Regional District of
Kitimat-Stikine

2020 FORCEMAN RIDGE WASTE MANAGEMENT FACILITY ANNUAL REPORT

June 2021

Prepared for:

British Columbia Ministry of
Environment & Climate Change
Strategy
EnvAuthorizationsReporting@gov.bc.ca

Prepared by:

Regional District of Kitimat-Stikine
Suite 300 - 4545 Lazelle Avenue
Terrace, BC V8G 4E1

Forceman Ridge Waste Management Facility Overview

The Forceman Ridge Waste Management Facility (herein referred to as the Forceman Ridge WMF) opened in November 2016 and is owned and operated by the Regional District of Kitimat-Stikine (Regional District or RDKS). It is located 30 km south of the City of Terrace at 3112 Highway 37. Access is via the Chist Creek Forest Service Road.

Forceman Ridge WMF is responsible for the management of municipal solid and liquid waste generated from commercial and residential sources in the Greater Terrace area in accordance with the Regional District Kitimat-Stikine Solid Waste Management Plan (1995). The majority of solid waste received is consolidated at the Thornhill Transfer Station, also owned and managed by the Regional District, and hauled to Forceman Ridge WMF for final disposal.

Landfill operations are regulated by the Ministry of Environment's Operation Certificate MR-17227, issued in November 2008, most recently amended in September 2019. Operations are conducted in accordance with the Forceman Ridge Landfill Design Operations and Closure Plan prepared by Sperling Hansen Associates in 2017.

The footprint for the entire Waste Management Facility is 53.5 ha in size; this area includes buffer reserves. Forceman WMF contains a compost facility, septage receiving facility, an engineered landfill, five stage leachate treatment and detection system, and a phytoremediation orchard. Currently the landfill filling is in Phase 1A.

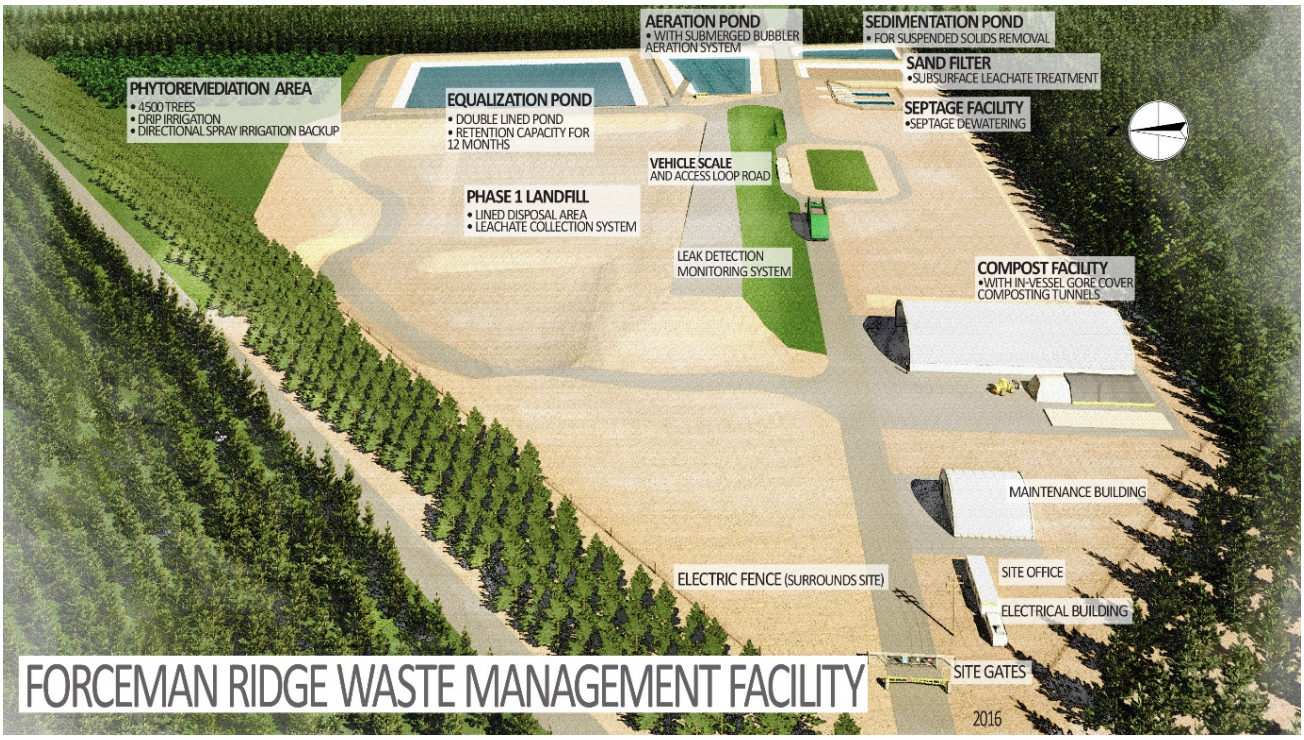

Figure 1 Overview Forceman Ridge Waste Management Facility

The landfill is double lined with a high-density polyethylene and clay matting composite with leachate capture. Captured leachate is pumped to the 90,000 m^3 equalization pond. Leachate is pumped from the equalization pond to the aeration pond, which has 30 diffusers for bio-oxidation treatment. After treatment in the aeration pond, leachate flows passively to the sedimentation pond, which allows for settling of biomasses and suspended solids. Treated leachate is then sent through a sand filter and discharged to the phytoremediation orchard. The details of the Facility water quality monitoring program, including results of groundwater, surface water, and treated leachate discharge monitoring are discussed in the *Forceman Ridge Waste Management Facility 2020 Annual Water Quality Monitoring Report*, prepared by Sperling Hansen Associates and contained in Appendix A of this report. An overview of the Forceman WMF is shown in Figure 1.

Landfill gas management has not yet begun at the landfill. Development of a landfill gas generation model is in progress to estimate gas volumes.

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1.0 Introduction

This annual report covers the period from January to December 2020 and has been prepared to fulfill the requirements of the Forceman Ridge Landfill Operational Certificate MR-17227.

Issued by the Ministry of Environment in November 2008, and amended in September 2019, the Operational Certificate authorizes the discharge of municipal solid and liquid wastes and outlines the criteria for environmental and human protection at the Forceman Ridge WMF.

This report meets the requirements in Section 14.2 of the Operational Certificate by providing the following information:

- Total volume or tonnage of waste discharged to the landfill during 2020;
- Total volume or tonnage of waste composted during 2020;
- Total volume or tonnage of waste recycled and diverted during 2020;
- Total volume of sewage waste collected in the septage receiving facility during 2020;
- Total volume of leachate generated by the landfill during 2020;
- Occurrences or observations of wildlife attempting to access the facility; and
- The results and evaluation the 2020 water quality monitoring program was completed by Sperling Hansen Associates, and is contained in Appendix A.

2.0 Waste Disposal

The Forceman Ridge WMF serves residents and business in the Greater Terrace area. In 2020, the population that utilized the landfill was approximately 19,500. The facility also accepts waste from industrial sources and contaminated soils from outside the designated service area. In 2020, out-of-service-area wastes were charged a 25% surcharge on tipping fees.

2.1 Solid Waste Disposal

Solid waste collected through curbside collection programs or self-hauled to the Thornhill Transfer Station is sorted, compacted, and hauled to the Forceman Ridge WMF. In 2020, a total of 15,289.6 tonnes of municipal and industrial solid waste including garbage, construction and demolition waste, and various types of controlled waste were disposed of within Phase 1A, lifts 1 and 2 of the Forceman Ridge Landfill. The annual totals from January through to December 2020 of solid waste received at the Forceman Ridge WMF are shown in Table 1. Tonnages of diverted wastes are also included in the table.

The Forceman Ridge WMF accepts waste from tax-paying, “in-service area” users, as well as waste from non-taxpaying, “out-of-service area” users. Out-of-service area users refer large industry, short-term projects and/or camps within the region. Out-of-service area waste comprised 37% of the total waste landfilled and 75% of diverted waste at the Forceman Ridge WMF in 2020.

Table 1: Waste Discharge Quantities for 2020

Materials Landfilled	2020 Quantity* (Tonnes)		
	In Service Area	Out of Service Area	Total
Garbage received from Thornhill Transfer Station			
- Curbside Refuse - Residential Self-haul - Commercial Refuse - Construction & Demolition Waste	9,208.7		9,208.7
Controlled Wastes – Direct Haul to Forceman Ridge WMF			
Asbestos	57.02	12.59	69.61
Construction and Demolition	412.49	4,695.14	5,107.63
Concrete	1.46	90.41	91.87
Municipal-type garbage from Industry		797.15	797.15
Land Clearing	0.48		0.48
Sludge Cake		106.48	106.48
Total Waste Landfilled	**9,680.15**	**5,701.77**	**15,381.92**

*Waste material used as cover and road construction materials are not included in the waste discharge quantities.

Table 2: Waste Diversion Quantities for 2020

Materials Diverted from Landfill	2020 Quantity (Tonnes)		
	In Service Area	Out of Service Area	Total
Organics received from Thornhill Transfer Station	1,668.08	83.99	1,752.07
Septage as received - prior to dewatering**	1,045.53**	1,997.53**	3,043.06**
Dewatered Septage Solids to windrow	84.43		84.43
Contaminated Soils	850.85	8,313.9	9,164.44
Clean Wood Waste	60.74	576.65	637.39
Asphalt Roofing Shingles	3.7		3.7
Total Diverted Materials	**2,703.69**	**8,938.34**	**11,642.03**

**Septage tonnage prior to dewatering is not included in total for diverted materials, as dewatered septage solids are processed separately through windrowing on the landfill footprint (biosolids for future use as landfill cover).

2.1.1 Garbage

Garbage is defined as discharged materials, substances, or objects, not including controlled wastes, restricted wastes or prohibited wastes. Per the bylaw, these items are defined as:

- Controlled Waste - animal carcasses weighing more than 50 kg, asbestos, contaminated soils, construction and demolition or land clearing wastes over five cubic meters, clean soils, broken concrete, broken asphalt, ash from incinerators, and septage;

- Restricted Wastes - metal, organics, and recyclable materials;

- Prohibited Wastes - hazardous or radioactive waste, slaughter waste, smoldering or flammable material, explosive or highly combustible materials, broken concrete or asphalt 300 millimeters in diameter or greater, Extended Producer Responsibility (EPR) Materials, tires, and cardboard and paper products, whether or not they fall within the definition of EPR materials.

Garbage, not including the aforementioned items, is disposed of in the Landfill at the Forceman Ridge WMF. In 2020, 9,208.7 tonnes of in-service-area garbage were disposed of in the landfill.

2.1.2 Asbestos

Asbestos-containing waste generated within the Terrace service area from residential, commercial, and institutional customers is accepted in the Forceman Ridge Landfill through the Controlled Waste application process. Asbestos-containing waste is delivered to the landfill using approved containment methods and is accepted by scheduled appointment for immediate burial in the landfill.

In 2020, 69.61 tonnes of various forms of asbestos waste were disposed of in the Forceman Ridge landfill.

2.1.3 Construction and Demolition

Construction and demolition (C&D) waste materials are mainly wood waste, with soft construction materials like dry wall and insulation. C&D waste is defined as waste produced from the construction, renovation, and demolition of buildings and other structures, but does not include waste containing or contaminated with asbestos, creosote, polychlorinated biphenyl (PCBS) or any other Hazardous Waste.

In 2020, 5,199.5 tonnes of construction and demolition waste (including 91.87 tonnes of concrete) was disposed of in the Forceman Ridge landfill.

2.1.4 Waste from Industry

Waste generated from industrial sources outside of the Terrace Solid Waste Service Area (but generated within the Regional District) is referred to as out-of-service area waste. Most of the waste from industry coming to the Forceman WMF is generated from industrial work camps and construction sites related to liquified natural gas projects.

In 2020, 16,643.1 tonnes of waste were accepted from industrial sources from outside of the service area. Of this waste, 5,611.4 tonnes were landfilled, including refuse, construction and demolition waste, asbestos, and sludge cake. The remaining 11,031.7 tonnes accepted were divertible waste, including concrete, clean wood, contaminated soil, septage, and organic waste.

Sludge cake (sewage cake) comprised of dewatered septage solids from a wastewater treatment plant serving a work camp in Kitimat. This material was later determined in 2021 to be unauthorized and outside of the definition of MSW under the Operational Certificate and a temporary amendment was obtained to accept sewage cake for a four-week period. Notice was served to the waste generator during this period and acceptance of this waste stream was ultimately discontinued.

2.1.5 Land Clearing Debris

Land clearing debris is defined as waste produced from the clearing of land for development, including trunks, stumps, tree branches 75 millimeters in diameter or greater, tree tops, and whole trees. Land clearing debris does not include other organic materials, such as vegetative matter, tree branches under 75 millimeters, and compostable structural wood waste. Due to presence of rock and gravel within this land clearing debris, this material is often deposited in the landfill.

In 2020, 0.48 tonnes of land clearing debris were disposed of in the landfill.

3.0 Diverted Materials

Diverted materials are collected in several locations or methods, as follows: collected at the Thornhill Transfer Station, collected in curbside pick-up, collected by commercial haulers, or deposited at designated Extended Producer Responsibility (EPR) Stewardship Depots.

3.1 Clean Wood Waste

Clean Wood means wood that is free of glue, laminate, paint, treatment, and may include small metal fasteners but does not include plywood or OSB. Clean wood is segregated, and either burned as prescribed in the Operational Certificate or chipped and used as hog fuel in the compost facility.

In 2020, 637.39 tonnes total of clean wood waste was collected and diverted.

3.2 Contaminated Soils – Suitable for Landfill Cover

Contaminated soils are defined as soils that contain contaminants in concentrations less than “hazardous waste,” as defined by the Hazardous Waste Regulation.

In 2020, 9,164.7 tonnes of contaminated soils were collected and used as cover material on the landfill. Of this material, 91% was from out-of-service area users (generally industrial sources).

3.3 Extended Producer Responsibility (EPR) Products

The Regional District does not track the volume of EPR products (i.e., recyclables) that residents self-haul to the many recycling depots in the Terrace area. The City of Terrace provides curbside collection of Printed Paper & Packaging (PPP) for residents through Recycle BC. The RDKS also provides curbside collection of PPP recyclables for residents of Electoral Area E (Thornhill) and many regions of Electoral Area C (greater Terrace area). RDKS curbside collection for recyclables is currently managed outside of a contract with Recycle BC.

3.3.1 Septage

Septage is disposed of directly in the Forceman Ridge septage receiving facility. The facility has two lagoons (septage bays) available for disposal. Liquid from dewatering is treated in the leachate treatment system. Septage is defined as septic tank pumpage and treated sewage sludge, but does not include other sewage wastes (wastewater, sewage or slurry, including catch basins, oil water separators, or shop floor drains).

In 2020, 3,043.06 tonnes of septage were disposed of in the septage facility. Dewatered solids cleaned from the bottom of the septage bays are mixed with wood chips and the resulting product is windrowed in a designated location on the landfill footprint. In 2020, 84.43 tonnes of dewatered septage were transferred to the designated windrow for composting. The resulting biosolids will be utilized as final cover material for the landfill.

4.0 Organics Collection and Compost Facility

Since November 2016, Forceman Ridge WMF has operated a compost facility for residential, and institutional, commercial and industrial (ICI) organics in the Terrace area. Residential organics are collected curbside or residents can self-haul their organics to the Thornhill Transfer Station. Organics collection for businesses and industry is through contracted commercial haulers. Collected organics are taken to the Thornhill Transfer Station, consolidated and hauled to the Forceman Ridge Compost Facility. The City of Terrace operates a yard and garden waste collection from May to September for Terrace residents only; it is windrow composted and the finished product is used in municipal parks and community garden areas.

The Forceman Ridge Compost Facility utilizes a Gore® composting system and has the capability of producing Class A compost. The facility hosts three windrow stations inside a Mega-Dome®, and two curing bays outside. Collected organics are mixed with hog fuel collected from a local sawmill or from chipping diverted untreated and unprocessed wood residue. Temperature, oxygen, and moisture levels are monitored during the composting process. It takes approximately eight weeks to generate Class A compost. The finished compost is initially slated to be used as final cover material for final closure of the Thornhill Landfill, as well as to close future phases of the Forceman Ridge Landfill. Leachate from the compost facility is collected and stored in separate containment near the compost facility. The collected

leachate is used for additional moisture for the compost; any surplus of compost leachate is sent through the leachate treatment process.

In 2020, the Forceman Ridge WMF diverted 1,752.07 tonnes of organics to the Compost Facility. Of this, 83.99 tonnes were from out-of-service-area (i.e., industrial) sources.

5.0 Environmental Monitoring Report

Environmental monitoring for the Forceman Ridge WMF was conducted by the RDKS Environmental Technician, following Ministry of Environment and Climate Change Strategy, 2013 British Columbia Field Sampling Manual. In-situ and laboratory data for groundwater, surface water, and leachate estimates have been compiled, analyzed, and interpreted in the *Forceman Ridge Waste Management Facility 2020 Annual Water Quality Monitoring Report*, prepared by Sperling Hansen Associates (contained in Appendix A).

6.0 Wildlife Occurrences and Observations

The Forceman Ridge WMF is located in an area with bears, wolves, coyotes, several species of birds of prey, and many other species of mammals that may attempt access to the facility. To prevent wildlife from gaining access, the entire facility is enclosed in a 2.1-metre-high composite electrified fence. To prevent vectors from gaining access to the landfill active face, Revelstoke Iron Grizzly (RIG) plates are used as alternative daily cover and are positioned on the active face at the end of each day to cover all waste. Soil from site is used as intermediate cover.

Facility operators are required to inspect the fence line daily, testing for proper voltage, proper tension on fence stands, overall condition of the fence, and signs of wildlife activity. The results of the inspections are recorded on the Daily Operation Inspection Forms.

There were no mammalian wildlife incidents or encounters observed during 2020 at the Forceman Ridge WMF. There was minimal vector activity from birds, including raptor species (bald eagles), and corvid species (crows and ravens).

6.1 Bird Control

Birds, such as ravens and crows, are a nuisance at landfill sites, as they can scatter litter into the surrounding environment. Bird control at Forceman Ridge WMF is based on thorough and complete cover of waste. The active face is only exposed when a load of waste is delivered to the landfill. Between loads, the active face is covered with the RIG plates an alternative daily cover.

7.0 Landfill Gas Collection

Landfill gas collection and flaring has not been initiated at the Forceman Ridge WMF. The Forceman Ridge site is now in the planning and design stage of landfill gas collection.

8.0 Summary

During 2020, 15,381.92 tonnes of refuse, including garbage, construction and demolition materials, and controlled waste, were disposed in the Forceman Ridge landfill; 11,642.03 tonnes of materials were diverted from the landfill. Diverted materials include 1,752.07 tonnes of organics, 84.43 tonnes of dewatered septage, 9,164.44 tonnes of contaminated soils, 637.39 tonnes of clean wood and 3.7 tonnes of asphalt shingles.

There were no mammalian wildlife incidents or encounters observed during 2020 at the Forceman Ridge WMF. There was minimal vector activity from birds, including raptor species (bald eagles), and corvid species (crows and ravens).

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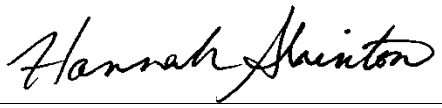
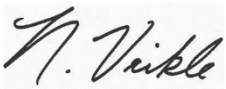


Hannah Shinton, B.Sc.
Environmental Technician
Regional District of Kitimat-Stikine
300 – 4545 Lazelle Avenue
Terrace, BC V8G 4E1
hshinton@rdks.bc.ca

Document reviewed by:



Nicki Veikle, B.Sc., A.Sc.T., A.Ag.
Environmental Coordinator
Regional District of Kitimat-Stikine
300 – 4545 Lazelle Avenue
Terrace, BC V8G 4E1
nveikle@rdks.bc.ca

Appendix A. Environmental Monitoring Report

Forceman Ridge Waste Management Facility 2020 Annual Water Quality Monitoring Report - FINAL -

PREPARED FOR: REGIONAL DISTRICT OF KITIMAT-STIKINE

PREPARED BY: SPERLING HANSEN ASSOCIATES

June 21, 2021

PRJ21014

SPERLING
HANSEN
ASSOCIATES

• Landfill Engineering
• Solid Waste Planning
• Environmental Monitoring
• Landfill Fire Control

June 21st, 2021 PRJ21014

Nicki Veikle
Regional District of Kitimat-Stikine
Suite 300, 4545 Lazelle Avenue
Terrace, B.C., V8G 4E1

RE: Forceman Ridge Waste Management Facility 2020 Annual Water Quality Monitoring Report

Sperling Hansen Associates is pleased to provide you with the Forceman Ridge Waste Management Facility 2020 Annual Water Quality Monitoring Report. This document reports on the site conditions, groundwater and surface water quality, leachate discharge characteristics as well as the monitoring program for 2020.

If you have any questions regarding this report or require any further information, please do not hesitate to contact the undersigned.

Yours truly,

SPERLING HANSEN ASSOCIATES

Carly Wolfe, EIT
Bioresource Engineer

EXECUTIVE SUMMARY

Sperling Hansen Associates (SHA) was retained by the Regional District of Kitimat-Stikine (RDKS) to prepare a 2020 Annual Water Quality Monitoring Report for the Forceman Ridge Waste Management Facility, which includes the Forceman Ridge Regional Landfill. This report details a review of the site conditions, groundwater and surface water quality monitoring results, groundwater flow analysis and leachate discharge characteristics for the year of 2020, as regulated by the Operational Certificate (OC) 17227, last amended on September 19, 2019. Of note, a temporary OC amendment was issued on November 3rd, 2020 to permit additional discharge for the year of 2020 only.

Analytical results in this report have been compared to the appropriate guidelines established in the OC. Groundwater results were compared to the Contaminated Sites Regulation (CSR) for Drinking Water (DW). Surface water guidelines were not specified in the OC but the results were compared to the British Columbia Water Quality Guidelines (BCWQG) for Aquatic Life (AW). Leachate data was compared to the OC specified discharge criteria. Lastly, soil guidelines were not specified in the OC but the soil data was compared to the CSR soil standards for DW and AW.

The groundwater monitoring program includes four groups of monitoring wells: 1) background wells for establishing uncontaminated ground water condition, 2) early warning wells to determine early signs of leachate impact, 3) compliance wells for regulatory compliance, and 4) groundwater flow direction wells for establishing groundwater flow conditions. Surface water samples were collected at five surface water monitoring locations at Onion Lake, Clearwater Lakes and the streams that drain these water bodies. In general, post landfill results for groundwater and surface water quality are similar to pre-landfill results, indicating no discernable impact from leachate at these locations. One exceedance of the CSR-DW standards was noted for nitrate at MW-08 which is a compliance monitoring well. Given that no other exceedances of the CSR DW standards occurred at MW-08 in 2020, the exceedance for nitrate at MW-08 is unlikely to be due to landfill leachate. Therefore, the reason for the nitrate exceedance at MW-08 is unknown at this time, however it could possibly be due to contamination by fertilizer. Follow up sampling in 2021 will verify if the exceedance was an anomaly or requires further investigation.

The groundwater flow velocity for the landfill was calculated to estimate the time required for leachate leaving the existing landfill to reach the down gradient environment. A porosity of 0.4 was selected for the soil. The porosity assumes the material is homogeneous. The resulting velocity is 1.5 meters per day which equates to a travel time of 4 years for groundwater to travel the 2.2 km from the edge of the Landfill footprint to Upper Clearwater Lake. However, this only serves as a rough estimate and does not consider localized soil stratigraphy or varying hydraulic conductivity across the site. Furthermore, these limitations also apply to areas outside the Landfill borders with the addition of varying flow depth.

The leachate monitoring plan is to confirm discharge compliance at the discharge compliance point, as specified by the OC. Sampling results indicate that leachate is highly diluted and treated by the time it reaches the discharge point. There were no exceedances of the OC criteria at the discharge compliance point in 2020.

Phytoremediation soil samples were taken once in 2020 to establish background soil conditions prior to leachate discharge, as stipulated by the OC. All results are compliant with the criteria and did not show signs of metals accumulation or excessive salinity in the phytoremediation soil.

The total volume of leachate discharged for the 2020 year was estimated using recorded pump hour data from Pump Station 5. Discharge occurred from June 16th, 2020 to November 10th, 2020, a period of 163 days. The RDKS was issued a temporary OC amendment to discharge leachate until November 9th, 2020 due to a large amount of precipitation that occurred during 2020. Over the discharge period, pump discharge hours totaled 977.4 hours at an estimated discharge rate of 53 m^3 per pump hour. Therefore, the calculated volume of leachate discharged onto the phytoremediation area was estimated to be 51,802.2 m^3 in 2020. The 2020 leachate discharge rate and volume are compliant with the OC.

Overall, environmental monitoring results indicate that the Landfill is not having any discernable impact on the surrounding environment.

