (Ti)-Dissolved (mg/L)	<0.010	<0.010	<0.010	<0.010	<0.010
	Uranium (U)-Dissolved (mg/L)	0.00039	0.00042	0.00043	0.00043	0.00043
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Zinc (Zn)-Dissolved (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Speciated Metals	Methylmercury (as MeHg)-Dissolved (ug/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Methylmercury (as MeHg)-Total (ug/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2011209-6	L2011209-7			
	Description	Water	Water			
	Sampled Date	20-OCT-17	20-OCT-17			
	Sampled Time					
	Client ID	FIELD BLANK	TRAVEL BLANK			
Grouping	**Analyte**					
WATER						
Dissolved Metals	Cadmium (Cd)-Dissolved (mg/L)	<0.0000050				
	Calcium (Ca)-Dissolved (mg/L)	<0.10				
	Chromium (Cr)-Dissolved (mg/L)	<0.0010				
	Cobalt (Co)-Dissolved (mg/L)	<0.00030				
	Copper (Cu)-Dissolved (mg/L)	<0.0010				
	Iron (Fe)-Dissolved (mg/L)	<0.030				
	Lead (Pb)-Dissolved (mg/L)	<0.00050				
	Lithium (Li)-Dissolved (mg/L)	<0.0010				
	Magnesium (Mg)-Dissolved (mg/L)	<0.10				
	Manganese (Mn)-Dissolved (mg/L)	0.00010 RRV				
	Mercury (Hg)-Dissolved (ug/L)	<0.00050				
	Molybdenum (Mo)-Dissolved (mg/L)	<0.0010				
	Nickel (Ni)-Dissolved (mg/L)	<0.0010				
	Phosphorus (P)-Dissolved (mg/L)	<0.30				
	Potassium (K)-Dissolved (mg/L)	<2.0				
	Selenium (Se)-Dissolved (mg/L)	<0.000050				
	Silicon (Si)-Dissolved (mg/L)	<0.050				
	Silver (Ag)-Dissolved (mg/L)	<0.000020				
	Sodium (Na)-Dissolved (mg/L)	<2.0				
	Strontium (Sr)-Dissolved (mg/L)	<0.0050				
	Thallium (Tl)-Dissolved (mg/L)	<0.00020				
	Tin (Sn)-Dissolved (mg/L)	<0.00050				
	Titanium (Ti)-Dissolved (mg/L)	<0.010				
	Uranium (U)-Dissolved (mg/L)	<0.00020				
	Vanadium (V)-Dissolved (mg/L)	<0.00050				
	Zinc (Zn)-Dissolved (mg/L)	<0.0050				
Speciated Metals	Methylmercury (as MeHg)-Dissolved (ug/L)	<0.000050				
	Methylmercury (as MeHg)-Total (ug/L)	<0.000050	<0.000050			

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Total Organic Carbon	MS-B	L2011209-3, -4, -5, -6, -7
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2011209-1, -2, -3, -4, -5, -6
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2011209-1, -2, -3, -4, -5, -6
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2011209-1, -2, -3, -4, -5, -6
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2011209-1, -2, -3, -4, -5, -6
Matrix Spike	Aluminum (Al)-Total	MS-B	L2011209-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Calcium (Ca)-Total	MS-B	L2011209-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Manganese (Mn)-Total	MS-B	L2011209-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Strontium (Sr)-Total	MS-B	L2011209-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Total Nitrogen	MS-B	L2011209-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Total Nitrogen	MS-B	L2011209-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Nitrate (as N)	MS-B	L2011209-3, -4, -6, -7

Qualifiers for Individual Parameters Listed:

Qualifier	Description
HTC	Hardness was calculated from Total Ca and/or Mg concentrations and may be biased high (dissolved Ca/Mg results unavailable).
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.
RRV	Reported Result Verified By Repeat Analysis

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

ANIONS-N+N-CALC-VA	Water	Nitrite & Nitrate in Water (Calculation)	EPA 300.0

Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).

BR-L-IC-N-VA	Water	Bromide in Water by IC (Low Level)	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

CARBONS-DOC-VA	Water	Dissolved organic carbon by combustion	APHA 5310B TOTAL ORGANIC CARBON (TOC)

This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis.