SHA recommends that the following measures be taken:

- Continue the groundwater monitoring program as per the OC.
- Continue the surface water monitoring program as per the OC.
- Continue the leachate monitoring program as per the OC.
- Continue the soil sampling program as per the OC.
- Conduct a one-time sample for VOCs at the leachate discharge compliance point for background levels as per the OC.
- Analyze 2021 water quality at MW-08 to determine if exceedance of the CSR-DW criteria for nitrate in 2020 is a cause for concern.
- Monitor maximum flow readings from Pump #5 to ensure that the phytoremediation discharge does not exceed the OC discharge criteria.
- Continue to follow QA/QC guidelines for water quality sampling, including collection of one duplicate sample during each sample event.
- Obtain and keep current, the laboratory precision, accuracy and blank quality control criteria for each laboratory analyzed parameters from the analytical laboratory.
- If impacts to groundwater quality are observed, develop a dynamic groundwater flow model with MODFLOW software to interpret groundwater flow patterns and leachate plume migration. More monitoring well locations must be added to the network to confirm if the conceptual model is accurate.

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1. INTRODUCTION

Sperling Hansen Associates (SHA) was retained by the Regional District of Kitimat-Stikine (RDKS) to prepare a 2020 Annual Water Quality Monitoring Report for the Forceman Ridge Waste Management Facility (WMF), which includes the Forceman Ridge Regional Landfill (Landfill).

The Landfill is located approximately 30 kilometers (km) south of Terrace and 600 meters (m) off Highway 37 as shown on Figure 3-1. The legal location of the Landfill is described as District Lot 8128, Range 5, within the Coast District.

The Landfill operations began in November of 2016 when the Ministry of Environment and Climate Change Strategy (ENV) approved the Operational Certificate (OC) 17227 issued on November 7th, 2008. A copy of the most recent OC 17227 can be found in Appendix D. A copy of the temporary amendment for the OC issued on November 3rd, 2020 can also be found in Appendix D.

The OC requires that the quality of the constituents within the discharge at the Landfill are typical of municipal solid waste (MSW), the landfill must exclude all un-authorized special wastes, waste oils, automobiles, automobile batteries, appliances containing ozone depleting substances, large animal carcasses, and slaughter house or fish hatchery wastes and by-products. In addition, the OC requires all authorized liquid waste discharge shall be typical of septic tank pumpage, holding tank effluent, sewage treatment plant sludges, and wash water and grit from drain sumps at car and light truck wash facilities parking lots.

MSW residuals are being transferred in Titan end dump trailers from Thornhill Transfer Station to the Landfill's active phase. The Landfill will be expanded progressively in seven phases, each with several sub phases. Currently, only 2.1 Ha Phase 1A is being developed to an elevation of 238 m. Next, Phase 1B will be extended laterally to the west to the same 238 m elevation. Phase 1C and 1D will then be added to the north, followed by Phase 1E and 1F, also to the north. Phases 2 through 7 will then be piggy backed northward to elevation 252 m on top of Phase 1A to 1F.

Protection of groundwater resources was of paramount importance to the community during the Landfill sighting. Thus, a double geomembrane liner system, equipped with a leak detection system was added in Phase 1A to provide early warning of potential problems. The leachate treatment system situated on the east side of the landfill was designed for minimum impact as well. The system includes a 90,000 m^3 equalization lagoon capable of storing a full year of leachate production, an aeration lagoon complete with 30 diffusers, a sedimentation pond, a sand filter and a 2.5 Ha phytoremediation area planted with more than 4,000 poplar, alder and cottonwood trees. During the summer treatment season the trees will uptake most of the treated leachate that will be generated on this project, resulting in minimal discharge to the environment.

SHA developed the Landfill Design, Operations, and Closure Plan (DOCP), which presents the design and operational considerations for the Landfill (SHA, 2015). The DOCP provides a lifespan analysis and gives additional details on the environmental control systems as well as outlines environmental monitoring programs for groundwater, surface water, leachate discharge and phytoremediation soils sampling.

RDKS initiated their surface water and groundwater sampling monitoring program in 2017, with their first sampling event occurring in April of 2017. This report details a review of the site conditions, groundwater and surface water quality monitoring results, groundwater flow direction, and leachate discharge characteristics for the year of 2020, as regulated by the Operational Certificate (OC) 17227.

2. SCOPE OF WORK

The Operational Certificate and/or the DOCP stipulates that the following monitoring should be completed at the Landfill:

- Monthly measurements of field parameters (pH, conductivity, temperature, dissolved oxygen, turbidity, water level, and flow rate) from the leachate compliance point known as station F5, Treated Leachate Prior to Discharge to Phytoremediation Area. Sampling frequency reduced to quarterly after two complete years of sampling.
- Quarterly sampling of leachate station F5. Sampling frequency reduce to annually after two complete years of sampling.
- Continuous measurement of leachate discharge volume during seasonal discharge period.
- Annual sampling of a composite soil sample from the Phytoremediation Area, obtained prior to discharge each season.
- Monthly measurements of field parameters (pH, conductivity, temperature, and water level) from ten monitoring wells MW-02, MW-13, MW-01, MW-03, MW-04, MW-07, MW-08, MW-09, MW-15, and MW-16. Sampling frequency reduced to quarterly after two complete years of sampling.
- Quarterly measurements of water elevation from six monitoring wells MW-05, MW-06, MW-10, MW-11, MW-12, and MW-14.
- Quarterly sampling of ten monitoring wells MW-02, MW-13, MW-01, MW-03, MW-04, MW-07, MW-08, MW-09, MW-15, and MW-16. Sampling frequency reduced to annually after two complete years of sampling.
- Monthly measurements of field parameters (pH, conductivity, temperature, turbidity, flow rate, and dissolved oxygen) from five surface water monitoring locations. Sampling frequency reduced to quarterly after two complete years of sampling.
- Quarterly sampling of the five surface water stations. Sampling frequency reduced to annually after two complete years of sampling.
- Compilation of an annual environmental monitoring report (this report).

3. SITE DESCRIPTION

3.1 Physiography and Topography

The Landfill is located off Chist Creek Forest Service Road, approximately mid-way between Terrace and Kitimat along Highway 37. The Landfill is located on the northeast crest of the Onion Lake Flats, south of Forceman Ridge. The Landfill site occupies a total area of 53.5 hectares including buffer reserves, as shown on Figure 3-1. The existing topography slopes from north to south as shown on Figure 1 (Appendix A).

The elevation of the ground surface surrounding the Landfill is approximately 230 meters above sea level (masl). The Landfill is located within the Skeena watershed; the Skeena River is the second-longest river entirely within British Columbia.

SHA completed an extensive review and analysis of available climate data to estimate the anticipated leachate generation volumes at the Landfill as part of the detailed design process undertaken in 2015 and early 2016. The Forceman Ridge Landfill is located in a relatively rainy/snowy/wet region of the province (SHA, 2015).

The average annual precipitation at the Terrace Airport is 1,341 mm/year based on the 1980 to 2000 precipitation data. A review of the available 56-year climatic record indicates that the highest precipitation occurred in 1991 when the Terrace Airport station experienced 1,847.2 mm of precipitation.

SHA also undertook a statistical review of the Terrace Airport rainfall data. The historic mean of precipitation from 1956 to 2014 is 1,315 mm/year and the standard deviation is 202.3 mm. The 1 in 100 return period event (99% of data to left of normal curve) is 2.33 standard deviations from mean. In this case, the 1 in 100 year rainfall predicted for the Terrace Airport station is 1,786 mm/year.

Figure 3-1: Landfill Site Location

3.2 Regional and Local Surficial and Bedrock Geology

The regional and local surficial geology of the Landfill comprises of quaternary glaciofluvial sediments which consist mainly of deltaic sands and gravels that span at least 10 m in thickness (Clague 1983).

The regional and local shallow bedrock geology of the Landfill consist of Paleozoic intrusive rocks. These Paleozoic rocks consist mainly of diorite, granodiorite, tonalite, and metagabbro. The Landfill resides within a Paleozoic intermontane volcanic belt (Nelson 2009).

Previous investigations conducted by Golder Associates and AGRA in December of 2013 and 1997 to 2005 respectively, determined the underlying surficial geology at the Landfill consisted of surficial fills and topsoil and stratifies sands and gravels extending to a depth of at least 60 meters below grade (mbg). Borehole logs are available for reference in Appendix E.

The stratified sands and gravel material ranges from gravelly sand to sandy gravel, with layers of clean sand and some cobbles throughout. The lithology was brown to brown grey in colour with some oxidation staining present. Grain sieve analysis done on samples of this material were typically found to be well-graded. Based on the drilling done by AGRA and Golder, subsurface geology at the Landfill typically consists of the following sequence from native ground surface:

- 0.6 m or less of topsoil and surficial fill
- 0.6 to 60 m of stratified sand and gravel
- 60 m Bedrock

3.3 Applicable Regulatory Criteria

The Landfill is required to operate in accordance with the monitoring requirements outlined in the amended Operational Certificate (#17227) approved by the BC Ministry of Environment, last amended on September 19, 2019, that stipulates the following conditions with respect to groundwater quality:

- The characteristics of the groundwater at the property boundary shall not exceed drinking water (DW) standards in Schedule 3.2[1] of the Contaminated Sites Regulation (CSR). Where natural background water quality concentrations exceed the aforementioned standard, the characteristics of the groundwater at the property boundary must not exceed background concentrations.

- Where monitoring shows contaminant concentrations exceed the applicable water use, or other standards, the Operational Certificate holder shall notify the Director and take one of the following actions outlined in the OC under Section 6 subsection 16. Please see the OC contained in Appendix A for the actions to be taken if contaminant concentrations exceed the applicable standards.

Criteria for the surface water monitoring program is not specified in the OC, as such SHA established that the Approved Water Quality Guidelines (BCWQG) for the protection of Aquatic Life (AW) will be applied to all surface water samples. As is standard SHA practice, limits from "A Compendium of

[1] CSR standards have been updated and Schedule 3.2 replaced the redacted Schedule 6

Working Water Quality Guidelines for British Columbia: 2020 Edition" were used for parameters which currently don't have approved water quality limits.

The surface water monitoring program is not intended to serve as a detection / compliance program. Rather the program will be maintained to monitor the overall health of the receiving environment. This is the case because water quality in surface waters of Onion Lake and Clearwater drainage may be affected by other anthropogenic uses, in particular Hwy 37. Also, it is estimated that the travel time for groundwater to reach the lakes is on the order of 4 years.

Criteria for the Phytoremediation soil sample program is not specified in the OC, as such SHA established that the CSR Industrial Land Use Criteria for Drinking Water (CSR-DW) and groundwater flowing to aquatic life habitat (CSR-AW) would be used for all soil samples (CSR Schedule 3.1).

3.4 Groundwater

Since 1997, sixteen (16) groundwater monitoring wells have been drilled and completed at the Landfill as shown on Figure 2 in Appendix A. A historical summary of the installment of the groundwater monitoring well network is provided below:

- 1997: AGRA installed MW-01 to MW-03, with MW-01 being located to the east of the property, MW-02 located to the northeast of the property and MW-03 located in the southwest portion of the property;
- 2000: Golder installed MW-04 to MW-06 which are located south of the property;
- 2003: Golder installed MW-07 to MW-12 which are located west and south of the property;
- 2009: Golder installed MW-13 and MW-14, with MW-13 located to the northeast of the property and MW-14 located to the southeast of the property;
- 2016: SHA installed MW-15 and MW-16, located along the south property line of the site.
- 2017: RDKS installed replacement wells for MW-15 and MW-16 as the original 2016 wells proved to be dry part of the year.

Historical groundwater elevations for the Landfill are reported to range from 187.64 masl (MW-02) to 184.29 masl (MW-01) taken in the year 2006. These elevations correspond to about 43 m and 47 m below existing ground level (mbg), respectively. Throughout the eight-year monitoring period, fluctuations of the groundwater table were approximately 2 m in MW-03 and approximately 4 m in MW-02. Higher water levels were recorded during the later spring and early summer months.

Golder 2006 reported the groundwater flows direction to be towards the southeast and there is a regional groundwater flow divide to the south of the Landfill which extends southwest to northeast. Groundwater from the north side of the site discharges into Onion and Clearwater Lakes, while groundwater from the south side of the site discharges into a wetland north of Kitimat River.

The groundwater monitoring well network has been sub-divided into three categories as outlined within the OC 17227; background monitoring wells, early detection monitoring wells and compliance property boundary monitoring wells. In addition to these wells, an additional six wells (MW-05, MW-06, MW-10, MW-11, MW-12 and MW-14) are to be monitored quarterly for water levels. A list of the sub-divided categories and corresponding monitoring wells are provided below in Table 3-1 for reference and are shown on Figure 2 (Appendix A).

Table 3-1: Description of Groundwater Monitoring Locations

Well Type	Monitoring Location	UTM Coordinates (+/- 5m)	Description
Background Well	MW-02 (E251531)	531429.292 E 6018918.294 N	Located northeast of the property and considered to be up-gradient of the WMF and thus represents background groundwater quality
Background well	MW-13 (E287385)	531474.768 E 6019310.351 N	Located northeast of the property and north of MW-02 and considered to be up-gradient of the WMF and thus represents background groundwater quality
Early Detection Well	MW-01 (E251530)	531389.758 E 6018097.03 N	Located along the east property line
Early Detection Well	MW-03 (E251532)	530751.085 E 6018175.245 N	Located at the southwest portion of the property
Early Detection Well	MW-15 (E302210)	531174.897 E 6017953.145 N	Located at the southeast property line
Early Detection Well	MW-16 (E302211)	531014.933 E 6017983.296 N	Located at the south property line
Compliance Property Well	MW-04 (E251533)	530838.009 E 6017265.713 N	Located approximately 900 meters south of the property
Compliance Property Well	MW-07 (E251530)	530310.586 E 6019126.073 N	Located approximately 1 km northwest of the property
Compliance Property Well	MW-08 (E302210)	529937.722 E 6018353.56 N	Located approximately 750 meters west of the property on the north side of the Christ Creek Forest Road
Compliance Property Well	MW-09 (E302211)	530045.064 E 6017464.218 N	Located approximately 900 meters southwest of the property
Water Level only	MW-05	529926.085 E 6016425.245 N	Located approximately 2 km southwest of the property and west of the Stewart-Cassiar Highway
Water Level only	MW-06	531226.085 E 6015925.245 N	Located approximately 2.5 km south of the property
Water Level only	MW-10	531376.085 E 6016475.245 N	Located approximately 1.5 km south of the property
Water Level only	MW-11	532126.085 E 6015625.245 N	Located approximately 3 km southeast of the property
Water Level only	MW-12	530651.085 E 6016325.245 N	Located approximately 2 km south of the property
Water Level only	MW-14	531960.532 E 6017131.66 N	Located approximately 1.2 km southeast of the property

As part of the development of the Forceman Landfill Design, Operations and Closure Plan (SHA, 2017), SHA conducted a review of the local hydrogeology. A provincial water well and aquifer records search was performed using the Government iMap BC georeferenced database to help understand the regional hydrostratigraphic units in proximity to the Landfill. The results of the water well and aquifer search are summarized below for reference.

- Aquifer 0794: Located 3 km west of the Landfill – The unconfined aquifer consists of undifferentiated intermixed glaciofluvial and lacustrine deltaic sediments and is 11.7 km^2. Reported yields are 0.1 and 7.0 L/s. Depth to water 18 to 53 mbg. This aquifer is used for commercial and industrial water users.

- Aquifer 0818: Located 3 km west of the Landfill – The confined aquifer consists of glaciofluvial and lacustrine deltaic sediments comprised of sand and gravel and is 0.6 km^2. Reported yields are 3.8 and 10 L/s. Depth to water ranges from 84 to 85 mbg. This aquifer is used for commercial and industrial water users.

- Water wells: The results of the water well search indicate there are ten (10) water well users in a 5 km radius of the site.

3.5 Surface Water

There are three lakes, Onion Lake, Lower and Upper Clearwater Lakes and two surface water receiving environments, Onion Creek, and Clearwater Creek located downgradient from the Landfill, as shown on Figure 2 (Appendix A).

Baseline surface water sampling stations are sampled and maintained on the southeast outlet of Onion Lake, at the outlet of Upper Clearwater Lake, and at the outlet of Lower Clearwater Lake where groundwater seepage / drainage has been observed. Two additional sites, at the outflow creek from Onion Lake and Clearwater Creek immediately upstream of where these creeks cross the existing Forest Service Road, are sampled as per the sampling program outlined in Section 2. A description of the surface water sampling locations is provided below in Table 3-2.

Table 3-2: Description of Surface Water Monitoring Locations

Monitoring Location	UTM Coordinates (+/- 5m)	Description
SW-01	529691.578 E 6018322.753 N	East side of Onion Lake
SW-02	528942.587 E 6017456.235 N	Outlet of Upper Clearwater lake
SW-03	528778.181 E 6018126.088 N	Outlet of Lower Clearwater Lake
SW-04	528325.255 E 6019465.882 N	Creek from Onion Lake
SW-05	528450.437 E 6019552.438 N	Clearwater Creek

One of the primary objectives of the surface water management plan is to minimize leachate production by means of surface water diversion. Secondary objectives are to prevent erosion of the operational and final cover systems, to prevent ponding of surface water on the cover system, to control flooding of the active landfill areas and control surface water in a manner compatible with the proposed end-uses. In order to manage the surface water from the Landfill and to protect the Landfill area from erosion as mentioned above, crest ditches were constructed and lined with an erosion control blanket to convey the surface water to various downchutes located along the slopes of the landfill. The downchutes will then convey the surface water to the toe ditches, installed along the toe of the landfill footprint, inside the perimeter berm and access roads.

Clean run-on water will be diverted by the perimeter berm to prevent any site flooding. Site flooding has occurred in the past because of the existing topography which can be viewed in Figure 1. In general, the existing topography slopes downwards from North to South which allowed two flood events to occur in November 2016 and January 2017 that contributed large volumes of run-on water to the North border and subsequently the Phase 1B excavation. An investigation revealed that during extreme precipitation and snow melt events the old Scully Creek forest service road collects run-off from a large upland catchment and conveys that run-off westward along the road until a slight escarpment is reached approximately at the middle of the landfill excavation. The perimeter berm was constructed to mitigate this issue.

3.6 Leachate

Leachate samples are collected at one leachate station F5, which is the OC compliance point for leachate discharge onto the phytoremediation area. Leachate station F5 is shown on Figure 4 and described in Table 1. The leachate sample station has been equipped with a stop-cock sampling port that make sample collection efficient and convenient. An annual soil sample from the phytoremediation area is also to be collected and tested, as per the OC 17227. Section 2 details the sampling frequency and sampling parameters for the leachate monitoring program.

The leachate treatment system has been designed to reduce contaminant concentrations through the four-stage treatment process (equalization, aeration, sedimentation, sand filter) and to consume the majority of the treated effluent in the on-site phytoremediation plantation. The leachate monitoring plan is to confirm discharge

compliance. Discharge compliance criteria is detailed in the OC 17227, which can be viewed in Appendix D.

Landfill leachate typically has elevated concentrations of several indicator parameters. Conductivity is a parameter indicative of the total amount of dissolved minerals in a water sample and higher conductivity levels (>500 µS/cm) are often indicative of leachate impact. Chloride is also used as a leachate indicator at municipal landfills since chloride is a common constituent of materials disposed of in municipal solid waste. Chloride has low affinity to soil or other matter meaning that it remains dissolved in solution after it enters a water system. Raw leachate from municipal landfills typically has very high chloride concentrations that typically occur in the range of 100 mg/L to 3,000 mg/L. Chloride concentrations typically decrease as the leachate mixes with the groundwater and becomes diluted. Ammonia is another indicator of landfill impact as leachate typically has high concentrations of organic compounds.

Leachate generation modelling completed by SHA as part of the development of the DOCP for the site showed that the average annual leachate production is 1,413 mm, 353 mm, and 0.43 mm per year for active areas, temporary closed areas, and geomembrane capped areas, respectively. Under extreme conditions, the annual leachate production is 1,957 mm, 489 mm, and 0.86 mm for active areas, temporary closed areas, and geomembrane capped areas, respectively. A summary of the design precipitation and leachate generation rates for the Landfill is presented in Table 20, contained in Appendix B.

4. METHODS

4.1 Field Techniques

Monitoring well construction details including ENV identifier and elevations are summarized in Table 1. In 2020 there were sixteen (16) active monitoring wells, five (5) surface water stations, and one (1) leachate monitoring station. Surface water, groundwater, and leachate sampling frequency and sampling parameters are listed within Table 1 and Appendix B.

Water quality monitoring and sampling for groundwater, surface water and leachate occurred at a frequency listed in Tables 4-1, 4-2, and 4-3. Water quality monitoring and sampling was conducted by RDKS qualified environmental personnel according to methods and procedures specified in the British Columbia Field Sampling Manual for Continuous Monitoring and the Collection of Air, Air Emissions, Water, Wastewater, Soil, Sediment and Biological Samples (BC 2013)".

Table 4-1: 2020 Surface Water Monitoring and Sampling Events

Monitoring Location	Monitoring Event	Monitoring and Sampling Event	Monitoring Event
SW-01	June 18, 2020	July 16, 2020	November 9, 2020
SW-02	June 18, 2020	July 16, 2020	November 9, 2020
SW-03	June 18, 2020	July 16, 2020	November 9, 2020
SW-04	June 18, 2020	July 16, 2020	November 9, 2020
SW-05	June 18, 2020	July 16, 2020	November 9, 2020

Table 4-2: 2020 Groundwater Monitoring and Sampling Events

Monitoring Location	Monitoring Event	Monitoring Event	Monitoring and Sampling Event
Background Wells			
MW-2	June 29, 2020	August 14, 2020	November 3, 2020
MW-13	June 29, 2020	-	Dry
Early Detection Wells			
MW-1	June 29, 2020	August 14, 2020	November 4, 2020
MW-3	June 29, 2020	August 14, 2020	November 4, 2020
MW-4	June 29, 2020	August 14, 2020	Dry
MW-7	June 29, 2020	August 14, 2020	Dry
MW-8	June 29, 2020	August 14, 2020	November 4, 2020
MW-9	June 29, 2020	August 14, 2020	Dry
MW-15	June 29, 2020	August 14, 2020	November 3, 2020
MW-16	June 29, 2020	August 14, 2020	November 3, 2020
Groundwater Levels Only			
MW-5	Well Locked	Well Locked	Well Locked
MW-6	Dry	August 14, 2020	November 4, 2020
MW-10	June 29, 2020	August 14, 2020	November 4, 2020
MW-11	Dry	Dry	November 4, 2020
MW-12	June 29, 2020	August 14, 2020	November 4, 2020
MW-14	June 29, 2020	Dry	Dry

Table 4-3: 2020 Leachate Monitoring and Sampling Events

Monitoring Location	Monitoring and Sampling Event	Monitoring Event	Monitoring Event	Monitoring Event
F5	May 27, 2020	July 22, 2020	September 4, 2020	October 30, 2020

4.2 Quality Assurance

The OC 17227 stipulates for the Landfill a quality assurance and quality control plan as part of their sampling program. The OC 17227 stipulates the terms of the quality assurance program under Section 13.4.3. As part of the program the Landfill must report the results of their field duplicate in terms of the degree of variation as the relative percent difference. The calculation of the relative percent difference is provided below for reference:

$$RPD = \frac{D1 - D2}{\frac{D1 + D2}{2}} X\ 100\%$$

Where:

RPD = Relative Percent Difference
D1 = Measured value of the first duplicate
D2 = Measured value of the second duplicate

5. RESULTS

5.1 Groundwater

The groundwater flow conceptual model for the Landfill was generated using the June 2020 groundwater elevation data which was collected by the RDKS, as shown on Figure 3 (Appendix A). The monitoring well data can be found in Table 1 (Appendix B). The monitoring wells at the Landfill are screened within an unconfined shallow aquifer consisting of well graded sands and gravels.

The predominant groundwater flow direction at the Landfill is directed towards the center of the Landfill. There is a local groundwater divide just south of the Landfill as shown on Figure 3. The bottom of the Landfill is lined with a geomembrane liner as discussed in Section 3.6. The Landfill's geomembrane liner impedes natural infiltration of precipitation and as a result has created a localized groundwater elevation low point. Groundwater flow is driven in part by gravitational forces, as such groundwater will move from high elevation to low elevation. The lower groundwater elevations at the landfill means that groundwater naturally migrates toward the landfill. The groundwater flow conceptual model will require more information ie. the drilling of more boreholes and measuring the water elevation within the local lakes and rivers to confirm if the conceptual model is spatially accurate.

The average groundwater elevations measured at the Landfill in 2020 are provided within summary Table 5-1 below. An average, minimum, maximum and difference between minimum and maximum are provided for reference. In 2020, the lowest groundwater elevation at the Landfill was measured within MW-09 (149.79 masl) in June and the highest groundwater elevation was measured within MW-14 (195.80 masl) in June. Groundwater elevations fluctuated between 0.30 m to 2.95 m annually.

Table 5-1: 2020 Groundwater Elevation Summary Table

MW	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16
Average	180.55	184.63	180.82	172.38	Dry	167.61	185.44	182.77	150.30	170.04	164.94	166.18	186.95	195.80	180.68	181.76
Min	180.55	184.63	179.26	172.22	Dry	167.45	185.44	181.82	149.79	169.90	163.75	165.65	186.95	195.80	180.10	181.15
Max	180.55	184.63	182.21	172.52	Dry	167.76	185.44	183.62	151.13	170.28	166.12	166.77	186.95	195.80	181.09	182.10
Diff	0.00	0.00	2.95	0.30	Dry	0.31	0.00	1.80	1.34	0.38	2.37	1.12	0.00	0.00	0.99	0.95

5.2 Average Linear Groundwater Velocity

The average linear groundwater velocity was calculated for the Landfill, ie. the amount of time it takes for leachate leaving the Landfill to reach the down gradient property boundary assuming groundwater is flowing away from the Landfill. The stratified sands and gravel materials underlying the Landfill are assumed to transmit groundwater through its more permeable sandy layers; therefore, the hydraulic conductivity of $7\times 10^{-6}\,\mathrm{m/s}$ was selected based on typical hydraulic values for sands and gravels.