CARBONS-TOC-VA	Water	Total organic carbon by combustion	APHA 5310B TOTAL ORGANIC CARBON (TOC)

This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)".

CHLOROA-F-VA	Filter	Chlorophyll a by Fluorometer (Filter)	EPA 445.0

This analysis is done using procedures modified from EPA Method 445.0. Chlorophyll-a is determined by a routine acetone extraction followed with analysis by fluorometry using the non-acidification procedure. This method is not subject to interferences from chlorophyll b.

CL-IC-N-VA	Water	Chloride in Water by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

COLOUR-TRUE-VA	Water	Colour (True) by Spectrometer	BCMOE Colour Single Wavelength

This analysis is carried out using procedures adapted from British Columbia Environmental Manual "Colour- Single Wavelength." Colour (True Colour) is determined by filtering a sample through a 0.45 micron membrane filter followed by analysis of the filtrate using the platinum-cobalt colourimetric method.
Colour measurements can be highly pH dependent, and apply to the pH of the sample as received (at time of testing), without pH adjustment. Concurrent measurement of sample pH is recommended.

EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510

Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.

F-IC-N-VA	Water	Fluoride in Water by IC	EPA 300.1 (mod)

Reference Information

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

HARDNESS-CALC-VA Water Hardness APHA 2340B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HG-D-U-CVAF-VA Water Diss. Mercury in Water by CVAFS (Ultra) APHA 3030 B / EPA 1631 REV. E

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from Method 1631 Rev. E. by the United States Environmental Protection Agency (EPA). The procedure may involve preliminary sample treatment by filtration (APHA 3030B) and involves a cold-oxidation of the acidified sample using bromine monochloride prior to a purge and trap concentration step and final reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry.

HG-T-U-CVAF-VA Water Total Mercury in Water by CVAFS (Ultra) EPA 1631 REV. E

This analysis is carried out using procedures adapted from Method 1631 Rev. E. by the United States Environmental Protection Agency (EPA). The procedure involves a cold-oxidation of the acidified sample using bromine monochloride prior to a purge and trap concentration step and final reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry.

IONBALANCE-VA Water Ion Balance Calculation APHA 1030E

Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:

Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum]

MEHG-D-GCAF-VA Water Diss. Methylmercury in Water by GCAFS EPA 1630

This method follows Method 1630 of the US EPA. Samples are distilled under an inert gas flow to isolate methylmercury and minimize matrix interferences. The distillate is analyzed by aqueous phase ethylation, purge and trap, desorption and GC separation. The separated species are then pyrolized to elemental Hg and quantified by cold vapour atomic flourescence spectroscopy. Results are reported "as MeHg".

MEHG-T-GCAF-VA Water Total Methylmercury in Water by GCAFS EPA 1630

This method follows Method 1630 of the US EPA. Samples are distilled under an inert gas flow to isolate methylmercury and minimize matrix interferences. The distillate is analyzed by aqueous phase ethylation, purge and trap, desorption and GC separation. THe separated species are then pyrolized to elemental Hg and quantified by cold vapour atomic flourescence spectroscopy. Results are reported "as MeHg".

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

N-T-COL-VA Water Total Nitrogen in water by Colour APHA4500-P(J)/NEMI9171/USGS03-4174

This analysis is carried out using procedures adapted from APHA Method 4500-P (J) "Persulphate Method for Simultaneous Determination of Total Nitrogen and Total Phosphorus" and National Environmental Methods Index - Nemi method 5735.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-VA Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-VA Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

P-T-PRES-COL-VA Water Total P in Water by Colour APHA 4500-P Phosphorus

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorus is determined colourimetrically after persulphate digestion of the sample.
Samples with very high dissolved solids (i.e. seawaters, brackish waters) may produce a negative bias by this method. Alternate methods are available for these types of samples.

Reference Information

Arsenic (5+), at elevated levels, is a positive interference on colourimetric phosphate analysis.