The flow of groundwater beneath the site was calculated using Darcy's Law as shown by the relationship:

$$q\ (m/s) = -k \times (\Delta h/\Delta l)$$

where: k = hydraulic conductivity,
$\Delta h/\Delta l$ = hydraulic gradient

Figure 3 in Appendix A shows the groundwater flow contours for the Landfill. The hydraulic gradient can be determined by the head differentials which can be inferred from the groundwater contours map. It is observed that the hydraulic gradient at the landfill is on average 1 m of head per 10 m of distance. With the above hydraulic conductivity and the hydraulic gradient, the Darcy velocity q is calculated at $0.6\ m/d$

The resultant advective velocity of the groundwater can be determined from q using the porosity of the soil as shown in the relationship below:

$$v = q/n$$

where: v = velocity in m/s
n = porosity of soil

A porosity of 0.4 was selected for the soil. The porosity assumes the material is homogeneous. The resulting velocity is 1.5 m/d which equates to a travel time of 4 years for groundwater to travel the 2.2 km from the edge of the Landfill footprint to Upper Clearwater Lake. However, this only serves as a rough estimate and does not consider localized soil stratigraphy or varying hydraulic conductivity across the site. Furthermore, these limitations also apply to areas outside the Landfill borders with the addition of varying flow depth.

5.3 Groundwater Quality

Groundwater quality data for 2020 as well as historical data are summarized in Tables 2 to 14, which are available in Appendix B. As seen in the tables, some parameter guidelines are dependent upon hardness

or pH, which were taken into account when determining if the parameter concentrations exceeded CSR DW Standards.

5.3.1 Background Groundwater Quality

Background water quality is observed from sampling results corresponding to monitoring wells MW-02 and MW-13. The monitoring well network categories are described in detail in Section 3.4.

A local background groundwater characterization was completed for the Landfill to establish a benchmark to compare all 2020 groundwater quality data against. Below is a list of the key groundwater quality indicator parameters used in the background groundwater characterization for 2020, along with their corresponding values. These are considered key parameters, as elevated concentrations of these parameters may be indicative of leachate influence within groundwater. As monitoring well MW-13 was dry during all sampling events in 2020, only water quality data from MW-02 was used in the background groundwater characterization for 2020.

- pH was 6.93;
- Hardness was 20.3 mg/L as CaCO3;
- Conductivity was 48.5 µS/cm;
- Ammonia was 0.0771 mg/L;
- Chloride was non-detectable;
- Manganese was 0.0346 mg/L; and
- Iron was 0.059 mg/L.

There were no BC CSR DW Guideline exceedances for the background groundwater monitoring well network in 2020, nor have there been any exceedances in previous sampling events. In general, the dissolved metals concentrations, if detectable, are at least one order of magnitude below the CSR-DW criteria.

5.3.2 Early Detection and Compliance Monitoring Well Network

Water quality for the early detection wells fall into two categories, pre-landfill results and post landfill results. Specifically, pre-landfill results correspond to values prior to the year of 2016, whereas post landfill results are after this time. The following monitoring wells are part of the early detection monitoring well network; MW-01, MW-03, MW-04, MW-07, MW-08, MW-09, MW-15 and MW-16. As specified in the DOCP (SHA, 2017), monitoring wells MW-04, 07, 08 and 09 are compliance points. All paragraphs beginning with an "*" denote the monitoring well is a compliance point.

Monitoring well MW-01 is located at the south east corner of the Landfill property line boundary. The groundwater quality indicator parameters were all below background concentrations (Section 5.3.1). All groundwater parameters analyzed during the 2020 program were below CSR DW Standards. Based on the monitoring results, no leachate impact is observed at this location.

Monitoring well MW-03 is located at the south west corner of the Landfill. The groundwater quality indicator parameters at MW-03 were all below background concentrations (Section 5.3.1) with the exception of conductivity (137 µS/cm) and hardness (65.3 mg/L). The pH at this location was more basic

(8.02) than background (6.93). All groundwater parameters analyzed during the 2020 program were below CSR DW Standards. Based on the monitoring results, no leachate impact is observed at this location.

Monitoring well MW-15 is located at the southern perimeter boundary of the Landfill. The groundwater quality indicator parameters were below background concentrations with the exception of conductivity (226 µS/cm), hardness (116 mg/L), and chloride (2.94 mg/L). The pH at this location was more basic (8.17) than background (6.93). All parameters analyzed during the 2020 program were below CSR DW Standards. Based on the monitoring results, no leachate impact is observed at this location.

Monitoring well MW-16 is located at the southern perimeter boundary of the Landfill. The groundwater quality indicator parameters were all below background concentrations with the exception of conductivity (180 µS/cm), hardness (89.5 mg/L), and chloride (0.52 mg/L). Conductivity ranged from 152 - 159 µS/cm and hardness ranged from 77.6 – 83.9 mg/L. The pH at this location was more basic (8.15) than background (6.93). All parameters analyzed during the 2020 program were below CSR DW Standards. Based on the monitoring results, no leachate impact is observed at this location.

*Monitoring well MW-04 is a compliance point and is located approximately 800 m south of the Landfill. Groundwater sampling at this location was not conducted in 2020 as the well was dry during the sampling event. However, all groundwater parameters analyzed during the 2019 program were below CSR DW Standards.

*Monitoring well MW-07 is located approximately 500 m northwest of the Landfill. Groundwater sampling at this location was not conducted in 2020 as the well was dry during the sampling event. However, concentrations during the last sampling event when the well contained water in 2017, showed groundwater quality indicator parameters all below background concentrations with the exception of conductivity and hardness. Also, all groundwater parameters analyzed during the 2017 program were below CSR DW Standards.

*Monitoring well MW-08 is located approximately 500 m west of the Landfill. All parameters analyzed during the 2020 program were below CSR DW Standards with the exception of nitrate, which had a concentration of 12.7 mg/L during the sampling event. The CSR DW standards for nitrate is 10.0 mg/L. Select leachate groundwater quality indicator parameters were slightly above background concentrations such as conductivity (160 µS/cm), hardness (59.7 mg/L), chloride (5.89 mg/L), and iron (0.358 mg/L). Ammonia and manganese concentrations were both below background levels. It is suspected that the elevated nitrate may be a result of herbicide application on the hydro line (glyphosate = C3H8NO5P) or along the highway ditch given that monitoring well MW-08 is located at the junction of where the egress road leaving the Forceman Landfill meets Highway 37 and is at the base of a steep hill where at the top is the BC Hydro line. Follow up sampling in 2021 will verify if the exceedance was an anomaly or requires further investigation. Given that no other exceedances of the CSR DW standards occurred at MW-08 in 2020, the exceedance for nitrate at MW-08 is likely an anomaly and is unlikely to be due to landfill leachate.

*Monitoring well MW-09 is located south west of the Landfill. Groundwater sampling at this location was not conducted in 2020 as the well was dry during the sampling event. However, all groundwater parameters analyzed during the 2019 program were below CSR DW Standards.

5.4 Surface Water Quality

Surface water quality data for 2020, as well as historical data are summarized in Tables 15 to 19 and are available in Appendix B. Some parameter guidelines are dependent upon hardness or pH which were taken into account when determining if the parameter concentrations exceeded BCWQG-AW Standards.

5.4.1 Surface Water Monitoring Stations

Surface water samples were collected at the five surface water monitoring locations; at Onion Lake (SW-01), Clearwater Lakes (SW-02 and SW-03) and the streams that drain these water bodies (SW-04 and SW-05). Surface water monitoring locations can be viewed on Figure 2 in Appendix A. Each monitoring location is specified for sampling frequency and monitoring parameters as required by the DOCP surface water monitoring program, regulated by the OC 17227. This program is summarized in Section 2.0.

Baseline surface water sampling stations were maintained on the southeast side of Onion Lake where groundwater seepage / drainage is located, at the outlet of Upper Clearwater Lake, and at the outlet of Lower Clearwater Lake. Two additional sites at the outflow creek from Onion Lake and Clearwater Creek immediately upstream of where these creeks cross the existing Forest Service Road are sampled for field parameters. Full lab analysis is conducted at both of the creek sites also, as per the Section 13.3 of the 2019 OC.

5.4.1.1 SW-01 (Onion Lake)

Surface water site SW-01 was sampled once for pre-landfill water quality results (prior to 2016), in October of 2012. Below is a list of parameters and values from that sampling event which are key parameters for pre-landfill conditions. These parameters are analyzed, as they are generally indicative of leachate influence.

- pH: 6.3
- Hardness: 3.9 mg/L as CaCO3
- Conductivity: 33.7 µS/cm
- Ammonia: Non-detectable.
- Chloride: 10.3 mg/L
- Manganese-Total: 0.0211 mg/L
- Iron-Total: 0.0304 mg/L

The only parameter that exceeded the BCWQG-AW during the pre-landfill sampling was cadmium and is therefore believed to be naturally occurring. Also, pH was below the specified range of 6.5-9.0 during the October 2012 sampling event when pH was 6.3.

Post landfill results obtained at SW-01 in 2020 are summarized below with a list of parameters and values for key leachate indicator parameters.

- pH: 6.21
- Hardness: 2.28 mg/L as CaCO3.
- Conductivity: 22.4 µS/cm.

- Ammonia: Non-detectable.
- Chloride: 4.90 mg/L.
- Manganese-Total: 0.0108 mg/L.
- Iron-Total: Non-detectable mg/L.

No exceedances of the BCWQG-AW occurred in 2020, with the exception of pH which was below the specified range of 6.5 – 9.0. However, pH levels below 6.5 also occurred pre-landfill as seen during the October 2012 sampling event when pH was 6.3. Based on the monitoring results, no leachate impact is observed at this location.

5.4.1.2 SW-02 (Upper Clearwater Lake)

Surface water site SW-02 was sampled twice for pre-landfill water quality results (prior to 2016), in October 2012 and April 2013. Below is a list of parameters and values ranges for key leachate indicating parameters for pre-landfill conditions.

- pH ranged from 7.8 to 8.0.
- Hardness ranged from 74.8 and 75.6 mg/L as CaCO3.
- Conductivity was 154 µS/cm for both events.
- Ammonia was non- detectable.
- Chloride ranged from 1.1 to 1.8 mg/L.
- Manganese-Total was non-detectable in 2012. During the 2013 sample, this parameter was in exceedance of the BCWQG-AW criteria with a value of 2.06 mg/L.
- Iron-Total was non-detectable in 2012. During the 2013 sample, this value was 0.0171 mg/L.

The only parameters that exceeded the BCWQG-AW during the pre-landfill sampling were cadmium, and manganese, which are likely naturally occurring.

Post landfill results obtained at SW-02 in 2020 are summarized below with a list of parameters and values for key leachate indicating parameters.

- pH: 8.13
- Hardness: 73 mg/L as CaCO3.
- Conductivity: 156 µS/cm.
- Ammonia: 0.0062 mg/L.
- Chloride: 0.87 mg/L.
- Manganese-Total: 0.00046 mg/L.
- Iron-Total: non-detectable.

No exceedances of the BCWQG-AW occurred in 2020. Based on the monitoring results, no leachate impact is observed at this location.

5.4.1.3 SW-03 (Lower Clearwater Lake)

Monitoring location SW-03 was sampled twice for pre-landfill results (prior to 2016), in October 2012 and April 2013. Below is a list of parameters and values ranges for key leachate indicating parameters for pre-landfill conditions.

- pH ranged from 7.9 to 8.2.
- Hardness ranged from 72.8 to 73.3 mg/L as CaCO3.
- Conductivity ranged from 149 to 151 µS/cm for both events.
- Ammonia was non-detectable.
- Chloride ranged from 1.3 to 1.7 mg/L.
- Manganese-Total was non-detectable for both sampling events.
- Iron-Total ranged from 0.0069 to 0.0091 mg/L.

There were no exceedances of the BCWQG-AW at this location during pre-landfill monitoring.

Post landfill results obtained in 2020 are summarized below with a list of parameters and values for key leachate indicating parameters.

- pH: 8.06
- Hardness: 69.3mg/L as CaCO3.
- Conductivity: 152 µS/cm.
- Ammonia: non-detectable.
- Chloride: 0.91 mg/L.
- Manganese-Total: 0.00103 mg/L.
- Iron-Total: non-detectable.

No exceedances of the BCWQG-AW occurred in 2020. Based on the monitoring results, no leachate impact is observed at this location.

5.4.1.4 SW-04 (Creek from Onion Lake)

Only post landfill monitoring data was available for SW-04. The results obtained in 2020 are summarized below with a list of parameters and values for key leachate indicating parameters.

- pH: 7.56
- Hardness: 33.9mg/L as CaCO3.
- Conductivity: 105 µS/cm.
- Ammonia: 0.0053 mg/L.
- Chloride: 11.5 mg/L.
- Manganese-Total: 0.059 mg/L.
- Iron-Total: 0.25 mg/L.

No exceedances of the BCWQG-AW occurred in 2020. Based on the monitoring results, no leachate impact is observed at this location.

5.4.1.5 SW-05 (Clearwater Creek)

Only post landfill data was available for SW-05. The results obtained in 2020 are summarized below with a list of parameters and value ranges for key leachate indicating parameters.

- pH: 8.02.
- Hardness: 71.1 mg/L as CaCO3.
- Conductivity: 160 µS/cm.
- Ammonia: non-detectable.
- Chloride: 1.1 mg/L.
- Manganese-Total: 0.00138 mg/L.
- Iron-Total: 0.019 mg/L.

No exceedances of the BCWQG-AW occurred in 2020. Based on the monitoring results, no leachate impact is observed at this location.

5.5 Leachate Monitoring

5.5.1 Leachate Monitoring Stations and Criteria

The Forceman WMF has been designed with a state-of-the-art leachate treatment system that comprises of five stages: (1) equalization, (2) aeration, (3) sedimentation, (4) sand filtration, and (5) phytoremediation. The four stages, prior to phytoremediation, take place within lined treatment ponds. In the final step, Phytoremediation, treated leachate is discharged by drip irrigation onto a 1.85 Ha area planted with 2,800 hybrid poplars, cotton woods, and alders that uptake the treated leachate.

Field readings of pH, conductivity, temperature, dissolved oxygen, turbidity, water level, and flow rate are to be collected at the leachate monitoring location on a monthly basis during the first two years of operation, and then quarterly following two complete years of sampling. Volume is to be measured continuously during periods of discharge (typically April to October). Laboratory samples are to be extracted from sampling ports at each pump station initially at a quarterly frequency for the first two years, and then at an annual frequency in subsequent years. A one-time sample of VOCs is required for background levels.

Water quality sampling was conducted in May 2020 at the leachate monitoring location compliance point (F5), shown on Figure 4 in Appendix A. The water quality results are presented in Table 21 in Appendix B. VOCs were not sampled in 2020 and are scheduled to be sampled in 2021 for background levels as per the OC.

5.5.1.1 F5: Sand Cyclone

Leachate monitoring station F5 is the compliance point as per the OC criteria and is located at the sand cyclone outlet. The leachate treatment system was shut down for the winter in 2019 and leachate treatment started up again in April 2020. The compliance sample was collected on May 27, 2020. Water quality results for this location can be viewed in Table 21 (Appendix B). The water quality results at F5 indicate that the leachate that was treated in 2020 was in compliance with the OC criteria.

5.5.2 Leachate Discharge Volume

This section discusses the volume of leachate discharged to the phytoremediation area for 2020. The system consists of one pressure sensor controlled pump station to pump the leachate from the base of the landfill to the top of the equalization pond (Pump Station 1), a second float controlled pump station to refill the aeration pond (Pump Station 3), and a third float controlled pump station to distribute treated effluent into the drip irrigation system (Pump Station 5). See Figure 1 for a schematic of the Forceman WMF treatment system. The RDKS installed a flow meter in 2020 at Pump Station 5 and the flow was recorded to be 53 m^3 per pump hour. The total volume of leachate discharged for the 2020 year was estimated using recorded pump hour data from Pump Station 5. Discharge occurred from June 16th, 2020 to November 10th, 2020, a period of 163 days. The RDKS was issued a temporary OC amendment (Appendix D) to discharge until November 9th, 2020 due to a large amount of precipitation that occurred during 2020. Over the 163 day discharge period, pump discharge hours totaled 977.4 hours at an estimated discharge rate of 53 m^3 per pump hour. Therefore, the calculated volume of leachate discharged onto the phytoremediation area was estimated to be 51,802 m^3 in 2020.

The 2020 leachate discharge rate and volume are compliant with the OC. The OC states the following with respect to authorized discharge:

- Number of days authorized to discharge = 210 days
- Authorized average daily discharge rate = 400 m^3/day
- Authorized max daily discharge rate = 609 m^3/day
- Authorized maximum total discharge from April to October = 84,000 m^3

5.6 Phytoremediation Soil Sample

A composite soil sample from the phytoremediation area was taken on May 7, 2020. As per the OC, the composite soil sample was assembled from 4 locations in the phytoremediation area. The results can be viewed in Table 22 (Appendix B). Soil results were compared against the Contaminated Sites Regulation Industrial Land Use criteria for Drinking Water and Aquatic Life. All results were compliant with the criteria and do not show signs of metals accumulation or excessive salinity in the phytoremediation soil.

6. DISCUSSION

6.1 Groundwater

A summary of the groundwater quality results for the background, early detection, and compliance monitoring wells are shown in Table 6-1 below. In general, the 2020 post landfill results are similar to the pre-landfill results, indicating no leachate impact. Also, the early detection and compliance property

groundwater monitoring well network water quality was all below CSR DW Standards with the exception of nitrate which exceeded the CSR DW standards at MW-08. In general, all conductivity results are representative of naturally occurring water. Conductivity is a parameter indicative of the total amount of dissolved minerals in a water sample and higher conductivity levels (>500 µS/cm) are often indicative of leachate impact. The highest conductivity reading in 2020 was recorded at MW-08 (160 µS/cm). As mentioned previously, select leachate groundwater quality indicator parameters at MW-08 were slightly above background concentrations and pre-landfill concentrations. The results from 2021 sampling at MW-08 will help to confirm if the 2020 readings were an anomaly or if there is reason for concern.

Leachate indicator parameters such as conductivity, chloride, manganese, and iron have been graphed in Graphs 1 through 4 (Appendix C) as a visual representation of pre-landfill and post-landfill water quality. Due to the scarcity of lab conductivity readings, the majority of the conductivity levels in Graph 1 are field conductivity readings. Given that field conductivity readings are not as accurate as lab conductivity readings, the field conductivity readings should be used for reference purposes only.

Table 6-1: Summary of Groundwater Quality Results 2020

Parameter	**Background Well (MW-02)**	**Background Well (MW-13)**	**Early Detection Well (MW-01)**		**Early Detection Well (MW-03)**	
	Post-Landfill (2020)	*Post-Landfill (2020)*	*Pre-Landfill (prior to 2016)*	*Post-Landfill (2020)*	*Pre-Landfill (prior to 2016)*	*Post-Landfill (2020)*
pH	6.9	Dry	6.8 – 7.0	7.0	8.7	8.0
Hardness	20.3	Dry	10.4	14.9	14.9	65.3
Conductivity (µS/cm)	48.5	Dry	15.2	36.9	29.3	137
Ammonia (mg/L)	0.0771	Dry	0.19	ND	0.03	0.006
Chloride (mg/L)	ND	Dry	ND	ND	ND – 1.0	ND
Manganese (mg/L)	0.0346	Dry	0.0374 – 0.339	0.00502	0.0053 – 0.0178	0.00056
Iron (mg/L)	0.059	Dry	0.0082 – 0.0923	0.04	ND	ND
ND is non-detectable.						

Parameter	Early Detection Well (MW-09)		Early Detection Well (MW-15)	Early Detection Well (MW-16)	Compliance Monitoring Well (MW-04)	
	Pre-Landfill (prior to 2016)	*Post-Landfill (2020)*	*Post-Landfill (2020)*	*Post-Landfill (2020)*	*Pre-Landfill (prior to 2016)*	*Post-Landfill (2020)*
pH	6.7 – 6.9	Dry	8.2	8.2	7.4 – 8.5	Dry
Hardness	20.4	Dry	116	89.5	22.9	Dry
Conductivity (µS/cm)	63.7	Dry	226	180	47.5	Dry
Ammonia (mg/L)	ND	Dry	ND	ND	0.06	Dry
Chloride (mg/L)	ND – 2.4	Dry	2.94	0.52	ND	Dry
Manganese (mg/L)	0.0038 – 0.0048	Dry	0.00238	0.00059	0.0963 – 0.348	Dry
Iron (mg/L)	ND	Dry	0.012	ND	ND – 0.0338	Dry

Parameter	Compliance Monitoring Well (MW-07)		Compliance Monitoring Well (MW-08)		Compliance Monitoring Well (MW-09)	
	Pre-Landfill (prior to 2016)	*Post-Landfill (2020)*	*Pre-Landfill (prior to 2016)*	*Post-Landfill (2020)*	*Pre-Landfill (prior to 2016)*	*Post-Landfill (2020)*
pH	8.5 – 8.6	Dry	6.3 – 6.5	6.7	6.7 – 6.9	Dry
Hardness	67.3	Dry	14.1	59.7	20.4	Dry
Conductivity (µS/cm)	59.2	Dry	27.5	160	63.7	Dry
Ammonia (mg/L)	ND	Dry	ND	0.0089	ND	Dry
Chloride (mg/L)	ND - 1.3	Dry	ND	5.89	ND – 2.4	Dry
Manganese (mg/L)	ND – 0.00082	Dry	ND – 0.0098	0.0188	0.0038 – 0.0048	Dry
Iron (mg/L)	ND – 0.0069	Dry	ND	0.358	ND	Dry

ND is non-detectable.

6.2 Surface Water

A summary of the surface water quality results for surface water monitoring locations SW-01 to SW-05 is shown in Table 6-2 below. In general, the 2020 post landfill results are similar to the pre-landfill results, indicating no leachate impact. Leachate indicator parameters such as conductivity, chloride, manganese, iron, and aluminum have been graphed in Graphs 5 through 9 as a visual representation of pre-landfill and post-landfill water quality. All conductivity results are representative of naturally occurring water with conductivity less than 200 µS/cm. This is expected given the distance of the sample locations from the Landfill.

Table 6-2: Summary of Surface Water Results 2020

	SW-01		**SW-02**		**BCWQG-AW**
	Pre Landfill (prior to 2016)	*Post Landfill (post 2016)*	*Pre Landfill (prior to 2016)*	*Post Landfill (post 2016)*	
pH	6.3	6.2	7.8 – 8.0	8.1	6.5 – 9.0
Hardness	3.9	2.3	74.8 – 75.6	73.0	-
Conductivity (µS/cm)	33.7	22.4	154	156	-
Ammonia (mg/L)	ND	ND	ND	0.0062	2.0 – 26.5
Chloride (mg/L)	10.3	4.9	1.1 – 1.8	0.87	600
Manganese (mg/L)	0.0211	0.0108	ND – 2.06	0.00046	0.8 – 3.4
Iron (mg/L)	0.0304	ND	ND – 0.0171	ND	1
	SW-03		**SW-04**	**SW-05**	**BCWQG-AW**
	Pre Landfill	*Post Landfill*	*Post Landfill*	*Post Landfill*	
pH	7.9 – 8.2	8.0	7.7 – 7.9	7.6	6.5 – 9.0
Hardness	72.8 – 73.3	69.3	26.4 – 39.4	33.9	-
Conductivity (µS/cm)	149 - 151	152	50 - 85	105	-
Ammonia (mg/L)	ND	ND	ND – 0.0058	0.0053	2.0 – 26.5
Chloride (mg/L)	1.3 – 1.7	0.91	7.02 – 13.8	11.5	600
Manganese (mg/L)	ND	0.0013	0.00937 – 0.244	0.059	0.8 – 3.4
Iron (mg/L)	0.0069 – 0.0091	ND	0.055 – 0.795	0.25	1

ND is non-detectable.

6.3 Leachate

The performance of the leachate treatment system can be evaluated by analyzing the water quality results at the leachate monitoring compliance point F5, located at the sand cyclone outlet prior to discharge to the phytoremediation area. It is evident that as the leachate passes through the system it is highly diluted and effectively treated as the concentrations of leachate indicator parameters at the discharge point (F5) are all below the OC criteria.

To start establishing water quality trends, the OC criteria discharge parameters pH, ammonia, chloride, cadmium, iron, and zinc have been graphed in Graphs 10 to 15 to create a visual representation of the water quality at the compliance point for the 2017 to 2020 discharge period. As seen in Graphs 10 to 15, the water quality has improved from 2017 to 2020.