P-TD-COL-VA Water Total Dissolved P in Water by Colour APHA 4500-P Phosphorous

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Dissolved Phosphorus is determined colourimetrically after persulphate digestion of a sample that has been lab or field filtered through a 0.45 micron membrane filter.
Samples with very high dissolved solids (i.e. seawaters, brackish waters) may produce a negative bias by this method. Alternate methods are available for these types of samples.

Arsenic (5+), at elevated levels, is a positive interference on colourimetric phosphate analysis.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

PO4-DO-COL-VA Water Diss. Orthophosphate in Water by Colour APHA 4500-P Phosphorus

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Dissolved Orthophosphate is determined colourimetrically on a sample that has been lab or field filtered through a 0.45 micron membrane filter.
Samples with very high dissolved solids (i.e. seawaters, brackish waters) may produce a negative bias by this method. Alternate methods are available for these types of samples.

Arsenic (5+), at elevated levels, is a positive interference on colourimetric phosphate analysis.

SILICATE-COL-VA Water Silicate by Colourimetric analysis APHA 4500-SiO2 E.

This analysis is carried out using procedures adapted from APHA Method 4500-SiO2 E. "Silica". Silicate (molybdate-reactive silica) is determined by the molybdosilicate-heteropoly blue colourimetric method.

SO4-IC-N-VA Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-CALC-VA Water TDS (Calculated) APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".
The Total Dissolved Solids result is calculated from measured concentrations of anions and cations in the sample.

TKN-F-VA Water TKN in Water by Fluorescence APHA 4500-NORG D.

This analysis is carried out using procedures adapted from APHA Method 4500-Norg D. "Block Digestion and Flow Injection Analysis". Total Kjeldahl Nitrogen is determined using block digestion followed by Flow-injection analysis with fluorescence detection.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.
Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

TURBIDITY-VA Water Turbidity by Meter APHA 2130 Turbidity

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

Reference Information

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Tetra Tech Canada Inc.
ATTN: Danielle MacDonald
14940 - 123 Avenue, NW
Edmonton AB T5V 1B4

Date Received: 22-OCT-17
Report Date: 08-NOV-17 16:02 (MT)
Version: FINAL

Client Phone: 780-886-3055

Certificate of Analysis

Lab Work Order #: L2011210

Project P.O. #: NOT SUBMITTED
Job Reference: VENW03060
C of C Numbers:
Legal Site Desc:

Brent Mack, B.Sc.
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2011210-1	L2011210-2	L2011210-3		
Description	Soil	Soil	Soil		
Sampled Date	20-OCT-17	20-OCT-17	20-OCT-17		
Sampled Time	15:00	18:00			
Client ID	WILLISTON (W1)	DINOSAUR (D1)	DUPLICATE 1 (DUP 1)		
Grouping / **Analyte**					
SOIL					
Physical Tests pH (1:2 soil:water) (pH)	8.56	8.00	8.16		
Particle Size % Gravel (>2mm) (%)	<1.0	1.5	<1.0		
% Sand (2.00mm - 1.00mm) (%)	<1.0	<1.0	<1.0		
% Sand (1.00mm - 0.50mm) (%)	<1.0	1.1	<1.0		
% Sand (0.50mm - 0.25mm) (%)	1.9	7.2	1.7		
% Sand (0.25mm - 0.125mm) (%)	7.7	23.8	19.7		
% Sand (0.125mm - 0.063mm) (%)	3.4	23.9	24.3		
% Silt (0.063mm - 0.0312mm) (%)	5.0	18.3	23.3		
% Silt (0.0312mm - 0.004mm) (%)	25.9	17.8	24.0		
% Clay (<4um) (%)	55.8	5.6	5.6		
Texture	Clay	Sandy loam	Sandy loam		
Leachable Anions & Nutrients Total Kjeldahl Nitrogen (%)	0.075	0.095	0.073		
Anions and Nutrients Total Nitrogen by LECO (%)	0.137	0.132	0.112		
Organic / Inorganic Carbon Total Organic Carbon (%)	0.91	1.47	0.989		
Plant Available Nutrients Available Ammonium-N (mg/kg)	1.8	2.5	3.5		
Nitrate+Nitrite-N (mg/kg)	<2.0	<2.0	<2.0		
Nitrate-N (mg/kg)	<2.0	<2.0	<2.0		
Nitrite-N (mg/kg)	<0.40	<0.40	0.51		
Available Phosphate-P (mg/kg)	2.3	4.0	6.4		
Metals Aluminum (Al) (mg/kg)	8670	7220	6350		
Antimony (Sb) (mg/kg)	0.93	0.73	0.67		
Arsenic (As) (mg/kg)	6.11	6.47	6.22		
Barium (Ba) (mg/kg)	120	284	291		
Beryllium (Be) (mg/kg)	0.32	0.37	0.33		
Bismuth (Bi) (mg/kg)	<0.20	<0.20	<0.20		
Boron (B) (mg/kg)	<5.0	5.4	5.3		
Cadmium (Cd) (mg/kg)	1.04	1.07	0.761		
Calcium (Ca) (mg/kg)	44400	19500	15900		
Chromium (Cr) (mg/kg)	22.8	18.3	18.8		
Cobalt (Co) (mg/kg)	14.7	6.92	6.15		
Copper (Cu) (mg/kg)	19.8	15.4	13.2		
Iron (Fe) (mg/kg)	20000	18000	17700		
Lead (Pb) (mg/kg)	9.03	9.04	7.92		
Lithium (Li) (mg/kg)	11.8	9.0	7.6		
Magnesium (Mg) (mg/kg)	10500	7490	6090		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2011210-1 Soil 20-OCT-17 15:00 WILLISTON (W1)	L2011210-2 Soil 20-OCT-17 18:00 DINOSAUR (D1)	L2011210-3 Soil 20-OCT-17 DUPLICATE 1 (DUP 1)		
Sample ID						
Description						
Sampled Date						
Sampled Time						
Client ID						
SOIL						
Metals	Manganese (Mn) (mg/kg)	691	313	284		
	Mercury (Hg) (mg/kg)	0.0204	0.0344	0.0298		
	Molybdenum (Mo) (mg/kg)	1.43	1.05	0.95		
	Nickel (Ni) (mg/kg)	40.6	22.3	19.9		
	Phosphorus (P) (mg/kg)	623	825	794		
	Potassium (K) (mg/kg)	1130	1260	1240		
	Selenium (Se) (mg/kg)	0.35	0.36	0.33		
	Silver (Ag) (mg/kg)	<0.10	0.19	0.15		
	Sodium (Na) (mg/kg)	115	75	71		
	Strontium (Sr) (mg/kg)	98.5	50.1	45.2		
	Sulfur (S) (mg/kg)	<1000	<1000	<1000		
	Thallium (Tl) (mg/kg)	0.202	0.166	0.143		
	Tin (Sn) (mg/kg)	<2.0	<2.0	<2.0		
	Titanium (Ti) (mg/kg)	292	<110 DLM	126		
	Tungsten (W) (mg/kg)	<0.50	<0.50	<0.50		
	Uranium (U) (mg/kg)	0.722	0.651	0.628		
	Vanadium (V) (mg/kg)	45.2	40.8	41.3		
	Zinc (Zn) (mg/kg)	67.4	78.7	66.0		
	Zirconium (Zr) (mg/kg)	4.5	1.3	1.2		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
C-TIC-PCT-SK	Soil	Total Inorganic Carbon in Soil	CSSS (2008) P216-217

A known quantity of acetic acid is consumed by reaction with carbonates in the soil. The pH of the resulting solution is measured and compared against a standard curve relating pH to weight of carbonate.

C-TOC-CALC-SK	Soil	Total Organic Carbon Calculation	CSSS (2008) 21.2

Total Organic Carbon (TOC) is calculated by the difference between total carbon (TC) and total inorganic carbon. (TIC)

C-TOT-LECO-SK	Soil	Total Carbon by combustion method	CSSS (2008) 21.2

The sample is ignited in a combustion analyzer where carbon in the reduced CO2 gas is determined using a thermal conductivity detector.

HG-200.2-CVAF-VA	Soil	Mercury in Soil by CVAFS	EPA 200.2/1631E (mod)

Soil samples are digested with nitric and hydrochloric acids, followed by analysis by CVAFS.