7. QUALITY ASSURANCE AND QUALITY CONTROL

A quality assurance and quality control (QA/QC) program is a system of procedures, checks, audits and corrective actions that will assist in ensuring that the data generated at the laboratory is of the highest achievable quality. This is of prime importance, as the monitoring data forms the basis for all of the conclusions regarding the impact of the Landfill on the surrounding environment. As per the OC, one duplicate sample should be collected during each sampling event from one of the discharge points. Furthermore, each duplicate sample should be submitted to the laboratory; one of the pair identified as the regular sample, and the other, as a blind sample identified by a fictitious site-name established solely to identify the duplicate sample. The results of the field duplicates in terms of the degree of variation as the relative percent difference should be reported for each parameter, as specified in the OC.

In 2020, duplicate samples were obtained during the July sampling event at surface water monitoring location SW-05 and the November groundwater sampling event from MW-01. The results of the duplicate samples and the degree of variation as the relative percent difference for each parameter are presented in Table 16 and Table 17.

In general, the duplicate samples obtained in 2020 had a relative percent difference less than 20%, with the exception of two analytes. A summary of the analytes which were out of compliance (RPD > 20%) are listed below in Table 7-1.

Table 7-1: Summary of Duplicate Sample Non-Compliance 2020

Sampling Location	Monitoring Event	Analyte	RPD
MW-01	November 4, 2020	Total Kjeldahl Nitrogen	31%
MW-01	November 4, 2020	Cadmium	47%
MW-01	November 4, 2020	Iron	22%

8. CONCLUSIONS AND RECOMMENDATIONS

This report documented the groundwater, surface water, and leachate water quality for the 2020 year at the Forceman Ridge WMF. For surface water and groundwater, the post landfill results are not significantly different from the pre-landfill results, indicating no discernable leachate impact. Monitoring well MW-08 had an exceedance of the CSR-DW standards for nitrate and should continue to be monitored in 2021 to determine if the reading was an anomaly or should be investigated further. In general, all conductivity results are representative of naturally occurring water with conductivity less than 200 µS/cm. Based on the 2020 sampling results, there is no discernable leachate impact at any of the groundwater or surface water monitoring locations.

Leachate was sampled from the OC compliance point (F5) prior to discharge and during the discharge period. In general, results indicate that leachate is highly diluted and treated by the time it reaches the discharge point. There were no exceedances of the OC criteria at F5.

Phytoremediation soil samples were taken once in 2020. All results are compliant with the criteria and do not show signs of metals accumulation or excessive salinity in the phytoremediation soil.

SHA recommends that the following measures be taken:

- Continue the groundwater monitoring program as per the OC.
- Continue the surface water monitoring program as per the OC.
- Continue the leachate monitoring program as per the OC.
- Continue the soil sampling program as per the OC.
- Conduct a one-time sample for VOCs at the leachate discharge compliance point for background levels as per the OC.
- Monitor maximum flow readings from Pump #5 to ensure that the phytoremediation discharge does not exceed the OC discharge criteria.
- Ensure that one duplicate sample is collected during each sampling event from one of the discharge points.
- Obtain and keep current, the laboratory precision, accuracy and blank quality control criteria for each laboratory analyzed parameters from the analytical laboratory.
- Develop a dynamic groundwater flow model with MODFLOW software to interpret groundwater flow patterns and leachate plume migration if leachate impacts are observed. More monitoring well locations must be added to the network to confirm if the conceptual model is accurate.

9. STATEMENT OF LIMITATIONS

This report has been prepared by Sperling Hansen Associates (SHA) on behalf of the Regional District of Kitimat-Stikine in accordance with generally accepted engineering practices to a level of care and skill normally exercised by other members of the engineering and science professions currently practicing under similar conditions in British Columbia, subject to the time limits and financial and physical constraints applicable to the services.

The report, which specifically includes all tables, charts, and figures, is based on engineering analysis by SHA staff of data compiled during the course of the project. Except where specifically stated to the contrary, the information on which this study is based has been obtained from external sources. This external information has not been independently verified or otherwise examined by Sperling Hansen Associates to determine its accuracy and completeness. Sperling Hansen Associates has relied in good faith on this information and does not accept responsibility of any deficiency, misstatements or inaccuracies contained in the reports as a result of omissions, misinterpretation and/or fraudulent acts of the persons interviewed or contacted, or errors or omissions in the reviewed documentation.

The report is intended solely for the use of the Regional District of Kitimat-Stikine. Any use which a third party makes of this report, or any reliance on, or decisions to be made based on it, are the responsibilities of such third parties. Sperling Hansen Associates does not accept any responsibility for other uses of the material contained herein nor for damages, if any, suffered by any third party because of decisions made or actions based on this report. Copying of this intellectual property for other purposes is not permitted.

The findings and conclusions of this report are valid only as of the date of this report. The interpretations presented in this report and the conclusions and recommendations that are drawn are based on information that was made available to Sperling Hansen Associates during the course of this project. Should additional new data become available in the future, Sperling Hansen Associates should be requested to re-evaluate the findings of this report and modify the conclusions and recommendations drawn, as required.

Report Prepared By:

Carly Wolfe, EIT
Bioresource Engineer

Report Reviewed By:

David Kvick M.Sc.,
Environmental Scientist

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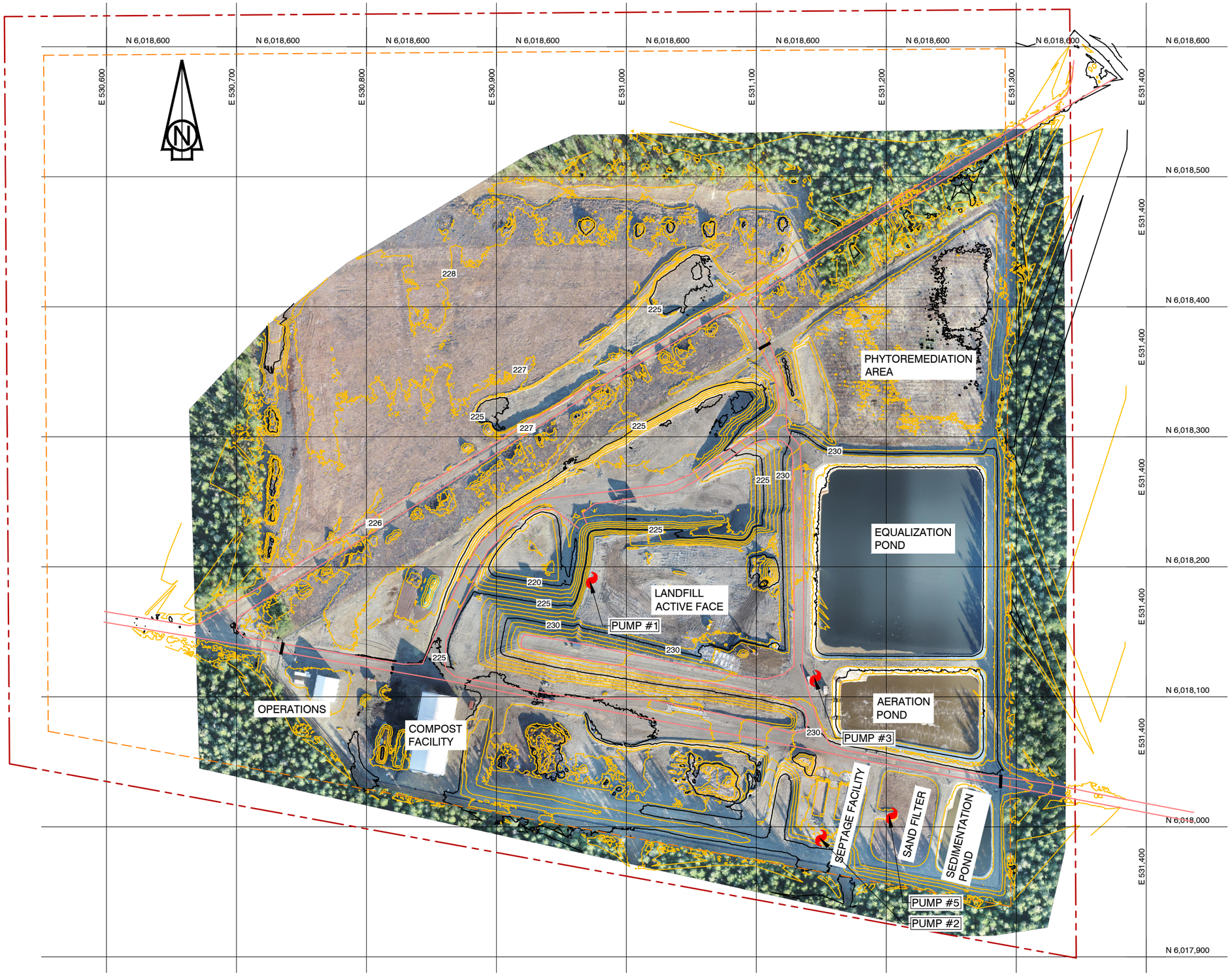
Appendix A: Figures



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Landfill Services Group

- Landfill Siting
- Design & Operations Plans
- Landfill Closure
- Environmental Monitoring

#8 - 1225 Keith Road East
North Vancouver, B.C. V7J 1J3
Phone: (604) 986-7723

LEGEND:

- 5m EXISTING CONTOUR
- 1m EXISTING CONTOUR
- LEGAL BOUNDARY
- 50m OFFSET FROM LEGAL BOUNDARY
- EXISTING ROAD
- EXISTING PUMP

CLIENT: Regional District of Kitimat-Stikine

PROJECT: FORCEMAN WMF ANNUAL WATER QUALITY MONITORING REPORT 2020

TITLE: **EXISTING TOPOGRAPHY NOVEMBER 6, 2020**

SCALE:	DATE:	PROJECT NO:
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DESIGNED	TS	DRAWING NO:
DRAWN	NL	**FIGURE 1**
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BACKGROUND LOCATION:
MW-13

EARLY WARNING LOCATIONS:
MW-01, MW-03, MW-15 & MW-16

COMPLIANCE MONITORING LOCATIONS:
MW-04, MW-07, MW-08 & MW-09

GROUNDWATER FLOW DIRECTION WELLS:
MW-01, MW-02, MW-05, MW-06, MW-10, MW-11, MW-12, & MW-14

SW-04
SW-05
SW-03
SW-02
SW-01
CLEARWATER CREEK
STEWART - CASSIAR HWY
ONION LAKE
LOWER CLEARWATER LAKE
UPPER CLEARWATER LAKE
MW-07
MW-08
MW-13
MW-02
PROPERTY LINE
SEE INSERT BELOW
SCULLY CREEK FOREST ROAD
CHIST CREEK FOREST ROAD
SS
LANDFILL
TL
MW-03
MW-01
MW-17 FUTURE
MW-16
MW-15
SITE BUILDING
MW-09
37
MW-04
MW-14
MW-05
MW-10
MW-12
MW-06
MW-11
© 2015 Google
© 2015 Cnes/Spot Image
©20 Google
0 500 1000m

INSERT

PHYTOREMEDIATION AREA
SCULLY CREEK FOREST ROAD
LANDFILL
EQ POND
AERATION POND
COMPOST FACILITYT
SEPTAGE FACILITY
SAND FILTER
SEDIMENTATION POND
F1
F2
F3
F4
F5
F6
MW-03
MW-16
MW-15
0 100 200m

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#8 - 1225 Keith Road East
North Vancouver, B.C. V7J 1J3
Phone: (604) 986-7723

LEGEND:

- ROAD
- PROPERTY LINE
- CREEK
- LANDFILL BOUNDARY
- MW-08 — MONITORING WELL
- SW-02 — SURFACE WATER MONITORING LOCATION
- TL — TREATED LEACHATE SAMPLE SITE AT CYCLONE
- SS — SOIL SAMPLE LOCATION
- PHYTOREMEDIATION AREA

LEACHATE SAMPLING LOCATIONS:

- F1 — RAW LANDFILL LEACHATE
- F2 — RAW SEPTAGE / COMPOSTING EFFLUENT
- F3 — AERATION POND INLET
- F4 — SEDIMENTATION POND INLET
- F5 — SAND CYCLONE (E249852)
- F6 — COMPOST FACILITY

CLIENT:
Regional District of Kitimat-Stikine

PROJECT:
FORCEMAN WMF ANNUAL WATER QUALITY MONITORING REPORT 2020

TITLE:
FORCEMAN LANDFILL MONITORING PROGRAM

SCALE:	DATE:	PROJECT NO:
N.T.S.	2021/04/18 yyyy/mm/dd	PRJ 21014

DESIGNED	TS	DRAWING NO:
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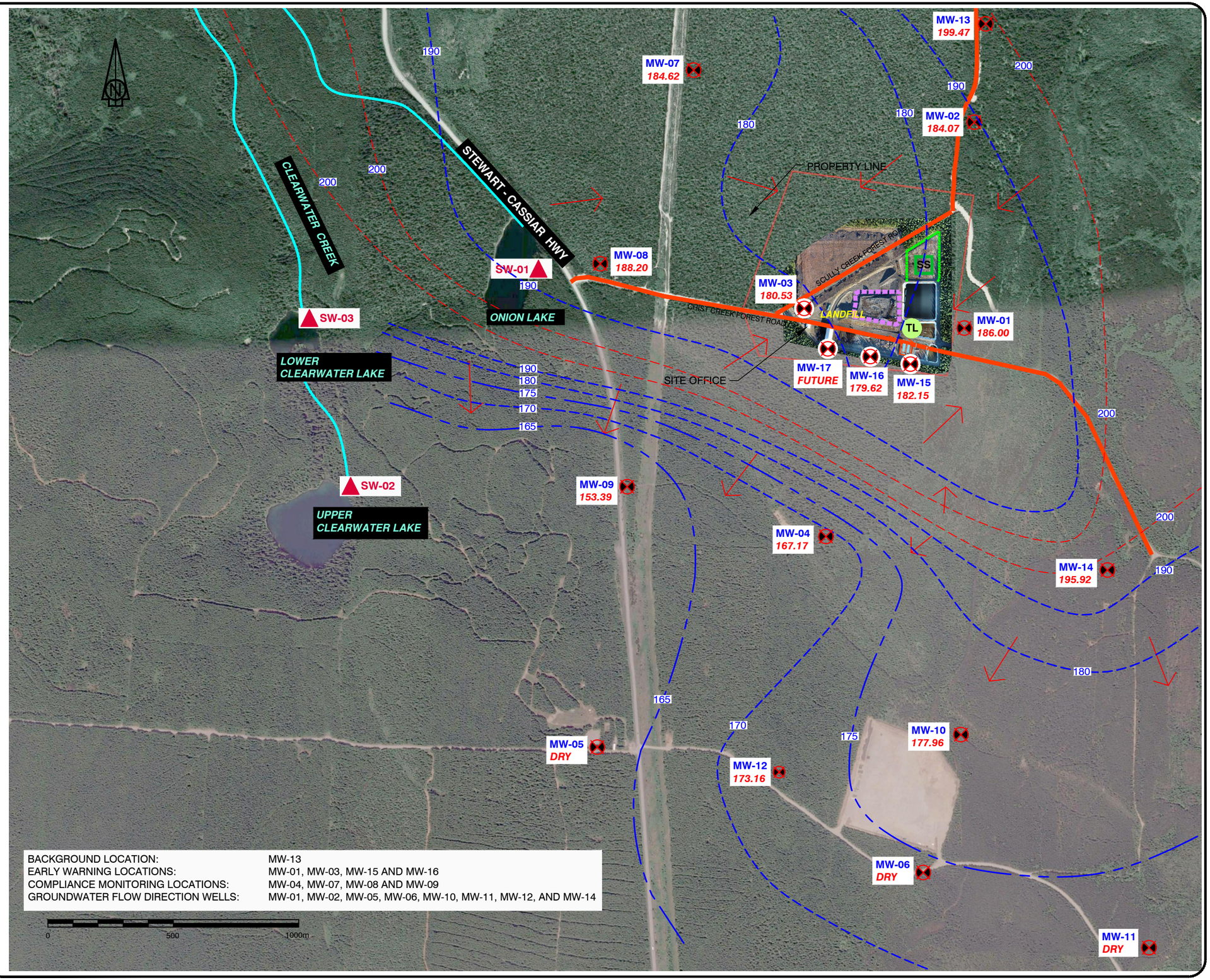

BACKGROUND LOCATION:	MW-13
EARLY WARNING LOCATIONS:	MW-01, MW-03, MW-15 AND MW-16
COMPLIANCE MONITORING LOCATIONS:	MW-04, MW-07, MW-08 AND MW-09
GROUNDWATER FLOW DIRECTION WELLS:	MW-01, MW-02, MW-05, MW-06, MW-10, MW-11, MW-12, AND MW-14

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Landfill Services Group
- Landfill Siting
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- Environmental Monitoring

#8 - 1225 Keith Road East
North Vancouver, B.C. V7J 1J3
Phone: (604) 986-7723

LEGEND:

- ROAD
- PROPERTY LINE
- CREEK
- LANDFILL BOUNDARY
- MW-08 / 184.90 — MONITORING WELL / GROUNDWATER ELEVATION (m ASL)
- SW-02 — SURFACE WATER MONITORING LOCATION
- TL — TREATED LEACHATE SAMPLE SITE AT CYCLONE
- SS — SOIL SAMPLE LOCATION
- PHYTOREMEDIATION AREA
- GROUNDWATER CONTOURS OCTOBER 2018
- FLOW DIRECTION
- GROUND WATER FLOW DIVIDE

CLIENT: Regional District of Kitimat-Stikine

PROJECT: FORCEMAN WMF ANNUAL WATER QUALITY MONITORING REPORT 2020

TITLE: **GROUNDWATER CONTOURS JUNE 2020**

SCALE:	DATE:	PROJECT NO:
N.T.S.	2021/04/18 yyyy/mm/dd	PRJ 21014

DESIGNED	TS	DRAWING NO: **FIGURE 3**
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Appendix B: Tables

Table 1. Forceman Landfill Monitoring Program

Monitoring Location	MOE Identifyer	Ground Elevation (mASL)	Top of Well Elevation (m)	Stick-up (m)	Well Bottom Elevation (m)	Well Depth (m)	Depth to Water* (m)	Water Column (m)	Well Type	Pump Installed (y/n)	Sampling Technique	Sampling Frequency	Field Readings	OC/RDKS Locations	Description	Comments
Groundwater Monitoring Wells																
MW-1	E251530	226.69	227.63	0.94	164.63	63.1	44.07	19.0	6"	Y	1" SS Pump	Annually	Quarterly	OC	Early Warning	
MW-2	E251531	230.43	231.43	1.00	171.43	60.0	43.76	16.2	6"			Annually	Quarterly	OC	Background	
MW-3	E251532	225.72	226.68	0.96	168.68	57.0	42.77	14.2	6"	Y	Supply Well Pump	Annually	Quarterly	OC	Early Warning	Supply well. Tap in site trailer.
MW-4	E251533	196.98	198.24	1.26	169.28	24.8	23.77	1.0	6"	Y	1.66" PVC Bladder	Annualy	Quarterly	OC	Compliance	
MW-5	E251534	209.33	210.46	1.13	151.02	59.4	45.37	14.1	6"	Y	Existing supply pump		Quarterly	OC	Water Elevation	
MW-6	E251535	200.30	201.53	1.23	166.48	35.1	32.05	3.0					Quarterly	OC	Water Elevation	
MW-7	E287379	229.93	230.82	0.89	164.63	44.2	44.44	-0.2	2"	Y	1" SS Pump	Annually	Quarterly	OC	Compliance	
MW-8	E287380	194.62	195.62	1.00	171.43	14.4	9.95	4.5	2"	Y	PVC Bladder	Annually	Quarterly	OC	Compliance	Has both barologger and level logger
MW-9	E287381		203.4		168.68	51.8	50.36	1.4	2"	Y	1" SS Pump	Annually	Quarterly	OC	Compliance	Level logger
MW-10	E287382		198.94		169.28	27.7	26.89	0.8	2"	Y	1" SS Pump		Quarterly	OC	Water Elevation	
MW-11	E287383		202.89		151.02	51.9	36.08	15.8					Quarterly	OC	Water Elevation	
MW-12	E287384	209.65	210.49	0.84	166.48	44.5	42.18	2.3	2"	Y	1" SS Pump		Quarterly	OC	Water Elevation	
MW-13	E287385	231.54	232.48	0.94		44.2	Dry	Dry	2"	Y	1" SS Pump	Annually	Quarterly	OC	Background	
MW-14	E287386	222.91	223.88	0.97			24.41						Quarterly	OC	Water Elevation	
MW-15-old						45.72	Dry	-	2" PVC							
MW15-new	E302210					61.53	44.47	17.0595	2" PVC		Bailer	Annually	Quarterly	OC	Early Warning	
MW-16-old						45.10	44.79	-	2" PVC							
MW16-new	E302211					61.55	45.05	16.503	2" PVC		Bailer	Annually	Quarterly	OC	Early Warning	
MW-17	Future Well													OC	Early Warning	Future well
Surface Water Monitoring Stations																
SW-1	E273828											Annually	Quarterly	OC	Onion Lake	
SW-2	E273829											Annually	Quarterly	OC	Upper Clearwater	
SW-3	E273831											Annually	Quarterly	OC	Lower Clearwater	
SW-4	E306587											Annually	Quarterly	OC	Ck. from Onion Lk	
SW-5	E296117											Annually	Quarterly	OC	Clearwater Ck.	
Leachate Monitoring																
F1														RDKS	Raw leachate	
F2														RDKS	Raw septage and leachate from composting	
F3														RDKS	Aeration pumping well into aeration pond	
F4														RDKS	Sedimentation pond gravity inflow	
F5	E249852											Annually	Quarterly	OC/RDKS	Sand filter pumping well	Treated leachate to phyto.
Soil Sampling																
Phyto Remediation	E306624											Annually	-	OC	Annual testing for metals before leachate discharge	

*average readings from historical sampling events

	Background Well
	Early Detection Wells
	Compliance Wells
	Surface Water Monitoring Stations
	Leachate Monitoring Locations
	Water level Monitoring
	Soil Sampling

Table 2: Groundwater Quality Results Sampling Location MW-2 (E251531)

Date		CSR Standards CSR-DW (2)	22-Oct-12	02-Apr-13	02-Oct-17	14-Nov-17	10-Apr-18	19-Jul-18	20-Nov-18	27-Mar-19	26-Jun-19	11-Jun-19
QA/QC Check												
Field	**Units**											
Conductivity	uS/cm	-			29.1	29.9	28	49	57	36.4	50	51
SPC	uS/cm	-										
pH	pH	-	-	-	6.36	6.31	5.84	5.97	6.48	7.02	6.57	
Dissolved Oxygen	mg/L	-	-	-	9.7	-	9.2	8.2	1.0	8.4	9.7	
Temperature	°C	-	-	-	4.3	4.5	4	4	4.4	4.4	4.6	4.6
Depth to Water	m	-	-	-	-	-	45.79	44.54	46.83	46.12	46.54	46.31
Elevation of Well	m	-										
Casing Height	m	-										
Analyte	Units											
Conductivity	uS/cm	-	18.8									
Hardness (as CaCO3)	mg/L	-	-	-	-	-	-	-	-	-	-	-
Hardness (as CaCO3), dissolved	mg/L	-	-	-	-	-	-	-	-	-	-	-
pH	pH	-	7	7	6.6	7.21	7.43			7.22	7.08	
Total Suspended Solids	mg/L	-	-	-	270					-	-	
Total Dissolved Solids	mg/L	-	9	-	24					-	-	
Alkalinity, Total (as CaCO3)	mg/L	-	12.6	13	24	-	22.2	31.1	25.2	22.6	27.2	
Ammonia, Total (as N)	mg/L	-	0.06	-	<0.03	<0.0050	<0.0050	0.0058	0.0134	0.0117	<0.0050	
Total Nitrogen as N	mg/L	-	0.317	-	0.383					-	-	
Bromide (Br)	mg/L	-							<0.050	<0.050	<0.050	
Chloride (Cl)	mg/L	250 (2)	ND	ND	<1	0.51	<0.50	<0.50	<0.50	<0.50	<0.50	
Fluoride (F)	mg/L	1.5 (2)	ND	ND	<0.1	-	0.021	0.027	0.023	0.049	0.025	
Nitrate (as N)	mg/L	10 (2)	ND	ND	<0.01	0.212	0.227	0.227	0.227	<0.0050	0.21	
Nitrite (as N)	mg/L	1.0 (2)	ND	ND	<0.1	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	
Sulfate (SO4)	mg/L	500 (2)	-	1.3	1.3	1.13	1.03	1.06	0.98	0.55	1.04	
Total Organic Carbon	mg/L	-	-	ND	-	-	0.85	8.43	6.4	3.85	1.22	
BOD	mg/L	-	-	-	-	-				-	-	
COD	mg/L	-	-	-	-	-	37	49	28	<20	<20	
Dissolved Metals												
Aluminum (Al)-Dissolved	mg/L	9.5 (2)	ND	ND	<0.005	0.0015	0.0015	0.002	0.0047	0.003	0.0028	
Antimony (Sb)-Dissolved	mg/L	0.006 (2)	ND	ND	<0.0002	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	
Arsenic (As)-Dissolved	mg/L	0.01 (2)	ND	0.000048	0.0005	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	
Barium (Ba)-Dissolved	mg/L	1.0 (2)	0.0018	0.0014	0.0085	0.0192	0.00867	0.0092	0.00828	0.00967	0.0114	
Beryllium (Be)-Dissolved	mg/L	0.008 (2)	ND	ND	<0.0001	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	
Bisumuth - Dissolved	mg/L	-	ND	ND	<0.0001	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	
Boron (B)-Dissolved	mg/L	5.0 (2)	ND	ND	<0.005	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	
Cadmium (Cd)-Dissolved	mg/L	0.005 (2)	0.000074	ND	0.000014	0.0000129	0.000029	0.0000234	0.00008	0.0000456	0.0000367	
Calcium (Ca)-Dissolved	mg/L	-	-	-	5.99	-	6.12	7.75	8.8	7.58	7.58	
Cesium (Cs) - Dissolved	mg/L	-	-	-		-	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	
Chromium (Cr)-Dissolved	mg/L	0.05 - 6.0 (2)	ND	ND	<0.0005	<0.00010	<0.00010	<0.00010	0.00011	0.00012	<0.00010	
Cobalt (Co)-Dissolved	mg/L	0.001 (2)	ND	0.00003	0.00012	0.00016	0.00014	0.00015	<0.00010	0.00024	0.00032	
Copper (Cu)-Dissolved	mg/L	1.5 (2) AO	0.00071	ND	<0.0004	<0.00020	<0.00020	<0.00020	0.00034	<0.00020	<0.00020	
Iron (Fe)-Dissolved	mg/L	6.5 (2)	ND	0.953	<0.01	0.060	0.074	<0.010	0.014	0.048	0.125	
Lead (Pb)-Dissolved	mg/L	0.01 (2)	ND	ND	<0.0002	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	
Lithium (Li)-Dissolved	mg/L	0.008 (2)	ND	ND	0.00012	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	
Magnesium (Mg)-Dissolved	mg/L	-	0.118	ND	0.763	0.658	0.62	0.832	0.956	0.724	0.741	
Manganese (Mn)-Dissolved	mg/L	1.5 (2)	0.137	0.153	0.0313	0.0461	0.032	0.0613	0.0495	0.0508	0.0613	
Mercury (Hg)-Dissolved	mg/L	0.001 (2)	ND	ND	<0.00001	<0.0000050	<0.0000050	<0.0000050	<0.0000050	0.0000074	<0.0000050	
Molybdenum (Mo)-Dissolved	mg/L	0.25 (2)	ND	0.000125	<0.0001	0.000062	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	
Nickel (Ni)-Dissolved	mg/L	0.08 (2)	-	-	0.00055	0.00059	0.00073	0.00061	0.00071	0.00055	0.00054	
Phosphorus - Dissolved	mg/L	-	-	-	<0.05	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	
Potassium (K)-Dissolved	mg/L	-	-	-	0.35	-	0.367	0.423	0.444	0.393	0.411	
Rubidium (Rb) - Dissovled	mg/L	-	-	-		-	0.00036	0.0005	0.0005	0.00042	0.00043	
Selenium (Se)-Dissolved	mg/L	0.01 (2)	ND	ND	<0.0005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	
Silicon - Dissolved	mg/L	-	0.276	0.156	6.1	5.66	5.7	5.62	5.54	6.09	5.75	
Silver (Ag)-Dissolved	mg/L	0.02 (2)	ND	ND	<0.00005	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	
Sodium (Na)-Dissolved	mg/L	200 (2)	1.89	1.64	1.66	2.03	1.6	1.64	1.71	1.64	1.68	
Strontium - Dissolved	mg/L	-	0.0185	0.0193	0.0417	0.0432	0.0483	0.0557	0.0483	0.0536	0.058	
Sulfur- Dissolved	mg/L	-	-	-	<3	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	
Tellurium - Dissolved	mg/L	-	-	-	<0.0005	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	
Thallium (Tl)-Dissolved	mg/L	-	-	-	<0.00002	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	
Thorium - Dissolved	mg/L	-	-	-	<0.0001	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	
Tin (Sn)-Dissolved	mg/L	2.5 (2)	ND	ND	<0.0002	<0.00010	<0.00010	<0.00010	0.00028	<0.00010	<0.00010	
Titanium (Ti)-Dissolved	mg/L	-	-	-	<0.005	-	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	
Tungsten (W) - Dissovled	mg/L	0.003 (2)	-	-		-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	
Uranium (U)-Dissolved	mg/L	0.020	ND	ND	<0.00002	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	
Vanadium (V)-Dissolved	mg/L	0.020 (2)	ND	ND	<0.001	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	
Zinc (Zn)-Dissolved	mg/L	3.0 (2)	ND	ND	<0.004	0.0013	<0.0010	<0.0010	<0.0010	<0.0010	0.001	
Zirconium - Dissolved	mg/L	-	ND	ND	<0.0001	<0.000060	<0.000060	<0.000060	<0.000060	<0.000060	<0.00020	

NOTES

(1) BC MoE Approved and Working Water Quality Guidelines, last updated March 2018
(2) BC Contaminated Sites Regulation (CSR) for drinking water, Schedule 3.2, last updated January 2019
(3) All criteria limits for BCWQG - Drinking Quality Guidelines based on Total Metal Concentration except Aluminum (Dissolved)
(4) BC MoE Water Quality Guidelines for Protection of Wildlife
(a) Range based on max pH 8.5 to min pH 6.5 at temperature of 6.0 'C
(b) at pH less than 6.5, limit is determined by regression equation, else limit is 0.1 mg/L.
(c) Limit for dissolved metals, not total metals
(d) Limit dependent upon hardness.
(e) Limit for chromium(VI) - data reported by lab as total chromium - limit assumes 100% chromium VI in sample
(f) Where hardness data was unavailable, 50 mg/L was assumed
(g) Maximum value
(h) Limit dependent upon chloride concentration
(i) Change of 25 mg/L from background for a duration of 24 hours during clear flows. Change of 10% of background during turbid flows

** Criteria exceeds detection limit*
MAC = Maximum Acceptable Concentration
AO = Aesthetic Objective

CSR-DW *BC Contaminated Sites Regulation Water Quality Guidelines for Drinking Water*

Table 2: Groundwater Quality Results Sampling Location MW-2 (E251531)

Date		CSR Standards CSR-DW (2)	29-Jun-20	14-Aug-20	03-Nov-20
QA/QC Check			monitor	monitor	
Field	**Units**				
Conductivity	uS/cm	-	60	64	28.7
SPC	uS/cm	-			47
pH	pH	-	-	-	5.95
Dissolved Oxygen	mg/L	-	-	-	7.9
Temperature	°C	-	4.0	4.2	4.2
Depth to Water	m	-	55.93	55.9	46.8
Elevation of Well	m	-			240
Casing Height	m	-			0.83
Analyte	Units				
Conductivity	uS/cm	-			48.5
Hardness (as CaCO3)	mg/L	-			
Hardness (as CaCO3), dissolved	mg/L	-			20.3
pH	pH	-			6.93
Total Suspended Solids	mg/L	-			-
Total Dissolved Solids	mg/L	-			-
Alkalinity, Total (as CaCO3)	mg/L	-			20.9
Ammonia, Total (as N)	mg/L	-			0.0771
Total Nitrogen as N	mg/L	-			-
Bromide (Br)	mg/L	-			-
Chloride (Cl)	mg/L	250 (2)			<0.50
Fluoride (F)	mg/L	1.5 (2)			<0.020
Nitrate (as N)	mg/L	10 (2)			0.256
Nitrite (as N)	mg/L	1.0 (2)			<0.0010
Sulfate (SO4)	mg/L	500 (2)			0.93
Total Organic Carbon	mg/L	-			1.57
BOD	mg/L	-			-
COD	mg/L	-			<20
Dissolved Metals					
Aluminum (Al)-Dissolved	mg/L	9.5 (2)			0.0024
Antimony (Sb)-Dissolved	mg/L	0.006 (2)			<0.00010
Arsenic (As)-Dissolved	mg/L	0.01 (2)			0.00014
Barium (Ba)-Dissolved	mg/L	1.0 (2)			0.0114
Beryllium (Be)-Dissolved	mg/L	0.008 (2)			<0.000100
Bisumuth - Dissolved	mg/L	-			<0.000050
Boron (B)-Dissolved	mg/L	5.0 (2)			<0.010
Cadmium (Cd)-Dissolved	mg/L	0.005 (2)			0.0000787
Calcium (Ca)-Dissolved	mg/L	-			7.13
Cesium (Cs) - Dissolved	mg/L	-			<0.000010
Chromium (Cr)-Dissolved	mg/L	0.05 - 6.0 (2)			<0.00010
Cobalt (Co)-Dissolved	mg/L	0.001 (2)			0.00016
Copper (Cu)-Dissolved	mg/L	1.5 (2) AO			0.00163
Iron (Fe)-Dissolved	mg/L	6.5 (2)			0.059
Lead (Pb)-Dissolved	mg/L	0.01 (2)			<0.000050
Lithium (Li)-Dissolved	mg/L	0.008 (2)			<0.0010
Magnesium (Mg)-Dissolved	mg/L	-			0.610
Manganese (Mn)-Dissolved	mg/L	1.5 (2)			0.0346
Mercury (Hg)-Dissolved	mg/L	0.001 (2)			<0.0000050
Molybdenum (Mo)-Dissolved	mg/L	0.25 (2)			<0.000050
Nickel (Ni)-Dissolved	mg/L	0.08 (2)			<0.00050
Phosphorus - Dissolved	mg/L	-			<0.050
Potassium (K)-Dissolved	mg/L	-			0.444
Rubidium (Rb) - Dissovled	mg/L	-			0.00044
Selenium (Se)-Dissolved	mg/L	0.01 (2)			<0.000050
Silicon - Dissolved	mg/L	-			5.83
Silver (Ag)-Dissolved	mg/L	0.02 (2)			<0.000010
Sodium (Na)-Dissolved	mg/L	200 (2)			1.80
Strontium - Dissolved	mg/L	-			0.0638
Sulfur- Dissolved	mg/L	-			<0.50
Tellurium - Dissolved	mg/L	-			<0.00020
Thallium (Tl)-Dissolved	mg/L	-			<0.000010
Thorium - Dissolved	mg/L	-			<0.00010
Tin (Sn)-Dissolved	mg/L	2.5 (2)			<0.00010
Titanium (Ti)-Dissolved	mg/L	-			<0.00030
Tungsten (W) - Dissovled	mg/L	0.003 (2)			<0.00010
Uranium (U)-Dissolved	mg/L	0.020			<0.000010
Vanadium (V)-Dissolved	mg/L	0.020 (2)			<0.00050
Zinc (Zn)-Dissolved	mg/L	3.0 (2)			0.0032
Zirconium - Dissolved	mg/L	-			<0.00020

NOTES

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(3) All criteria limits for BCWQG - Drinking Quality Guidelines based on Total Metal Concentratio
(4) BC MoE Water Quality Guidelines for Protection of Wildlife
(a) Range based on max pH 8.5 to min pH 6.5 at temperature of 6.0 'C
(b) at pH less than 6.5, limit is determined by regression equation, else limit is 0.1 mg/L.
(c) Limit for dissolved metals, not total metals
(d) Limit dependent upon hardness.
(e) Limit for chromium(VI) - data reported by lab as total chromium - limit assumes 100% chromium
(f) Where hardness data was unavailable, 50 mg/L was assumed
(g) Maximum value
(h) Limit dependent upon chloride concentration
(i) Change of 25 mg/L from background for a duration of 24 hours during clear flows. Change of 10

** Criteria exceeds detection limit*
MAC = Maximum Acceptable Concentration
AO = Aesthetic Objective

CSR-DW *BC Contaminated Sites Regulation Water (*

Table 3: Groundwater Quality Results Sampling Location MW-13 (E287385)

		CSR Standards CSR-DW (2)	22-Oct-12	03-Apr-13	12-Jun-13	05-Apr-17	06-Jul-17	14-Nov-17	11-Jun-19	26-Jun-19	29-Jun-20 Monitor	14-Aug-20 Dry	03-Nov-20 Dry
Field	**Units**									**Dry**			
Conductivity	uS/cm	-				31	81	17.7			30		
pH	pH	-	-	-	-	6.5	7.8	5.88			-	-	-
Temperature	°C	-	-	-	-	4.5	4.7	4.1			3.8	-	-
Dissolved Oxygen	mg/L	-	-	-	-	-	4.3	11			-	-	-
Depth to Water	m	-	-	-	-	-	-	-		44	43.53	-	-
Elevation of Well	m												243
Casing Height	m												0.78
Analyte	Units												
Conductivity	uS/cm	-	17.2	-	-	145		-					
Hardness (as CaCO3)	mg/L	-	-	27.3	-	-	25.5	11.6			-	-	-
Hardness (as CaCO3)	mg/L												
pH	pH	-	6	6.7	-	8	8	6.86			-	-	-
Total Suspended Solids	mg/L	-	-	-		1.1					-	-	-
Total Dissolved Solids	mg/L	-	8	-	-	82					-	-	-
Alkalinity, Total (as CaCO3)	mg/L	-	10.6	32	56.7	-	37	12.2			-	-	-
Ammonia, Total (as N)	mg/L	-	ND	-	<0.03	<0.03	<0.03	0.0127			-	-	-
Total Nitrogen as N	mg/L	-	0.25	-	-						-	-	-
Bromide (Br)	mg/L	-									-	-	-
Chloride (Cl)	mg/L	250 (2)	ND	ND	-	1.1	1.4	<0.50					
Fluoride (F)	mg/L	1.5 (2)	ND	ND	-	-	<0.10	0.023			-	-	-
Nitrate (as N)	mg/L	10 (2)	0.047	0.057	-	<0.01	<0.01	0.14			-	-	-
Nitrite (as N)	mg/L	1.0 (2)	0.0052	ND	-	-	0.15	<0.0010			-	-	-
Sulfate (SO4)	mg/L	500 (2)	-	1.52	-	2.6	2.6	0.48			-	-	-
Total Organic Carbon	mg/L	-	-	ND	-	-	<0.50	1.89			-	-	-
BOD	mg/L	-	-	-	-	-					-	-	-
COD	mg/L	-	-	-	-	-	-	<20			-	-	-
Dissolved Metals													
Aluminum (Al)-Dissolved	mg/L	9.5 (2)	0.0170	0.0096	-	<0.0050	0.0468	0.0309			-	-	-
Antimony (Sb)-Dissolved	mg/L	0.006(2)	ND	0.000082	-	<0.00010	0.00035	<0.00010			-	-	-
Arsenic (As)-Dissolved	mg/L	0.01(2)	ND	0.00068	-	0.00159	<0.00050	<0.00010			-	-	-
Barium (Ba)-Dissolved	mg/L	1.0(2)	0.0145	0.0101	-	0.018	<0.0050	0.0187			-	-	-
Beryllium (Be)-Dissolved	mg/L	0.008(2)	ND	ND	-	<0.00010	<0.00010	<0.00010			-	-	-
Bisumuth - Dissolved	mg/L	-	ND	ND	-	<0.00010	<0.00010	<0.000050			-	-	-
Boron (B)-Dissolved	mg/L	5.0(2)	ND	ND	-	<0.004	<0.0050	<0.010			-	-	-
Cadmium (Cd)-Dissolved	mg/L	0.005(2)	0.000053	0.000127	-	<0.00001	0.00008	0.0000119			-	-	-
Calcium (Ca)-Dissolved	mg/L	-	-	-	-	-	8.92	4.05			-	-	-
Cessium - Di	mg/L	-	-	-	-	-	-	-			-	-	-
Chromium (Cr)-Dissolved	mg/L	0.05 - 6.0 (2)	ND	ND	-	<0.0005	<0.00050	<0.00010			-	-	-
Cobalt (Co)-Dissolved	mg/L	0.001 (2)	ND	0.000022	-	<0.00005	<0.00010	<0.00010			-	-	-
Copper (Cu)-Dissolved	mg/L	1.5 (2) AO	0.00120	0.02020	-	<0.0002	0.00033	<0.00020			-	-	-
Iron (Fe)-Dissolved	mg/L	6.5(2)	ND	ND		<0.010	<0.010	<0.010					
Lead (Pb)-Dissolved	mg/L	0.01(2)	ND	0.000159	-	<0.0001	<0.00010	<0.000050			-	-	-
Lithium (Li)-Dissolved	mg/L	0.008 (2)	ND	ND	-	0.001	0.00012	<0.0010			-	-	-
Magnesium (Mg)-Dissolved	mg/L	-	0.290	0.860	-	1.82	0.21	0.370			-	-	-
Manganese (Mn)-Dissolved	mg/L	1.5 (2)	0.0036	0.00937		0.00026	0.00287	0.00121					
Mercury (Hg)-Dissolved	mg/L	0.001(2)	ND	ND	-	<0.00002	<0.000020	<0.0000050			-	-	-
Molybdenum (Mo)-Dissolved	mg/L	0.25(2)	ND	0.000059	-	0.0003	0.00471	<0.000050			-	-	-
Nickel (Ni)-Dissolved	mg/L	0.08 (2)	-	-	-	<0.0002	0.00021	<0.00050			-	-	-
Phosphorus - Dissolved	mg/L	-	-	-	-	<0.05	<0.050	<0.050			-	-	-
Potassium (K)-Dissolved	mg/L	-	-	-	-	-	0.87	0.225			-	-	-
Rubidium - (Rb)- Dissolved	mg/L	-	-	-	-	-	-	-			-	-	-
Selenium (Se)-Dissolved	mg/L	0.01 (2)	ND	ND	-	<0.00050	<0.00050	0.000076			-	-	-
Silicon - Dissolved	mg/L	-	2.98	3.21	-	4.8	<1.0	2.98			-	-	-
Silver (Ag)-Dissolved	mg/L	0.02 (2)	ND	ND	-	<0.00005	<0.000050	<0.000010			-	-	-
Sodium (Na)-Dissolved	mg/L	200(2)	1.02	1.28	-	1.69	5.55	0.825			-	-	-
Strontium - Dissolved	mg/L	-	0.0375	0.0605	-	0.0864	0.0629	0.0510			-	-	-
Sulfur- Dissolved	mg/L	-	-	-	-	<3.0	<3.0	<0.50			-	-	-
Tellurium (Te) - Dissolved	mg/L	-	-	-	-	<0.00020	<0.00020	<0.00020			-	-	-
Thallium (Tl)-Dissolved	mg/L	-	-	-	-	<0.00002	<0.000020	<0.000010			-	-	-
Thorium (Th)- Dissolved	mg/L	-	-	-	-	<0.00010	<0.00010	<0.00010			-	-	-
Tin (Sn)-Dissolved	mg/L	2.5 (2)	ND	ND	-	<0.00020	0.00975	<0.00010			-	-	-
Titanium (Ti)-Dissolved	mg/L	-	-	-	-	-	<0.0050	<0.00030			-	-	-
Tungsten (W) - Dissolved	mg/L	0.003 (2)	-	-	-	-	-	<0.00010			-	-	-
Uranium (U)-Dissolved	mg/L	0.020	ND	0.000044	-	0.0001	<0.000020	-			-	-	-
Vanadium (V)-Dissolved	mg/L	0.020 (2)	ND	ND	-	<0.0010	<0.0010	-			-	-	-
Zinc (Zn)-Dissolved	mg/L	3.0 (2)	ND	0.379	-	<0.0040	<0.0040	-			-	-	-
Zirconium - Dissolved	mg/L	-	ND	ND	-	<0.00010	<0.00010	-			-	-	-

NOTES

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(4) BC MoE Water Quality Guidelines for Protection of Wildlife
(a) Range based on max pH 8.5 to min pH 6.5 at temperature of 6.0 'C
(b) at pH less than 6.5, limit is determined by regression equation, else limit is 0.1 mg/L.
(c) Limit for dissolved metals, not total metals
(d) Limit dependent upon hardness.
(e) Limit for chromium(VI) - data reported by lab as total chromium - limit assumes 100% chromium VI in sample
(f) Where hardness data was unavailable, 50 mg/L was assumed
(g) Maximum value
(h) Limit dependent upon chloride concentration
(i) Change of 25 mg/L from background for a duration of 24 hours during clear flows. Change of 10% of background during turbid flows

** Criteria exceeds detection limit*
MAC = Maximum Acceptable Concentration
AO = Aesthetic Objective

CSR-DW *BC Contaminated Sites Regulation Water Quality Guidelines for Drinking Water*

Table 4: Groundwater Quality Results Sampling Location MW-1 (E251530)

		CSR Standards CSR-DW (2)	22-Oct-12	02-Apr-13	05-Apr-17	06-Jul-17	02-Oct-17	14-Nov-17	09-Apr-18	18-Jul-18	20-Nov-18	25-Mar-19
QA/QC Check												
Field	**Units**											
Conductivity	uS/cm	-	-		129	28.8	34.4	32.6	29.3	36	42	28.3
SPC	uS/cm											
pH	pH	-	-	-	7.9	8.3	6.49	6.33	5.81	5.75	6.15	6.74
Dissolved Oxygen	mg/L	-	-	-	-	2.5	-	9.8	8.6	7.3	0.8	10.5
Temperature	°C	-	-	-	5.8	6.8	5	4.7	4.8	5.1	5	5
Depth to Water	m	-	-	-	-	-	-	-	45.91	44.74	46.54	46.84
Elevation of Well	m	-										
Height of Casing	m	-										
Analyte	Units											
Conductivity	uS/cm	-	15.2	-	-		58.9	-				-
Hardness (as CaCO3)	mg/L	-	-	10.4	13.1	6.15	-	23.1	19.7	19.3	15.8	14
Hardness (as CaCO3), dissolved	mg/L											
pH	pH	-	6.8	7	6.7	6	6.8	7.26	7.52			6.68
Total Suspended Solids	mg/L	-	-	-	230							-
Total Dissolved Solids	mg/L	-	7	-	-		29					-
Alkalinity, Total (as CaCO3)	mg/L	-	10.2	13.6	18	12	-	27	28.1	1	21.9	15.7
Ammonia, Total (as N)	mg/L	-	0.19	-	<0.03	0.06	<0.03	<0.005	0.0066	0.0082	<0.0050	0.0117
Total Nitrogen as N	mg/L	-	0.322	-	-		0.175					-
Total Kjeldahl nitrogen (TKN)	mg/L											
Bromide (Br)	mg/L	-								<0.050	<0.050	<0.050
Chloride (Cl)	mg/L	250 (2)	ND	ND	<1.0	1.3	<1.0	<0.5	<0.50	<0.50	<0.50	0.56
Fluoride (F)	mg/L	1.5 (2)	ND	ND	<0.10	<0.10	-	0.044	0.051	0.047	0.043	0.034
Nitrate (as N)	mg/L	10 (2)	ND	ND	0.041	0.2	<0.01	0.156	0.148	0.166	0.166	0.0216
Nitrite (as N)	mg/L	1.0 (2)	ND	ND	<0.01	<0.01	-	<0.001	<0.0010	<0.0010	<0.0010	<0.0010
Sulfate (SO4)	mg/L	500 (2)	-	1.06	1.1	<1.0	<1.0	0.64	0.66	0.65	0.67	1.07
Total Organic Carbon	mg/L	-	-	2.14	0.59	1.1	-	0.52	3.76	1.95	5.2	4.46
BOD	mg/L	-	-	-	-		-					-
COD	mg/L	-	-	-	-	-	-	<20	<20	<20	23	<20
Dissolved Metals												
Aluminum (Al)-Dissolved	mg/L	9.5 (2)	ND	ND	<0.0050	<0.0050	<0.005	0.0024	0.0024	0.0039	0.0038	0.0035
Antimony (Sb)-Dissolved	mg/L	0.006 (2)	ND	0.000056	<0.00010	<0.00010	<0.0002	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Arsenic (As)-Dissolved	mg/L	0.01 (2)	ND	0.000201	<0.00050	<0.00050	<0.0005	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Barium (Ba)-Dissolved	mg/L	1.0 (2)	0.0013	0.00155	0.0137	<0.0050	0.0071	0.00683	0.0057	0.00587	0.00563	0.00551
Beryllium (Be)-Dissolved	mg/L	0.008 (2)	ND	ND	<0.00010	<0.00010	<0.0001	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Bisumuth - Dissolved	mg/L	-	ND	ND	<0.00010	<0.00010	<0.0001	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Boron (B)-Dissolved	mg/L	5.0 (2)	ND	ND	0.008	<0.0050	<0.005	<0.010	<0.010	<0.010	<0.010	<0.010
Cadmium (Cd)-Dissolved	mg/L	0.005 (2)	0.000016	0.000008	0.00002	0.000034	0.000023	0.0000573	0.0000309	0.0000183	0.0000939	0.0000906
Calcium (Ca)-Dissolved	mg/L	-	-	-	4.49	2.23	-	8.01	6.53	6.33	5.24	4.74
Cesium (Cs)- Dissolved	mg/L	-	-	-	-	-	-	-	<0.000010	<0.000010	<0.000010	<0.000010
Chromium (Cr)-Dissolved	mg/L	0.05 - 6.0 (2)	ND	ND	<0.0005	<0.00050	<0.0005	<0.00010	0.00013	0.00014	0.00012	0.00016
Cobalt (Co)-Dissolved	mg/L	0.001 (2)	ND	0.000764	0.00211	0.0002	0.00014	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Copper (Cu)-Dissolved	mg/L	1.5 (2) AO	0.00069	ND	0.0005	0.00022	<0.0004	<0.00020	<0.00020	<0.00020	0.00024	<0.00020
Iron (Fe)-Dissolved	mg/L	6.5 (2)	0.0082	0.0923	0.735	<0.010	<0.01	0.012	<0.010	<0.010	0.011	0.011
Lead (Pb)-Dissolved	mg/L	0.01 (2)	ND	ND	<0.0001	<0.00010	<0.0002	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Lithium (Li)-Dissolved	mg/L	0.008 (2)	ND	ND	<0.0001	0.00055	<0.0001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Magnesium (Mg)-Dissolved	mg/L	-	0.149	0.31	0.457	0.213	0.79	0.755	0.831	0.849	0.66	0.534
Manganese (Mn)-Dissolved	mg/L	1.5 (2)	0.374	0.339	0.39	0.356	0.032	0.0198	0.00776	0.00517	0.00575	0.00319
Mercury (Hg)-Dissolved	mg/L	0.001 (2)	ND	ND	<0.00002	<0.000020	<0.00001	<0.0000050	<0.0000050	<0.0000050	<0.0000050	0.0000057
Molybdenum (Mo)-Dissolved	mg/L	0.25 (2)	ND	0.000284	0.00016	<0.00010	<0.0001	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Nickel (Ni)-Dissolved	mg/L	0.08 (2)	-	-	0.0065	0.00105	<0.0004	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Phosphorus - Dissolved	mg/L	-	-	-	<0.05	<0.050	<0.05	<0.050	<0.050	<0.050	<0.050	<0.050
Potassium (K)-Dissolved	mg/L	-	-	-	0.27	1.09	-	0.270	0.25	0.273	0.27	0.255
Rubidium (Rb) - Dissolved	mg/L	-	-	-	-	-	-	-	0.00036	0.00039	0.00037	0.00037
Selenium (Se)-Dissolved	mg/L	0.01 (2)	ND	0.000056	<0.00050	<0.00050	<0.0005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Silicon - Dissolved	mg/L	-	0.481	0.22	2.8	1.1	5.4	5.10	5.23	4.93	5.28	5.47
Silver (Ag)-Dissolved	mg/L	0.02 (2)	ND	ND	<0.00005	<0.000050	<0.00005	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)-Dissolved	mg/L	200 (2)	1.70	1.35	1.57	1.95	1.4	1.29	1.4	1.5	1.55	1.4
Strontium - Dissolved	mg/L	-	0.0153	0.0326	0.0393	0.0161	0.0423	0.0439	0.0454	0.0446	0.0408	0.0434
Sulfur- Dissolved	mg/L	-	-	-	<3.0	<3.0	<3	<0.50	<0.50	<0.50	<0.50	<0.50
Tellurium - Dissolved	mg/L	-	-	-	<0.00020	<0.00020	<0.0005	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Thallium (Tl)-Dissolved	mg/L	-	-	-	<0.00002	<0.000020	<0.00002	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Thorium - Dissolved	mg/L	-	-	-	<0.00010	<0.00010	<0.0001	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Tin (Sn)-Dissolved	mg/L	2.5 (2)	ND	ND	<0.00020	<0.00020	<0.0002	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)-Dissolved	mg/L	-	-	-	<0.0050	<0.0050	-	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
Tungston (W) - Dissolved	mg/L	0.003 (2)	-	-	-	-	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Uranium (U)-Dissolved	mg/L	0.020	ND	ND	<0.00002	<0.000020	<0.00002	-	<0.000010	<0.000010	<0.000010	<0.000010
Vanadium (V)-Dissolved	mg/L	0.020 (2)	ND	ND	<0.0010	<0.0010	<0.001	-	<0.00050	<0.00050	<0.00050	<0.00050
Zinc (Zn)-Dissolved	mg/L	3.0 (2)	ND	ND	0.0178	<0.0040	<0.004	-	<0.0010	<0.0010	0.0011	<0.0010
Zirconium - Dissolved	mg/L	-	ND	ND	<0.00010	<0.00010	<0.0001	-	<0.000060	<0.000060	<0.000060	<0.000060