IC-CACO3-CALC-SK	Soil	Inorganic Carbon as CaCO3 Equivalent	Calculation
MET-200.2-CCMS-VA	Soil	Metals in Soil by CRC ICPMS	EPA 200.2/6020A (mod)

This method uses a heated strong acid digestion with HNO3 and HCl and is intended to liberate metals that may be environmentally available. Silicate minerals are not solubilized. Dependent on sample matrix, some metals may be only partially recovered, including Al, Ba, Be, Cr, Sr, Ti, Tl, V, W, and Zr. Volatile forms of sulfur (including sulfide) may not be captured, as they may be lost during sampling, storage, or digestion. Analysis is by Collision/Reaction Cell ICPMS.

N-TOT-LECO-SK	Soil	Total Nitrogen by combustion method	CSSS (2008) 22.4

The sample is ignited in a combustion analyzer where nitrogen in the reduced nitrous oxide gas is determined using a thermal conductivity detector.

N-TOTKJ-COL-SK	Soil	Total Kjeldahl Nitrogen	CSSS (2008) 22.2.3

The soil is digested with sulfuric acid in the presence of CuSO4 and K2SO4 catalysts. Ammonia in the soil extract is determined colrimetrically at 660 nm.

N2/N3-AVAIL-SK	Soil	Nitrate, Nitrite and Nitrate+Nitrite-N	APHA 4500 NO3F

Available Nitrate and Nitrite are extracted from the soil using a dilute calcium chloride solution. Nitrate plus Nitrite is quantitatively reduced to nitrite by passage of the sample through a copperized cadmium column. The nitrite (reduced nitrate plus original nitrite) is then determined by diazotizing with sulfanilamide followed by coupling with N-(1-naphthyl) ethylenediamine dihydrochloride. The resulting water soluble dye has a magenta color which is measured at colorimetrically at 520nm. Nitrite is determined on the same extract by following the same instrumental procedure without a cadmium column.
Reference: Recommended Methods of Soil Analysis for Canadian Prairie Agricultural Soils. Alberta Agriculture (1988) p. 19 and 28

NH4-AVAIL-SK	Soil	Available Ammonium-N	Comm Soil Sci 19(6)

Ammonium (NH4-N) is extracted from the soil using 2 N KCl. Ammonium in the extract is mixed with hypochlorite and salicylate to form indophenol blue, which is determined colorimetrically by auto analysis at 660 nm.

PH-1:2-VA	Soil	pH in Soil (1:2 Soil:Water Extraction)	BC WLAP METHOD: PH, ELECTROMETRIC, SOIL

This analysis is carried out in accordance with procedures described in the pH, Electrometric in Soil and Sediment method - Section B Physical/Inorganic and Misc. Constituents, BC Environmental Laboratory Manual 2007. The procedure involves mixing the dried (at <60°C) and sieved (No. 10 / 2mm) sample with deionized/distilled water at a 1:2 ratio of sediment to water. The pH of the solution is then measured using a standard pH probe.

PO4-AVAIL-SK	Soil	Available Phosphate-P	Comm. Soil Sci. Plant Anal. 25 (5&6)

Plant available phosphorus is extracted from the soil using Modified Kelowna solution. Phosphorous in the soil extract is determined colorimetrically at 880 nm.

PSA-PIPET-DETAIL-SK	Soil	Particle size - Sieve and Pipette	SSIR-51 METHOD 3.2.1

Particle size distribution is determined by a combination of techniques. Dry sieving is performed for coarse particles, wet sieving for sand particles and the pipette sedimentation method for clay particles.

Reference:

Reference Information

Burt, R. (2009). Soil Survey Field and Laboratory Methods Manual. Soil Survey Investigations Report No. 5. Method 3.2.1.2.2. United States Department of Agriculture Natural Resources Conservation Service.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
SK	ALS ENVIRONMENTAL - SASKATOON, SASKATCHEWAN, CANADA
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

APPENDIX B
LIMITATIONS ON THE USE OF THIS DOCUMENT