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** Criteria exceeds detection limit*
MAC = Maximum Acceptable Concentration
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CSR-DW *BC Contaminated Sites Regulation Water Quality Guidelines for Drinking Water*

Table 4: Groundwater Quality Results Sampling Location MW-1 (E251530)

		CSR Standards CSR-DW (2)	26-Jun-19	11-Jun-19	29-Jun-20	14-Aug-20	04-Nov-20	04-Nov-20	
QA/QC Check									
Field	**Units**				monitor	monitor	sample	Dup	RPD
Conductivity	uS/cm	-	38	37	40		23.6		
SPC	uS/cm						36.8	-	-
pH	pH	-	6.29		-	-	5.73	-	-
Dissolved Oxygen	mg/L	-	9.5		-	-	9.8	-	-
Temperature	°C	-	5.4	5.1	5.9	-	5.1	-	-
Depth to Water	m	-	46.83	46.84	57	>60	47.08	-	-
Elevation of Well	m	-					243	-	-
Height of Casing	m	-					0.98	-	-
Analyte	Units								
Conductivity	uS/cm	-	-		-	-	36.9	36.8	0%
Hardness (as CaCO3)	mg/L	-	14.1		-	-		-	-
Hardness (as CaCO3), dissolved	mg/L				-	-	14.9	14.9	0%
pH	pH	-	7.34		-	-	6.98	6.98	0%
Total Suspended Solids	mg/L	-	-		-	-	-	-	-
Total Dissolved Solids	mg/L	-	-		-	-	-	-	-
Alkalinity, Total (as CaCO3)	mg/L	-	15.3		-	-	16.1	17.2	7%
Ammonia, Total (as N)	mg/L	-	<0.0050		-	-	<0.0050	<0.0050	-
Total Nitrogen as N	mg/L	-	-		-	-	-	-	-
Total Kjeldahl nitrogen (TKN)	mg/L						0.145	0.106	31%
Bromide (Br)	mg/L	-	<0.050		-	-	-	-	-
Chloride (Cl)	mg/L	250 (2)	<0.50				<0.50	<0.50	-
Fluoride (F)	mg/L	1.5 (2)	0.047		-	-	0.044	0.045	2%
Nitrate (as N)	mg/L	10 (2)	0.168		-	-	0.195	0.192	2%
Nitrite (as N)	mg/L	1.0 (2)	0.003		-	-	<0.0010	<0.0010	-
Sulfate (SO4)	mg/L	500 (2)	0.78		-	-	0.67	0.68	1%
Total Organic Carbon	mg/L	-	3.19		-	-	2.1	2.09	0%
BOD	mg/L	-	-		-	-	-	-	-
COD	mg/L	-	<20		-	-	<20	<20	-
Dissolved Metals									
Aluminum (Al)-Dissolved	mg/L	9.5 (2)	0.0032		-	-	0.0084	0.0082	2%
Antimony (Sb)-Dissolved	mg/L	0.006(2)	<0.00010		-	-	<0.00010	<0.00010	-
Arsenic (As)-Dissolved	mg/L	0.01(2)	<0.00010		-	-	<0.00010	<0.00010	-
Barium (Ba)-Dissolved	mg/L	1.0(2)	0.00603		-	-	0.00542	0.00552	2%
Beryllium (Be)-Dissolved	mg/L	0.008(2)	<0.00010		-	-	<0.000100	<0.000100	-
Bisumuth - Dissolved	mg/L	-	<0.000050		-	-	<0.000050	<0.000050	-
Boron (B)-Dissolved	mg/L	5.0(2)	<0.010		-	-	<0.010	<0.010	-
Cadmium (Cd)-Dissolved	mg/L	0.005(2)	0.00018		-	-	0.0000264	0.0000424	47%
Calcium (Ca)-Dissolved	mg/L	-	4.81		-	-	5.14	5.16	0%
Cesium (Cs)- Dissolved	mg/L	-	<0.000010		-	-	<0.000010	<0.000010	-
Chromium (Cr)-Dissolved	mg/L	0.05 - 6.0 (2)	0.00014		-	-	0.00019	0.0002	5%
Cobalt (Co)-Dissolved	mg/L	0.001 (2)	<0.00010		-	-	<0.00010	<0.00010	-
Copper (Cu)-Dissolved	mg/L	1.5 (2) AO	<0.00020		-	-	<0.00020	0.00044	-
Iron (Fe)-Dissolved	mg/L	6.5(2)	<0.010				0.04	0.032	22%
Lead (Pb)-Dissolved	mg/L	0.01(2)	<0.000050		-	-	<0.000050	<0.000050	
Lithium (Li)-Dissolved	mg/L	0.008 (2)	<0.0010		-	-	<0.0010	<0.0010	-
Magnesium (Mg)-Dissolved	mg/L	-	0.512		-	-	0.502	0.501	0%
Manganese (Mn)-Dissolved	mg/L	1.5 (2)	0.00364				0.00502	0.00493	2%
Mercury (Hg)-Dissolved	mg/L	0.001(2)	<0.0000050		-	-	<0.0000050	<0.0000050	-
Molybdenum (Mo)-Dissolved	mg/L	0.25(2)	<0.000050		-	-	<0.000050	0.000079	-
Nickel (Ni)-Dissolved	mg/L	0.08 (2)	<0.00050		-	-	<0.00050	<0.00050	-
Phosphorus - Dissolved	mg/L	-	<0.050		-	-	<0.050	<0.050	-
Potassium (K)-Dissolved	mg/L	-	0.263		-	-	0.299	0.285	5%
Rubidium (Rb) - Dissolved	mg/L	-	0.00041		-	-	0.0004	0.00037	8%
Selenium (Se)-Dissolved	mg/L	0.01 (2)	<0.000050		-	-	<0.000050	<0.000050	-
Silicon - Dissolved	mg/L	-	5.03		-	-	5.34	5.33	0%
Silver (Ag)-Dissolved	mg/L	0.02 (2)	<0.000010		-	-	<0.000010	<0.000010	-
Sodium (Na)-Dissolved	mg/L	200(2)	1.49		-	-	1.59	1.6	1%
Strontium - Dissolved	mg/L	-	0.0465		-	-	0.0528	0.0537	2%
Sulfur- Dissolved	mg/L	-	<0.50		-	-	<0.50	<0.50	-
Tellurium - Dissolved	mg/L	-	<0.00020		-	-	<0.00020	<0.00020	-
Thallium (Tl)-Dissolved	mg/L	-	<0.000010		-	-	<0.000010	<0.000010	-
Thorium - Dissolved	mg/L	-	<0.00010		-	-	<0.00010	<0.00010	-
Tin (Sn)-Dissolved	mg/L	2.5 (2)	<0.00010		-	-	<0.00010	<0.00010	-
Titanium (Ti)-Dissolved	mg/L	-	<0.00030		-	-	0.00031	<0.00030	-
Tungston (W) - Dissolved	mg/L	0.003 (2)	<0.00010		-	-	<0.00010	<0.00010	-
Uranium (U)-Dissolved	mg/L	0.020	<0.000010		-	-	<0.000010	<0.000010	-
Vanadium (V)-Dissolved	mg/L	0.020 (2)	<0.00050		-	-	<0.00050	<0.00050	-
Zinc (Zn)-Dissolved	mg/L	3.0 (2)	<0.0010		-	-	<0.0010	0.0013	-
Zirconium - Dissolved	mg/L	-	<0.00020		-	-	<0.00020	<0.00020	-

NOTES

(1) BC MoE Approved and Working Water Quality Guidelines, last updated March 2018
(2) BC Contaminated Sites Regulation (CSR) for drinking water, Schedule 3.2, last updated January
(3) All criteria limits for BCWQG - Drinking Quality Guidelines based on Total Metal Concentratio
(4) BC MoE Water Quality Guidelines for Protection of Wildlife
(a) Range based on max pH 8.5 to min pH 6.5 at temperature of 6.0 'C
(b) at pH less than 6.5, limit is determined by regression equation, else limit is 0.1 mg/L.
(c) Limit for dissolved metals, not total metals
(d) Limit dependent upon hardness.
(e) Limit for chromium(VI) - data reported by lab as total chromium - limit assumes 100% chromium
(f) Where hardness data was unavailable, 50 mg/L was assumed
(g) Maximum value
(h) Limit dependent upon chloride concentration
(i) Change of 25 mg/L from background for a duration of 24 hours during clear flows. Change of 10

** Criteria exceeds detection limit*
MAC = Maximum Acceptable Concentration
AO = Aesthetic Objective

CSR-DW *BC Contaminated Sites Regulation Water (*

Table 5: Groundwater Quality Results Sampling Location MW-3 (E251532)

		CSR Standards CSR-DW (2)	22-Oct-12	02-Apr-13	06-Apr-17	06-Jul-17	02-Oct-17	14-Nov-17	10-Apr-18	20-Nov-18	25-Mar-19
QA/QC Check											
Field	**Units**										
Conductivity	uS/cm	-			132	108	82	78.6	66.5	79.9	79.6
SPC	uS/cm										
pH	pH	-	-	-	7.6	8.7	8.15	8.92	7.33	7.9	8.15
Dissolved Oxygen	mg/L	-	-	-	12	16.6	6	7.6	8.2	0.6	8.8
Temperature	°C	-	-	-	-	3.7	-	3	4.6	8.1	3.2
Depth to Water	m	-	-	-	-	-	-	-	44.53		-
Elevation of Well	m	-									
Casing Height	m	-									
Analyte	Units										
Conductivity	uS/cm	-	29.3	-	-		121	-			-
Hardness (as CaCO3)	mg/L	-	-	14.9	62	52.5	-	54.1	47.3	60	53.6
Hardness (as CaCO3), dissolved	mg/L										
pH	pH	-	8.7	8.7	8.1	8.8	7.6	8.23	7.93		8.08
Total Suspended Solids	mg/L	-	-	-	<1.0		1				-
Total Dissolved Solids	mg/L	-	13	-	-		60				-
Alkalinity, Total (as CaCO3)	mg/L	-	17.3	18.1	65	61	-	56.4	53.4	60.9	58.4
Ammonia, Total (as N)	mg/L	-	0.03	-	<0.03	<0.03	<0.03	<0.0050	0.0055	<0.0050	<0.0050
Total Nitrogen as N	mg/L	-	0.233	-	-		0.0848				-
TKN	mg/L										
Bromide (Br)	mg/L	-								<0.050	<0.050
Chloride (Cl)	mg/L	250 (2)	1	ND	<1.0	<1.0	<1	<0.50	<0.50	<0.50	0.9
Fluoride (F)	mg/L	1.5 (2)	0.13	0.12	<0.10	<0.01	-	0.039	0.041	0.045	0.028
Nitrate (as N)	mg/L	10 (2)	ND	ND	0.034	0.01	<0.01	0.0061	0.0104	0.036	0.0473
Nitrite (as N)	mg/L	1.0 (2)	ND	ND	<0.01	<0.01	-	<0.0010	<0.0010	<0.0010	<0.0010
Sulfate (SO4)	mg/L	500 (2)	-	1.13	1.5	1.6	1.5	1.15	0.93	1.04	0.37
Total Organic Carbon	mg/L	-	-	ND	<0.50	<0.50	-	<0.50	<0.50	<0.50	<0.50
BOD	mg/L	-	-	-	-		-				-
COD	mg/L	-	-	-	-	-	-	<20	<20	<20	<20
Dissolved Metals											
Aluminum (Al)-Dissolved	mg/L	9.5 (2)	ND	0.0101	<0.0050	0.0073	0.0146	0.0038	0.0022	0.0024	0.0023
Antimony (Sb)-Dissolved	mg/L	0.006(2)	ND	ND	<0.00010	<0.00010	<0.00020	<0.00010	<0.00010	<0.00010	<0.00010
Arsenic (As)-Dissolved	mg/L	0.01(2)	ND	0.000052	0.00065	0.0006	0.00093	0.00051	0.00058	0.00113	0.00079
Barium (Ba)-Dissolved	mg/L	1.0(2)	ND	0.00058	0.0087	0.0061	0.0086	0.00631	0.00797	0.0111	0.0103
Beryllium (Be)-Dissolved	mg/L	0.008(2)	ND	ND	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Bisumuth - Dissolved	mg/L	-	ND	ND	<0.00010	<0.00010	<0.00010	<0.000050	<0.000050	<0.000050	<0.000050
Boron (B)-Dissolved	mg/L	5.0(2)	ND	ND	<0.004	0.0241	<0.0050	<0.010	<0.010	<0.010	<0.010
Cadmium (Cd)-Dissolved	mg/L	0.005(2)	ND	ND	<0.00001	<0.000010	0.000021	0.000338	0.0000322	<0.0000050	<0.0000050
Calcium (Ca)-Dissolved	mg/L	-	-	-	21.5	11.9	-	13.5	16.8	21.8	19.1
Cesium (Cs) - Dissolved	mg/L	-	-	-	-	-	-	-	<0.000010	<0.000010	<0.000010
Chromium (Cr)-Dissolved	mg/L	0.05 - 6.0 (2)	ND	ND	<0.0005	0.00069	<0.00050	0.00019	0.00035	0.00029	0.00015
Cobalt (Co)-Dissolved	mg/L	0.001 (2)	ND	ND	<0.00005	0.00079	<0.00010	0.00025	<0.00010	<0.00010	<0.00010
Copper (Cu)-Dissolved	mg/L	1.5 (2) AO	0.00093	ND	0.0079	0.00841	0.0209	0.0211	0.00366	0.00315	0.00199
Iron (Fe)-Dissolved	mg/L	6.5(2)	ND	ND	0.016	<0.010	<0.010	0.012	0.014	<0.010	0.025
Lead (Pb)-Dissolved	mg/L	0.01(2)	ND	ND	0.0006	0.00028	0.00086	0.000922	0.000051	0.000135	0.000065
Lithium (Li)-Dissolved	mg/L	0.008 (2)	ND	ND	0.0007	0.00464	0.00078	0.0017	<0.0010	<0.0010	<0.0010
Magnesium (Mg)-Dissolved	mg/L	-	0.277	ND	1.36	5.52	1.38	4.95	1.32	1.33	1.45
Manganese (Mn)-Dissolved	mg/L	1.5 (2)	0.0178	0.0053	0.00569	0.00496	0.00885	0.0145	0.0316	0.00025	0.00597
Mercury (Hg)-Dissolved	mg/L	0.001(2)	ND	ND	<0.00002	<0.000020	<0.000010	<0.0000050	<0.0000050	<0.0000050	0.0000231
Molybdenum (Mo)-Dissolved	mg/L	0.25(2)	ND	0.000222	<0.00010	0.00013	0.00012	0.000129	0.000251	0.000052	0.000152
Nickel (Ni)-Dissolved	mg/L	0.08 (2)	-	-	<0.0002	0.00174	0.00115	0.00120	<0.00050	<0.00050	<0.00050
Phosphorus - Dissolved	mg/L	-	-	-	<0.05	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Potassium (K)-Dissolved	mg/L	-	-	-	0.51	0.46	-	0.563	0.505	0.524	0.53
Rubidium (Rd) - Dissolved	mg/L	-	-	-	-	-	-	-	0.00028	0.00032	0.00031
Selenium (Se)-Dissolved	mg/L	0.01 (2)	ND	ND	<0.00050	<0.00050	<0.00050	0.000080	<0.000050	0.00008	0.000111
Silicon - Dissolved	mg/L	-	ND	ND	5.1	4.5	5.2	4.14	4.01	5.11	4.01
Silver (Ag)-Dissolved	mg/L	0.02 (2)	ND	ND	<0.00005	<0.000050	<0.000050	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)-Dissolved	mg/L	200(2)	1.43	1.28	1.74	1.68	1.78	1.62	1.67	1.77	1.67
Strontium - Dissolved	mg/L	-	0.0286	0.0283	0.0803	0.0424	0.0761	0.0496	0.0705	0.0794	0.0829
Sulfur- Dissolved	mg/L	-	-	-	<3.0	<3.0	<3.0	<0.50	0.58	<0.50	<0.50
Tellurium - Dissolved	mg/L	-	-	-	<0.00020	<0.00020	<0.00050	<0.00020	<0.00020	<0.00020	<0.00020
Thallium (Tl)-Dissolved	mg/L	-	-	-	<0.00002	<0.000020	<0.000020	<0.000010	<0.000010	<0.000010	<0.000010
Thorium - Dissolved	mg/L	-	-	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Tin (Sn)-Dissolved	mg/L	2.5 (2)	ND	ND	<0.00020	<0.00020	<0.00020	0.00081	0.00026	<0.00010	<0.00010
Titanium (Ti)-Dissolved	mg/L	-	-	-	<0.0050	<0.0050	-	<0.00030	<0.00030	<0.00030	<0.00030
Tungston (W)- Dissolved	mg/L	0.003 (2)	-	-	-	-	-	0.00012	0.00028	<0.00010	0.00066
Uranium (U)-Dissolved	mg/L	0.020	ND	ND	<0.00002	<0.000020	0.000026	-	0.000013	0.000022	0.000017
Vanadium (V)-Dissolved	mg/L	0.020 (2)	ND	ND	<0.0010	<0.0010	<0.0010	-	<0.00050	0.00099	0.00074
Zinc (Zn)-Dissolved	mg/L	3.0 (2)	ND	ND	0.0111	0.0169	0.0302	-	0.0158	0.0073	0.0054
Zirconium - Dissolved	mg/L	-	ND	ND	<0.00010	<0.00010	<0.00010	-	<0.000060	<0.000060	<0.000060

NOTES

(1) BC MoE Approved and Working Water Quality Guidelines, last updated March 2018
(2) BC Contaminated Sites Regulation (CSR) for drinking water, Schedule 3.2, last updated January 2019
(3) All criteria limits for BCWQG - Drinking Quality Guidelines based on Total Metal Concentration except Aluminum (Dissolved)
(4) BC MoE Water Quality Guidelines for Protection of Wildlife
(a) Range based on max pH 8.5 to min pH 6.5 at temperature of 6.0 'C
(b) at pH less than 6.5, limit is determined by regression equation, else limit is 0.1 mg/L.
(c) Limit for dissolved metals, not total metals
(d) Limit dependent upon hardness.
(e) Limit for chromium(VI) - data reported by lab as total chromium - limit assumes 100% chromium VI in sample
(f) Where hardness data was unavailable, 50 mg/L was assumed
(g) Maximum value
(h) Limit dependent upon chloride concentration
(i) Change of 25 mg/L from background for a duration of 24 hours during clear flows. Change of 10% of background during turbid flows

** Criteria exceeds detection limit*
MAC = Maximum Acceptable Concentration
AO = Aesthetic Objective

CSR-DW *BC Contaminated Sites Regulation Water Quality Guidelines for Drinking Water*

Table 5: Groundwater Quality Results Sampling Location MW-3 (E251532)

		CSR Standards CSR-DW (2)	26-Jun-19	11-Jun-19	29-Jun-20	14-Aug-20	04-Nov-20
QA/QC Check							
Field	**Units**				monitor	monitor	sample
Conductivity	uS/cm	-	99.6		84	102	85.4
SPC	uS/cm						128.6
pH	pH	-	7.98		-	-	8.23
Dissolved Oxygen	mg/L	-	6.8		-	-	7
Temperature	°C	-	13.9		5.3	5.2	5.2
Depth to Water	m	-	-		44.47	47.42	45.69
Elevation of Well	m	-					225
Casing Height	m	-					
Analyte	Units						
Conductivity	uS/cm	-	-		-	-	137
Hardness (as CaCO3)	mg/L	-	67.6		-	-	-
Hardness (as CaCO3), dissolved	mg/L				-	-	65.3
pH	pH	-	8.05		-	-	8.02
Total Suspended Solids	mg/L	-	-		-	-	-
Total Dissolved Solids	mg/L	-	-		-	-	-
Alkalinity, Total (as CaCO3)	mg/L	-	67.7		-	-	66.8
Ammonia, Total (as N)	mg/L	-	<0.0050		-	-	0.006
Total Nitrogen as N	mg/L	-	-		-	-	-
TKN	mg/L				-	-	<0.050
Bromide (Br)	mg/L	-	<0.050		-	-	-
Chloride (Cl)	mg/L	250 (2)	<0.50				<0.50
Fluoride (F)	mg/L	1.5 (2)	0.048		-	-	0.047
Nitrate (as N)	mg/L	10 (2)	0.0337		-	-	0.0353
Nitrite (as N)	mg/L	1.0 (2)	<0.0010		-	-	0.0013
Sulfate (SO4)	mg/L	500 (2)	1.34		-	-	1.45
Total Organic Carbon	mg/L	-	<0.50		-	-	0.74
BOD	mg/L	-	-		-	-	-
COD	mg/L	-	<20		-	-	<20
Dissolved Metals							
Aluminum (Al)-Dissolved	mg/L	9.5 (2)	0.0032		-	-	0.0032
Antimony (Sb)-Dissolved	mg/L	0.006(2)	<0.00010		-	-	<0.00010
Arsenic (As)-Dissolved	mg/L	0.01(2)	0.00098		-	-	0.0012
Barium (Ba)-Dissolved	mg/L	1.0(2)	0.0108		-	-	0.0112
Beryllium (Be)-Dissolved	mg/L	0.008(2)	<0.00010		-	-	<0.000100
Bisumuth - Dissolved	mg/L	-	<0.000050		-	-	<0.000050
Boron (B)-Dissolved	mg/L	5.0(2)	<0.010		-	-	<0.010
Cadmium (Cd)-Dissolved	mg/L	0.005(2)	0.0000129		-	-	<0.0000050
Calcium (Ca)-Dissolved	mg/L	-	23.5		-	-	23.6
Cesium (Cs) - Dissolved	mg/L	-	<0.000010		-	-	<0.000010
Chromium (Cr)-Dissolved	mg/L	0.05 - 6.0 (2)	0.00031		-	-	0.00033
Cobalt (Co)-Dissolved	mg/L	0.001 (2)	0.00015		-	-	<0.00010
Copper (Cu)-Dissolved	mg/L	1.5 (2) AO	0.00249		-	-	0.00137
Iron (Fe)-Dissolved	mg/L	6.5(2)	<0.010				<0.010
Lead (Pb)-Dissolved	mg/L	0.01(2)	0.000085		-	-	<0.000050
Lithium (Li)-Dissolved	mg/L	0.008 (2)	<0.0010		-	-	<0.0010
Magnesium (Mg)-Dissolved	mg/L	-	1.64		-	-	1.54
Manganese (Mn)-Dissolved	mg/L	1.5 (2)	0.00289				0.00056
Mercury (Hg)-Dissolved	mg/L	0.001(2)	<0.0000050		-	-	<0.0000050
Molybdenum (Mo)-Dissolved	mg/L	0.25(2)	0.00009		-	-	<0.000050
Nickel (Ni)-Dissolved	mg/L	0.08 (2)	<0.00050		-	-	<0.00050
Phosphorus - Dissolved	mg/L	-	<0.050		-	-	<0.050
Potassium (K)-Dissolved	mg/L	-	0.553		-	-	0.576
Rubidium (Rd) - Dissolved	mg/L	-	0.00034		-	-	0.00033
Selenium (Se)-Dissolved	mg/L	0.01 (2)	0.000101		-	-	0.00015
Silicon - Dissolved	mg/L	-	4.65		-	-	5.08
Silver (Ag)-Dissolved	mg/L	0.02 (2)	<0.000010		-	-	<0.000010
Sodium (Na)-Dissolved	mg/L	200(2)	1.75		-	-	1.86
Strontium - Dissolved	mg/L	-	0.0922		-	-	0.0964
Sulfur- Dissolved	mg/L	-	<0.50		-	-	0.58
Tellurium - Dissolved	mg/L	-	<0.00020		-	-	<0.00020
Thallium (Tl)-Dissolved	mg/L	-	<0.000010		-	-	<0.000010
Thorium - Dissolved	mg/L	-	<0.00010		-	-	<0.00010
Tin (Sn)-Dissolved	mg/L	2.5 (2)	<0.00010		-	-	<0.00010
Titanium (Ti)-Dissolved	mg/L	-	<0.00030		-	-	<0.00030
Tungston (W)- Dissolved	mg/L	0.003 (2)	0.00029		-	-	<0.00010
Uranium (U)-Dissolved	mg/L	0.020	0.000021		-	-	0.000022
Vanadium (V)-Dissolved	mg/L	0.020 (2)	0.00077		-	-	0.00096
Zinc (Zn)-Dissolved	mg/L	3.0 (2)	0.0053		-	-	0.0023
Zirconium - Dissolved	mg/L	-	<0.00020		-	-	<0.00020

NOTES

(1) BC MoE Approved and Working Water Quality Guidelines, last updated March 2018
(2) BC Contaminated Sites Regulation (CSR) for drinking water, Schedule 3.2, last updated January
(3) All criteria limits for BCWQG - Drinking Quality Guidelines based on Total Metal Concentratio
(4) BC MoE Water Quality Guidelines for Protection of Wildlife
(a) Range based on max pH 8.5 to min pH 6.5 at temperature of 6.0 'C
(b) at pH less than 6.5, limit is determined by regression equation, else limit is 0.1 mg/L.
(c) Limit for dissolved metals, not total metals
(d) Limit dependent upon hardness.
(e) Limit for chromium(VI) - data reported by lab as total chromium - limit assumes 100% chromium
(f) Where hardness data was unavailable, 50 mg/L was assumed
(g) Maximum value
(h) Limit dependent upon chloride concentration
(i) Change of 25 mg/L from background for a duration of 24 hours during clear flows. Change of 10

** Criteria exceeds detection limit*
MAC = Maximum Acceptable Concentration
AO = Aesthetic Objective

CSR-DW *BC Contaminated Sites Regulation Water (*

Table 6: Groundwater Quality Results Sampling Location MW-15 (302210)

		CSR Standards CSR-DW (2)	02-Oct-17	14-Nov-17	09-Apr-18	18-Jul-18
QA/QC Check						
Field	**Units**					
Conductivity	uS/cm	-	90.3	96.2	97.6	157
SPC	uS/cm					
pH	pH	-	8.39	8.29	7.8	7.51
Dissolved Oxygen	mg/L	-	14.2	10.5	9.8	7.1
Temperature	°C	-	5.5	5.0	4.9	5.3
Depth to Water	m	-	-	-	44.66	43.8
Elevation of Well	m					
Casing Height	m					
Analyte	Units					
Conductivity	uS/cm	-	152	-		
Hardness (as CaCO3)	mg/L	-	-	72.9	75.7	79.5
Hardness (as CaCO3), dissolved	mg/L					
pH	pH	-	7.9	8.1	8.17	
Total Suspended Solids	mg/L	-	-	-		
Total Dissolved Solids	mg/L	-	75	-		
Alkalinity, Total (as CaCO3)	mg/L	-	77	78.1	82.4	83.6
Ammonia, Total (as N)	mg/L	-	<0.03	-	0.0052	<0.0050
Total Nitrogen as N	mg/L	-	0.0827	-		
TKN	mg/L					
Bromide (Br)	mg/L	-			<0.050	<0.050
Chloride (Cl)	mg/L	250 (2)	<1.0	<0.50	<0.50	<0.50
Fluoride (F)	mg/L	1.5 (2)	<0.1	0.032	0.034	0.034
Nitrate (as N)	mg/L	10 (2)	<0.01	0.089	0.0908	0.0873
Nitrite (as N)	mg/L	1.0 (2)	<0.01	<0.001	<0.0010	<0.0010
Sulfate (SO4)	mg/L	500 (2)	-	1.08	1.03	1.02
Total Organic Carbon	mg/L	-	-	<0.50	<0.50	<0.50
BOD	mg/L	-	-	-		
COD	mg/L	-	-	-	<20	<20
Dissolved Metals						
Aluminum (Al)-Dissolved	mg/L	9.5 (2)	<0.0050	0.0026	0.0023	0.0029
Antimony (Sb)-Dissolved	mg/L	0.006 (2)	<0.00020	<0.00010	<0.00010	<0.00010
Arsenic (As)-Dissolved	mg/L	0.01 (2)	0.00072	0.00082	0.00074	0.00078
Barium (Ba)-Dissolved	mg/L	1.0 (2)	0.0139	0.0200	0.0165	0.0165
Beryllium (Be)-Dissolved	mg/L	0.008 (2)	<0.00010	<0.00010	<0.00010	<0.00010
Bisumuth - Dissolved	mg/L	-	<0.00010	<0.000050	<0.000050	<0.000050
Boron (B)-Dissolved	mg/L	5.0 (2)	<0.0050	<0.010	<0.010	<0.010
Cadmium (Cd)-Dissolved	mg/L	0.005 (2)	<0.000010	<0.0000050	0.0000177	0.0000149
Calcium (Ca)-Dissolved	mg/L	-	-	-	28.2	29.6
Cessium (Cs) - Dissolved	mg/L	-	-	-	<0.000010	<0.000010
Chromium (Cr)-Dissolved	mg/L	0.05 - 6.0 (2)	<0.00050	0.00039	0.00021	0.00035
Cobalt (Co)-Dissolved	mg/L	0.001 (2)	<0.00010	<0.00010	<0.00010	<0.00010
Copper (Cu)-Dissolved	mg/L	1.5 (2) AO	<0.00040	<0.00020	<0.00020	<0.00020
Iron (Fe)-Dissolved	mg/L	6.5 (2)	<0.010	<0.010	<0.010	<0.010
Lead (Pb)-Dissolved	mg/L	0.01 (2)	<0.00020	<0.000050	<0.000050	<0.000050
Lithium (Li)-Dissolved	mg/L	0.008 (2)	0.00079	0.0011	<0.0010	<0.0010
Magnesium (Mg)-Dissolved	mg/L	-	1.22	1.33	1.27	1.39
Manganese (Mn)-Dissolved	mg/L	1.5 (2)	0.00032	0.00014	0.0001	0.00014
Mercury (Hg)-Dissolved	mg/L	0.001 (2)	<0.000010	<0.0000050	<0.0000050	<0.0000050
Molybdenum (Mo)-Dissolved	mg/L	0.25 (2)	<0.00010	<0.000050	<0.000050	<0.00010
Nickel (Ni)-Dissolved	mg/L	0.08 (2)	-	-	<0.00050	<0.00050
Phosphorus - Dissolved	mg/L	-	-	-	<0.050	<0.050
Potassium (K)-Dissolved	mg/L	-	-	-	0.543	0.602
Rubidium (Rd) - Dissolved	mg/L	-	-	-	0.00022	<0.00020
Selenium (Se)-Dissolved	mg/L	0.01 (2)	<0.00050	0.000080	0.000069	0.000082
Silicon - Dissolved	mg/L	-	5.7	5.49	5.47	5.05
Silver (Ag)-Dissolved	mg/L	0.02 (2)	<0.000050	<0.000010	<0.000010	<0.000010
Sodium (Na)-Dissolved	mg/L	200 (2)	1.47	1.39	1.51	1.59
Strontium - Dissolved	mg/L	-	0.0799	0.0852	0.0948	0.0894
Sulfur- Dissolved	mg/L	-	-	-	<0.50	<0.50
Tellurium - Dissolved	mg/L	-	-	-	<0.00020	<0.00020
Thallium (Tl)-Dissolved	mg/L	-	-	-	<0.000010	<0.000010
Thorium - Dissolved	mg/L	-	-	-	<0.00010	<0.00010
Tin (Sn)-Dissolved	mg/L	2.5 (2)	<0.00020	<0.00010	<0.00010	<0.00010
Titanium (Ti)-Dissolved	mg/L	-	-	-	<0.00030	<0.00030
Tungston (W) - Dissovled	mg/L	0.003 (2)	-	-	<0.00010	<0.00010
Uranium (U)-Dissolved	mg/L	0.020	0.000027	0.000022	0.000026	0.00003
Vanadium (V)-Dissolved	mg/L	0.020 (2)	<0.0010	0.00082	0.00075	0.00077
Zinc (Zn)-Dissolved	mg/L	3.0 (2)	<0.0040	<0.0010	<0.0010	<0.0010
Zirconium - Dissolved	mg/L	-	<0.00010	<0.000060	<0.000060	<0.000060

NOTES

(1) BC MoE Approved and Working Water Quality Guidelines, last updated March 2018
(2) BC Contaminated Sites Regulation (CSR) for drinking water, Schedule 3.2, last updated January 2019
(3) All criteria limits for BCWQG - Drinking Quality Guidelines based on Total Metal Concentration except Aluminum (Dissolved)
(4) BC MoE Water Quality Guidelines for Protection of Wildlife
(a) Range based on max pH 8.5 to min pH 6.5 at temperature of 6.0 'C
(b) at pH less than 6.5, limit is determined by regression equation, else limit is 0.1 mg/L.
(c) Limit for dissolved metals, not total metals
(d) Limit dependent upon hardness.
(e) Limit for chromium(VI) - data reported by lab as total chromium - limit assumes 100% chromium VI in sample
(f) Where hardness data was unavailable, 50 mg/L was assumed
(g) Maximum value
(h) Limit dependent upon chloride concentration
(i) Change of 25 mg/L from background for a duration of 24 hours during clear flows. Change of 10% of background during turbid flows

** Criteria exceeds detection limit*
MAC = Maximum Acceptable Concentration
AO = Aesthetic Objective

CSR-DW *BC Contaminated Sites Regulation Water Quality Guidelines for Drinking Water*

Table 6: Groundwater Quality Results Sampling Location MW-15 (302210)

		CSR Standards CSR-DW (2)	21-Nov-18	21-Nov-18	26-Mar-19	11-Jun-19
QA/QC Check						
Field	**Units**		DUP			
Conductivity	uS/cm	-		157	174	164
SPC	uS/cm					
pH	pH	-	-	7.9	6.5	
Dissolved Oxygen	mg/L	-	-	0.3	8.7	
Temperature	°C	-	-	5.1	5.1	5.4
Depth to Water	m	-	-	45.37	44.72	45.73
Elevation of Well	m					
Casing Height	m					
Analyte	Units					
Conductivity	uS/cm	-			-	
Hardness (as CaCO3)	mg/L	-	80.2	79.2	82.5	
Hardness (as CaCO3), dissolved	mg/L					
pH	pH	-			8.18	
Total Suspended Solids	mg/L	-			-	
Total Dissolved Solids	mg/L	-			-	
Alkalinity, Total (as CaCO3)	mg/L	-	87.4	77.5	83.4	
Ammonia, Total (as N)	mg/L	-	<0.0050	<0.0050	<0.0050	
Total Nitrogen as N	mg/L	-			-	
TKN	mg/L					
Bromide (Br)	mg/L	-	<0.050	<0.050	<0.050	
Chloride (Cl)	mg/L	250 (2)	<0.50	<0.50	<0.50	
Fluoride (F)	mg/L	1.5 (2)	0.027	0.027	0.039	
Nitrate (as N)	mg/L	10 (2)	0.0949	0.0941	0.0732	
Nitrite (as N)	mg/L	1.0 (2)	<0.0010	<0.0010	<0.0010	
Sulfate (SO4)	mg/L	500 (2)	0.93	0.91	1.17	
Total Organic Carbon	mg/L	-	<0.50	<0.50	0.5	
BOD	mg/L	-			-	
COD	mg/L	-	<20	<20	<20	
Dissolved Metals						
Aluminum (Al)-Dissolved	mg/L	9.5 (2)	0.0057	0.005	0.0031	
Antimony (Sb)-Dissolved	mg/L	0.006 (2)	<0.00010	<0.00010	0.00016	
Arsenic (As)-Dissolved	mg/L	0.01 (2)	0.0007	0.0007	0.00081	
Barium (Ba)-Dissolved	mg/L	1.0 (2)	0.0176	0.0167	0.0183	
Beryllium (Be)-Dissolved	mg/L	0.008 (2)	<0.00010	<0.00010	<0.00010	
Bisumuth - Dissolved	mg/L	-	<0.000050	<0.000050	<0.000050	
Boron (B)-Dissolved	mg/L	5.0 (2)	<0.010	<0.010	<0.010	
Cadmium (Cd)-Dissolved	mg/L	0.005 (2)	0.000225	0.000229	<0.0000050	
Calcium (Ca)-Dissolved	mg/L	-	29.9	29.5	30.5	
Cessium (Cs) - Dissolved	mg/L	-	<0.000010	<0.000010	<0.000010	
Chromium (Cr)-Dissolved	mg/L	0.05 - 6.0 (2)	0.00042	0.00039	0.0004	
Cobalt (Co)-Dissolved	mg/L	0.001 (2)	<0.00010	<0.00010	<0.00010	
Copper (Cu)-Dissolved	mg/L	1.5 (2) AO	0.00025	0.00024	<0.00020	
Iron (Fe)-Dissolved	mg/L	6.5 (2)	<0.010	<0.010	<0.010	
Lead (Pb)-Dissolved	mg/L	0.01 (2)	<0.000050	<0.000050	<0.000050	
Lithium (Li)-Dissolved	mg/L	0.008 (2)	<0.0010	<0.0010	<0.0010	
Magnesium (Mg)-Dissolved	mg/L	-	1.34	1.35	1.53	
Manganese (Mn)-Dissolved	mg/L	1.5 (2)	0.00059	0.00055	0.00012	
Mercury (Hg)-Dissolved	mg/L	0.001 (2)	<0.0000050	<0.0000050	<0.0000050	
Molybdenum (Mo)-Dissolved	mg/L	0.25 (2)	<0.000050	<0.000050	<0.000050	
Nickel (Ni)-Dissolved	mg/L	0.08 (2)	<0.00050	<0.00050	<0.00050	
Phosphorus - Dissolved	mg/L	-	<0.050	<0.050	<0.050	
Potassium (K)-Dissolved	mg/L	-	0.588	0.589	0.579	
Rubidium (Rd) - Dissolved	mg/L	-	0.00024	0.00021	0.00022	
Selenium (Se)-Dissolved	mg/L	0.01 (2)	<0.000050	<0.000050	0.000074	
Silicon - Dissolved	mg/L	-	5.64	5.68	6.1	
Silver (Ag)-Dissolved	mg/L	0.02 (2)	<0.000010	<0.000010	<0.000010	
Sodium (Na)-Dissolved	mg/L	200 (2)	1.65	1.66	1.56	
Strontium - Dissolved	mg/L	-	0.0925	0.0932	0.0987	
Sulfur- Dissolved	mg/L	-	<0.50	<0.50	<0.50	
Tellurium - Dissolved	mg/L	-	<0.00020	<0.00020	<0.00020	
Thallium (Tl)-Dissolved	mg/L	-	<0.000010	<0.000010	<0.000010	
Thorium - Dissolved	mg/L	-	<0.00010	<0.00010	<0.00010	
Tin (Sn)-Dissolved	mg/L	2.5 (2)	0.00018	0.00018	<0.00010	
Titanium (Ti)-Dissolved	mg/L	-	<0.00030	<0.00030	<0.00030	
Tungston (W) - Dissovled	mg/L	0.003 (2)	<0.00010	<0.00010	<0.00010	
Uranium (U)-Dissolved	mg/L	0.020	0.00003	0.00003	0.000025	
Vanadium (V)-Dissolved	mg/L	0.020 (2)	0.00074	0.00072	0.00083	
Zinc (Zn)-Dissolved	mg/L	3.0 (2)	0.005	0.0044	<0.0010	
Zirconium - Dissolved	mg/L	-	<0.000060	<0.000060	<0.000060	

NOTES

(1) BC MoE Approved and Working Water Quality Guidelines, last updated March 2018
(2) BC Contaminated Sites Regulation (CSR) for drinking water, Schedule 3.2, last updated January 201
(3) All criteria limits for BCWQG - Drinking Quality Guidelines based on Total Metal Concentration exc
(4) BC MoE Water Quality Guidelines for Protection of Wildlife
(a) Range based on max pH 8.5 to min pH 6.5 at temperature of 6.0 'C
(b) at pH less than 6.5, limit is determined by regression equation, else limit is 0.1 mg/L.
(c) Limit for dissolved metals, not total metals
(d) Limit dependent upon hardness.
(e) Limit for chromium(VI) - data reported by lab as total chromium - limit assumes 100% chromium VI i
(f) Where hardness data was unavailable, 50 mg/L was assumed
(g) Maximum value
(h) Limit dependent upon chloride concentration
(i) Change of 25 mg/L from background for a duration of 24 hours during clear flows. Change of 10% o

** Criteria exceeds detection limit*
MAC = Maximum Acceptable Concentration
AO = Aesthetic Objective

CSR-DW *BC Contaminated Sites Regulation Water Qual*

Table 6: Groundwater Quality Results Sampling Location MW-15 (302210)

		CSR Standards CSR-DW (2)	26-Jun-19	29-Jun-20	14-Aug-20	03-Nov-20
QA/QC Check						
Field	**Units**		Sample	Monitor	Monitor	Sample
Conductivity	uS/cm	-	164	166	170	135.2
SPC	uS/cm					215.5
pH	pH	-	7.67	-	-	7.75
Dissolved Oxygen	mg/L	-	10.4	-	-	10.4
Temperature	°C	-	5.8	5.2	5.1	4.8
Depth to Water	m	-	45.78	44.85	45.09	45.84
Elevation of Well	m					227
Casing Height	m					1.04
Analyte	Units					
Conductivity	uS/cm	-		-	-	226
Hardness (as CaCO3)	mg/L	-	87.4	-	-	
Hardness (as CaCO3), dissolved	mg/L			-	-	116
pH	pH	-	8.22	-	-	8.17
Total Suspended Solids	mg/L	-	-	-	-	-
Total Dissolved Solids	mg/L	-	-	-	-	-
Alkalinity, Total (as CaCO3)	mg/L	-	85.2	-	-	115
Ammonia, Total (as N)	mg/L	-	<0.0050	-	-	<0.0050
Total Nitrogen as N	mg/L	-	-	-	-	-
TKN	mg/L			-	-	0.109
Bromide (Br)	mg/L	-	<0.050	-	-	-
Chloride (Cl)	mg/L	250 (2)	<0.50			2.94
Fluoride (F)	mg/L	1.5 (2)	0.033	-	-	0.028
Nitrate (as N)	mg/L	10 (2)	0.096	-	-	0.278
Nitrite (as N)	mg/L	1.0 (2)	<0.0010	-	-	0.0016
Sulfate (SO4)	mg/L	500 (2)	0.95	-	-	1.24
Total Organic Carbon	mg/L	-	1.11	-	-	0.78
BOD	mg/L	-	-	-	-	-
COD	mg/L	-	<20	-	-	<20
Dissolved Metals						
Aluminum (Al)-Dissolved	mg/L	9.5 (2)	0.0036	-	-	0.0058
Antimony (Sb)-Dissolved	mg/L	0.006 (2)	<0.00010	-	-	<0.00010
Arsenic (As)-Dissolved	mg/L	0.01 (2)	0.00079	-	-	0.00055
Barium (Ba)-Dissolved	mg/L	1.0 (2)	0.0175	-	-	0.0256
Beryllium (Be)-Dissolved	mg/L	0.008 (2)	<0.00010	-	-	<0.000100
Bisumuth - Dissolved	mg/L	-	<0.000050	-	-	<0.000050
Boron (B)-Dissolved	mg/L	5.0 (2)	<0.010	-	-	<0.010
Cadmium (Cd)-Dissolved	mg/L	0.005 (2)	0.0000712	-	-	<0.0000050
Calcium (Ca)-Dissolved	mg/L	-	32.4	-	-	42.9
Cessium (Cs) - Dissolved	mg/L	-	<0.000010	-	-	<0.000010
Chromium (Cr)-Dissolved	mg/L	0.05 - 6.0 (2)	0.00036	-	-	0.00045
Cobalt (Co)-Dissolved	mg/L	0.001 (2)	<0.00010	-	-	<0.00010
Copper (Cu)-Dissolved	mg/L	1.5 (2) AO	0.0002	-	-	0.0005
Iron (Fe)-Dissolved	mg/L	6.5 (2)	<0.010			0.012
Lead (Pb)-Dissolved	mg/L	0.01 (2)	<0.000050	-	-	<0.000050
Lithium (Li)-Dissolved	mg/L	0.008 (2)	<0.0010	-	-	0.0013
Magnesium (Mg)-Dissolved	mg/L	-	1.54	-	-	2.1
Manganese (Mn)-Dissolved	mg/L	1.5 (2)	0.00025			0.00238
Mercury (Hg)-Dissolved	mg/L	0.001 (2)	<0.0000050	-	-	<0.0000050
Molybdenum (Mo)-Dissolved	mg/L	0.25 (2)	<0.000050	-	-	<0.000050
Nickel (Ni)-Dissolved	mg/L	0.08 (2)	<0.00050	-	-	<0.00050
Phosphorus - Dissolved	mg/L	-	<0.050	-	-	<0.050
Potassium (K)-Dissolved	mg/L	-	0.622	-	-	0.768
Rubidium (Rd) - Dissolved	mg/L	-	0.00024	-	-	0.00027
Selenium (Se)-Dissolved	mg/L	0.01 (2)	0.00007	-	-	0.000053
Silicon - Dissolved	mg/L	-	5.86	-	-	6.03
Silver (Ag)-Dissolved	mg/L	0.02 (2)	<0.000010	-	-	<0.000010
Sodium (Na)-Dissolved	mg/L	200 (2)	1.66	-	-	1.95
Strontium - Dissolved	mg/L	-	0.103	-	-	0.15
Sulfur- Dissolved	mg/L	-	<0.50	-	-	<0.50
Tellurium - Dissolved	mg/L	-	<0.00020	-	-	<0.00020
Thallium (Tl)-Dissolved	mg/L	-	<0.000010	-	-	<0.000010
Thorium - Dissolved	mg/L	-	<0.00010	-	-	<0.00010
Tin (Sn)-Dissolved	mg/L	2.5 (2)	<0.00010	-	-	<0.00010
Titanium (Ti)-Dissolved	mg/L	-	<0.00030	-	-	<0.00030
Tungston (W) - Dissovled	mg/L	0.003 (2)	<0.00010	-	-	<0.00010
Uranium (U)-Dissolved	mg/L	0.020	0.000027	-	-	0.000031
Vanadium (V)-Dissolved	mg/L	0.020 (2)	0.00074	-	-	0.00068
Zinc (Zn)-Dissolved	mg/L	3.0 (2)	<0.0010	-	-	<0.0010
Zirconium - Dissolved	mg/L	-	<0.00020	-	-	<0.00020

NOTES

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(c) Limit for dissolved metals, not total metals
(d) Limit dependent upon hardness.
(e) Limit for chromium(VI) - data reported by lab as total chromium - limit assumes 100% chromium VI i
(f) Where hardness data was unavailable, 50 mg/L was assumed
(g) Maximum value
(h) Limit dependent upon chloride concentration
(i) Change of 25 mg/L from background for a duration of 24 hours during clear flows. Change of 10% o

** Criteria exceeds detection limit*
MAC = Maximum Acceptable Concentration
AO = Aesthetic Objective

CSR-DW *BC Contaminated Sites Regulation Water Qual*

Table 7: Groundwater Quality Results Sampling Location MW-16 (E02211)

		CSR Standards CSR-DW (2)	05-Apr-17	02-Oct-17	14-Nov-17	09-Apr-18	18-Jul-18	21-Nov-18	26-Mar-19	26-Jun-19	11-Jun-19
Field	**Units**										
Conductivity	uS/cm	-	124	94.3	90.7	90.3	146	147	159	152	154
SPC	uS/cm										
pH	pH	-	7.8	8.37	8.23	7.24	7.81	7.81	7.52	7.64	
Dissolved Oxygen	mg/L	-	-	14.2	9.8	12.1	7.9	0.3	9.9	14.0	
Temperature	°C	-	-	5.8	4.6	4.8	5.6	5	5	5.9	5.3
Depth to Water	m	-	-	-	44.6	45.15	44.31	45.03	46.21	46.27	46.2
Elevation of Well	m	-									
Casing Height	m	-									
Analyte	Units										
Conductivity	uS/cm	-	137	-	-	-	-	-	-	-	
Hardness (as CaCO3)	mg/L	-	-	75	72.9	71.1	72.8	72.9	77.6	83.9	
Hardness (as CaCO3), dissolved	mg/L										
pH	pH	-	8	8	8.08	8.13	-	-	8.16	8.21	
Total Suspended Solids	mg/L	-	-	-	-	-	-	-	-	-	
Total Dissolved Solids	mg/L	-	81	-	-	-	-	-	-	-	
Alkalinity, Total (as CaCO3)	mg/L	-	94	80	77.8	77.2	77.7	77.5	78	84	
Ammonia, Total (as N)	mg/L	-	<0.03	-	<0.005	0.0061	<0.0050	<0.0050	<0.0050	<0.0050	
Total Nitrogen as N	mg/L	-	-	-	-	-	-	-	-	-	
TKN	mg/L										
Bromide (Br)	mg/L	-	-	-	-	<0.050	<0.050	<0.050	<0.050	<0.050	
Chloride (Cl)	mg/L	250 (2)	<1.0	<1	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	
Fluoride (F)	mg/L	1.5 (2)	<0.1	<0.1	0.036	0.039	0.039	0.038	0.036	0.036	
Nitrate (as N)	mg/L	10 (2)	0.028	<0.01	0.0793	0.0686	0.0747	0.0767	0.137	0.0757	
Nitrite (as N)	mg/L	1.0 (2)	<0.01	<0.01	<0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	
Sulfate (SO4)	mg/L	500 (2)	-	1.3	1.01	1.02	0.96	0.92	0.61	0.88	
Total Organic Carbon	mg/L	-	-	-	<0.50	<0.50	<0.50	<0.50	0.68	<0.50	
BOD	mg/L	-	-	-	-	-	-	-	-	-	
COD	mg/L	-	-	-	<20	<20	<20	<20	<20	<20	
Dissolved Metals											
Aluminum (Al)-Dissolved	mg/L	9.5 (2)	0.0106	<0.0050	0.0054	0.0036	0.0028	0.0037	0.0181	0.0024	
Antimony (Sb)-Dissolved	mg/L	0.006(2)	<0.00010	<0.00020	<0.00010	<0.00010	<0.00010	<0.00010	0.00016	<0.00010	
Arsenic (As)-Dissolved	mg/L	0.01(2)	0.00052	0.00055	0.00063	0.00061	0.00057	0.00058	0.00066	0.00058	
Barium (Ba)-Dissolved	mg/L	1.0(2)	0.138	0.0161	0.01780	0.01910	0.01810	0.01810	0.01950	0.01940	
Beryllium (Be)-Dissolved	mg/L	0.008(2)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	
Bisumuth - Dissolved	mg/L	-	<0.00010	<0.00010	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	
Boron (B)-Dissolved	mg/L	5.0(2)	0.014	<0.0050	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	
Cadmium (Cd)-Dissolved	mg/L	0.005(2)	0.00003	0.000018	<0.0000050	0.00003	0.00001	0.00008	0.00017	0.00004	
Calcium (Ca)-Dissolved	mg/L	-	-	-	26.90000	26.30000	26.90000	27.10000	28.60000	30.70000	
Cesium (Cs)- Dissolved	mg/L	-	-	-	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	
Chromium (Cr)-Dissolved	mg/L	0.05 - 6.0 (2)	0.0005	<0.00050	0.00038	0.00026	0.00037	0.00038	0.00055	0.00036	
Cobalt (Co)-Dissolved	mg/L	0.001 (2)	0.00012	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	
Copper (Cu)-Dissolved	mg/L	1.5 (2) AO	0.0042	<0.00040	<0.00020	<0.00020	<0.00020	<0.00020	0.00056	<0.00020	
Iron (Fe)-Dissolved	mg/L	6.5(2)	<0.010	<0.010	0.01000	<0.010	<0.010	<0.010	0.01500	<0.010	
Lead (Pb)-Dissolved	mg/L	0.01(2)	<0.0001	<0.00020	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	
Lithium (Li)-Dissolved	mg/L	0.008 (2)	0.0007	0.00096	0.00110	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	
Magnesium (Mg)-Dissolved	mg/L	-	0.992	1.37	1.40	1.29	1.38	1.27	1.51	1.53	
Manganese (Mn)-Dissolved	mg/L	1.5 (2)	0.0371	0.00752	0.00651	0.00314	0.00211	0.00186	0.00240	0.00046	
Mercury (Hg)-Dissolved	mg/L	0.001(2)	<0.00002	<0.000010	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	
Molybdenum (Mo)-Dissolved	mg/L	0.25(2)	0.00027	<0.00010	0.00005	0.00006	<0.00010	0.00005	0.00006	0.00006	
Nickel (Ni)-Dissolved	mg/L	0.08 (2)	-	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	
Phosphorus - Dissolved	mg/L	-	-	-	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	
Potassium (K)-Dissolved	mg/L	-	-	-	0.60800	0.62500	0.64400	0.60200	0.62100	0.62400	
Rubidium (Rd) - Dissolved	mg/L	-	-	-	0.00039	0.00043	0.00042	0.00042	0.00041	0.00036	
Selenium (Se)-Dissolved	mg/L	0.01 (2)	<0.00050	<0.00050	0.00009	0.00009	0.00007	0.00010	0.00009	0.00007	
Silicon - Dissolved	mg/L	-	4.5	5.5	5.28000	5.46000	5.15000	5.29000	5.54000	5.47000	
Silver (Ag)-Dissolved	mg/L	0.02 (2)	<0.00005	<0.000050	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	
Sodium (Na)-Dissolved	mg/L	200(2)	1.75	1.55	1.41	1.51	1.61	1.60	1.66	1.67	
Strontium - Dissolved	mg/L	-	0.0715	0.0912	0.0918	0.0953	0.0916	0.0886	0.1010	0.1110	
Sulfur- Dissolved	mg/L	-	-	-	<0.50	0.57000	<0.50	<0.50	<0.50	<0.50	
Tellurium - Dissolved	mg/L	-	-	-	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	
Thallium (Tl)-Dissolved	mg/L	-	-	-	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	
Thorium - Dissolved	mg/L	-	-	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	
Tin (Sn)-Dissolved	mg/L	2.5 (2)	0.00049	<0.00020	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	
Titanium (Ti)-Dissolved	mg/L	-	-	-	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	
Tungston (W)- Dissolved	mg/L	0.003 (2)	-	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	
Uranium (U)-Dissolved	mg/L	0.020	0.00005	0.000059	0.00004	0.00004	0.00004	0.00004	0.00004	0.00004	
Vanadium (V)-Dissolved	mg/L	0.020 (2)	<0.0010	<0.0010	0.00057	0.00061	0.00069	0.00062	0.00078	0.00053	
Zinc (Zn)-Dissolved	mg/L	3.0 (2)	0.0157	<0.0040	<0.0010	0.00110	<0.0010	<0.0010	0.00460	<0.0010	
Zirconium - Dissolved	mg/L	-	<0.00010	<0.00010	<0.000060	<0.000060	<0.000060	<0.000060	<0.000060	<0.00020	
Volatile Organic Compounds (Water)				-							
Benzene	mg/L	0.005 (2)	-	-	<0.00050	-	-	-			
Bromodichloromethane	mg/L	0.1(2)	-	-	<0.0010	-	-	-			
Bromoform	mg/L	0.1(2)	-	-	<0.0010	-	-	-			
Carbon Tetrachloride	mg/L	0.002(2)	-	-	<0.00050	-	-	-			
Chlorobenzene	mg/L	0.08(2)	-	-	<0.0010	-	-	-			
Dibromochloromethane	mg/L	0.1(2)	-	-	<0.0010	-	-	-			
Chloroethane	mg/L	-	-	-	<0.0010	-	-	-			
Chloroform	mg/L	0.1(2)	-	-	<0.0010	-	-	-			
Chloromethane	mg/L	-	-	-	<0.0050	-	-	-			
1,2-Dichlorobenzene	mg/L	0.2(2)	-	-	<0.00050	-	-	-			
1,3-Dichlorobenzene	mg/L	-	-	-	<0.0010	-	-	-			
1,4-Dichlorobenzene	mg/L	0.005(2)	-	-	<0.0010	-	-	-			
1,1-Dichloroethane	mg/L	0.03(2)	-	-	<0.0010	-	-	-			
1,2-Dichloroethane	mg/L	0.005(2)	-	-	<0.0010	-	-	-			
1,1-Dichloroethylene	mg/L	0.014(2)	-	-	<0.0010	-	-	-			
cis-1,2-Dichloroethylene	mg/L	0.008(2)	-	-	<0.0010	-	-	-			
trans-1,2-Dichloroethylene	mg/L	0.08(2)	-	-	<0.0010	-	-	-			
Dichloromethane	mg/L	0.05(2)	-	-	<0.0050	-	-	-			
1,2-Dichloropropane	mg/L	0.0045(2)	-	-	<0.0010	-	-	-			
cis-1,3-Dichloropropylene	mg/L	-	-	-	<0.00050	-	-	-			
trans-1,3-Dichloropropylene	mg/L	-	-	-	<0.00050	-	-	-			
1,3-Dichloropropene (cis & trans)	mg/L	0.0015(2)	-	-	<0.0010	-	-	-			
Ethylbenzene	mg/L	0.14(2)	-	-	<0.00050	-	-	-			
Methyl t-butyl ether (MTBE)	mg/L	0.095(2)	-	-	<0.00050	-	-	-			
Styrene	mg/L	0.8(2)	-	-	<0.00050	-	-	-			
1,1,1,2-Tetrachloroethane	mg/L	0.006(2)	-	-	<0.0010	-	-	-			
1,1,2,2-Tetrachloroethane	mg/L	0.008(2)	-	-	<0.00020	-	-	-			
Tetrachloroethylene	mg/L	0.03(2)	-	-	<0.0010	-	-	-			
Toluene	mg/L	0.06(2)	-	-	0.00189	-	-	-			
1,1,1-Trichloroethane	mg/L	8(2)	-	-	<0.0010	-	-	-			
1,1,2-Trichloroethane	mg/L	0.003(2)	-	-	<0.00050	-	-	-			
Trichloroethylene	mg/L	0.005(2)	-	-	<0.0010	-	-	-			
Trichlorofluoromethane	mg/L	1(2)	-	-	<0.0010	-	-	-			
Vinyl Chloride	mg/L	0.002(2)	-	-	<0.00040	-	-	-			
ortho-Xylene	mg/L	-	-	-	<0.00050	-	-	-			
meta- & para-Xylene	mg/L	-	-	-	<0.00050	-	-	-			
Xylenes	mg/L	0.09(2)	-	-	<0.00075	-	-	-			

NOTES

(1) BC MoE Approved and Working Water Quality Guidelines, last updated March 2018
(2) BC Contaminated Sites Regulation (CSR) for drinking water, Schedule 3.2, last updated January 2019
(3) All criteria limits for BCWQG - Drinking Quality Guidelines based on Total Metal Concentration except Aluminum (Dissolved)
(4) BC MoE Water Quality Guidelines for Protection of Wildlife
(a) Range based on max pH 8.5 to min pH 6.5 at temperature of 6.0 'C
(b) at pH less than 6.5, limit is determined by regression equation, else limit is 0.1 mg/L.
(c) Limit for dissolved metals, not total metals
(d) Limit dependent upon hardness.
(e) Limit for chromium(VI) - data reported by lab as total chromium - limit assumes 100% chromium VI in sample
(f) Where hardness data was unavailable, 50 mg/L was assumed
(g) Maximum value
(h) Limit dependent upon chloride concentration
(i) Change of 25 mg/L from background for a duration of 24 hours during clear flows. Change of 10% of background during turbid flows

** Criteria exceeds detection limit*
MAC = Maximum Acceptable Concentration
AO = Aesthetic Objective

CSR-DW *BC Contaminated Sites Regulation Water Quality Guidelines for Drinking Water*

Table 7: Groundwater Quality Results Sampling Location MW-16 (E02211)

		CSR Standards CSR-DW (2)	29-Jun-20	14-Aug-20	03-Nov-20
Field	**Units**		monitor	monitor	sample
Conductivity	uS/cm	-	235	163	106.8
SPC	uS/cm				171.5
pH	pH	-	-	-	8
Dissolved Oxygen	mg/L	-	-	-	10
Temperature	°C	-	6.2	5	4.5
Depth to Water	m	-	45.38	45.45	46.33
Elevation of Well	m	-			225
Casing Height	m	-			0.98
Analyte	Units				
Conductivity	uS/cm	-	-	-	180
Hardness (as CaCO3)	mg/L	-	-	-	
Hardness (as CaCO3), dissolved	mg/L		-	-	89.5
pH	pH	-	-	-	8.15
Total Suspended Solids	mg/L	-	-	-	-
Total Dissolved Solids	mg/L	-	-	-	-
Alkalinity, Total (as CaCO3)	mg/L	-	-	-	90.9
Ammonia, Total (as N)	mg/L	-	-	-	<0.0050
Total Nitrogen as N	mg/L	-	-	-	-
TKN	mg/L		-	-	0.084
Bromide (Br)	mg/L	-	-	-	
Chloride (Cl)	mg/L	250 (2)			0.52
Fluoride (F)	mg/L	1.5 (2)	-	-	0.035
Nitrate (as N)	mg/L	10 (2)	-	-	0.1
Nitrite (as N)	mg/L	1.0 (2)	-	-	<0.0010
Sulfate (SO4)	mg/L	500 (2)	-	-	1.11
Total Organic Carbon	mg/L	-	-	-	1.63
BOD	mg/L	-	-	-	-
COD	mg/L	-	-	-	27
Dissolved Metals					
Aluminum (Al)-Dissolved	mg/L	9.5 (2)	-	-	0.0024
Antimony (Sb)-Dissolved	mg/L	0.006(2)	-	-	<0.00010
Arsenic (As)-Dissolved	mg/L	0.01(2)	-	-	0.00059
Barium (Ba)-Dissolved	mg/L	1.0(2)	-	-	0.0193
Beryllium (Be)-Dissolved	mg/L	0.008(2)	-	-	<0.000100
Bisumuth - Dissolved	mg/L	-	-	-	<0.000050
Boron (B)-Dissolved	mg/L	5.0(2)	-	-	<0.010
Cadmium (Cd)-Dissolved	mg/L	0.005(2)	-	-	<0.0000050
Calcium (Ca)-Dissolved	mg/L	-	-	-	33
Cesium (Cs)- Dissolved	mg/L	-	-	-	<0.000010
Chromium (Cr)-Dissolved	mg/L	0.05 - 6.0 (2)	-	-	0.0004
Cobalt (Co)-Dissolved	mg/L	0.001 (2)	-	-	<0.00010
Copper (Cu)-Dissolved	mg/L	1.5 (2) AO	-	-	<0.00020
Iron (Fe)-Dissolved	mg/L	6.5(2)			<0.010
Lead (Pb)-Dissolved	mg/L	0.01(2)	-	-	<0.000050
Lithium (Li)-Dissolved	mg/L	0.008 (2)	-	-	0.001
Magnesium (Mg)-Dissolved	mg/L	-	-	-	1.7
Manganese (Mn)-Dissolved	mg/L	1.5 (2)			0.00059
Mercury (Hg)-Dissolved	mg/L	0.001(2)	-	-	<0.0000050
Molybdenum (Mo)-Dissolved	mg/L	0.25(2)	-	-	<0.000050
Nickel (Ni)-Dissolved	mg/L	0.08 (2)	-	-	<0.00050
Phosphorus - Dissolved	mg/L	-	-	-	<0.050
Potassium (K)-Dissolved	mg/L	-	-	-	0.659
Rubidium (Rd) - Dissolved	mg/L	-	-	-	0.00038
Selenium (Se)-Dissolved	mg/L	0.01 (2)	-	-	0.000077
Silicon - Dissolved	mg/L	-	-	-	5.31
Silver (Ag)-Dissolved	mg/L	0.02 (2)	-	-	<0.000010
Sodium (Na)-Dissolved	mg/L	200(2)	-	-	1.8
Strontium - Dissolved	mg/L	-	-	-	0.129
Sulfur- Dissolved	mg/L	-	-	-	<0.50
Tellurium - Dissolved	mg/L	-	-	-	<0.00020
Thallium (Tl)-Dissolved	mg/L	-	-	-	<0.000010
Thorium - Dissolved	mg/L	-	-	-	<0.00010
Tin (Sn)-Dissolved	mg/L	2.5 (2)	-	-	<0.00010
Titanium (Ti)-Dissolved	mg/L	-	-	-	<0.00030
Tungston (W)- Dissolved	mg/L	0.003 (2)	-	-	<0.00010
Uranium (U)-Dissolved	mg/L	0.020	-	-	0.000039
Vanadium (V)-Dissolved	mg/L	0.020 (2)	-	-	0.00062
Zinc (Zn)-Dissolved	mg/L	3.0 (2)	-	-	<0.0010
Zirconium - Dissolved	mg/L	-	-	-	<0.00020
Volatile Organic Compounds (Water)					
Benzene	mg/L	0.005 (2)	-	-	-
Bromodichloromethane	mg/L	0.1(2)	-	-	-
Bromoform	mg/L	0.1(2)	-	-	-
Carbon Tetrachloride	mg/L	0.002(2)	-	-	-
Chlorobenzene	mg/L	0.08(2)	-	-	-
Dibromochloromethane	mg/L	0.1(2)	-	-	-
Chloroethane	mg/L	-	-	-	-
Chloroform	mg/L	0.1(2)	-	-	-
Chloromethane	mg/L	-	-	-	-
1,2-Dichlorobenzene	mg/L	0.2(2)	-	-	-
1,3-Dichlorobenzene	mg/L	-	-	-	-
1,4-Dichlorobenzene	mg/L	0.005(2)	-	-	-
1,1-Dichloroethane	mg/L	0.03(2)	-	-	-
1,2-Dichloroethane	mg/L	0.005(2)	-	-	-
1,1-Dichloroethylene	mg/L	0.014(2)	-	-	-
cis-1,2-Dichloroethylene	mg/L	0.008(2)	-	-	-
trans-1,2-Dichloroethylene	mg/L	0.08(2)	-	-	-
Dichloromethane	mg/L	0.05(2)	-	-	-
1,2-Dichloropropane	mg/L	0.0045(2)	-	-	-
cis-1,3-Dichloropropylene	mg/L	-	-	-	-
trans-1,3-Dichloropropylene	mg/L	-	-	-	-
1,3-Dichloropropene (cis & trans)	mg/L	0.0015(2)	-	-	-
Ethylbenzene	mg/L	0.14(2)	-	-	-
Methyl t-butyl ether (MTBE)	mg/L	0.095(2)	-	-	-
Styrene	mg/L	0.8(2)	-	-	-
1,1,1,2-Tetrachloroethane	mg/L	0.006(2)	-	-	-
1,1,2,2-Tetrachloroethane	mg/L	0.008(2)	-	-	-
Tetrachloroethylene	mg/L	0.03(2)	-	-	-
Toluene	mg/L	0.06(2)	-	-	-
1,1,1-Trichloroethane	mg/L	8(2)	-	-	-
1,1,2-Trichloroethane	mg/L	0.003(2)	-	-	-
Trichloroethylene	mg/L	0.005(2)	-	-	-
Trichlorofluoromethane	mg/L	1(2)	-	-	-
Vinyl Chloride	mg/L	0.002(2)	-	-	-
ortho-Xylene	mg/L	-	-	-	-
meta- & para-Xylene	mg/L	-	-	-	-
Xylenes	mg/L	0.09(2)	-	-	-

NOTES

(1) BC MoE Approved and Working Water Quality Guidelines, last updated March 2018
(2) BC Contaminated Sites Regulation (CSR) for drinking water, Schedule 3.2, last updated January
(3) All criteria limits for BCWQG - Drinking Quality Guidelines based on Total Metal Concentratio
(4) BC MoE Water Quality Guidelines for Protection of Wildlife
(a) Range based on max pH 8.5 to min pH 6.5 at temperature of 6.0 'C
(b) at pH less than 6.5, limit is determined by regression equation, else limit is 0.1 mg/L.
(c) Limit for dissolved metals, not total metals
(d) Limit dependent upon hardness.
(e) Limit for chromium(VI) - data reported by lab as total chromium - limit assumes 100% chromium
(f) Where hardness data was unavailable, 50 mg/L was assumed
(g) Maximum value
(h) Limit dependent upon chloride concentration
(i) Change of 25 mg/L from background for a duration of 24 hours during clear flows. Change of 10

** Criteria exceeds detection limit*
MAC = Maximum Acceptable Concentration
AO = Aesthetic Objective

CSR-DW *BC Contaminated Sites Regulation Water (*

Table 8: Groundwater Quality Results Sampling Location MW-4 (E251533)

Date		CSR Standards CSR-DW (2)	22-Oct-12	02-Apr-13	13-Jun-13	06-Apr-17	07-Jul-17	03-Oct-17	15-Nov-17	11-Apr-18	18-Jul-18	20-Nov-18	27-Mar-19	11-Jun-19
QA/QC Check														
Field	**Units**													
Conductivity	uS/cm	-				57	61	33.5	33.3	40.8	66	68	47.9	68
pH	pH	-	-	-	-	7.8	7.9	8.2	8.04	7.96	7.33	6.6	7.66	
Dissolved Oxygen	mg/L	-	-	-	-	-	1.5	8.9	6.4	5.9	5.5	8.6	8	
Temperature	°C	-	-	-	-	6.3	5.6	6.1	5	5.3	5.5	5.5	4.6	5.6
Depth to Water	m	-	-	-	-	-	-		24.4	24.62	24.19	24.99	25.57	25.71
Elevation of Well	m	-												
Casing Height	m	-												
Analyte	Units													
Conductivity	uS/cm	-	47.5			59.5								
Hardness (as CaCO3)	mg/L	-	-	22.9	-	-	22.5	22.1	19.1	26.9	31.1	28.2	36	
Hardness (as CaCO3), dissolved	mg/L													
pH	pH	-	8.5	7.4	-	8.3	8.2	8.1	7.62	7.65			7.79	
Alkalinity, Total (as CaCO3)	mg/L	-	24.3	28.7	-	-	34	28	27.7	33.2	39	32.9	37.5	
Ammonia, Total (as N)	mg/L	-	0.06	-	-	<0.03	0.05	0.03	0.0229	0.0295	0.0266	0.0102	0.0129	
Total Nitrogen as N	mg/L	-	0.332	-	-			0.285					-	
Bromide (Br)	mg/L	-								<0.050	<0.050	<0.050	<0.050	
Chloride (Cl)	mg/L	250 (2)	ND	ND	-	<1.0	1.8	1.1	1.61	0.54	<0.50	<0.50	<0.50	
Fluoride (F)	mg/L	1.5 (2)	0.16	0.2	-	-	<0.10	0.11	0.09	0.076	0.048	0.045	<0.020	
Nitrate (as N)	mg/L	10 (2)	ND	ND	-	<0.01	0.071	<0.0100	0.0139	0.129	0.0618	0.0466	<0.0050	
Nitrite (as N)	mg/L	1.0 (2)	ND	ND	-	-	<0.01	<0.01	<0.001	<0.0010	<0.0010	<0.0010	<0.0010	
Sulfate (SO4)	mg/L	500 (2)	-	0.81	-	<1.0	<1.0	<1.0	<0.30	0.34	0.75	<0.30	<0.30	
Total Organic Carbon	mg/L	-	-	0.75	-	-	1.41	<0.50	3.45	0.54	1.42	4.9	5.27	
BOD	mg/L	-	-	-	-	-		4.4					-	
COD	mg/L	-	-	-	-	-	-	<20	<20	<20	21	43	<20	
Dissolved Metals														
Aluminum (Al)-Dissolved	mg/L	9.5 (2)	ND	0.0055	<0.0050	<0.0050	<0.0050	0.0178	0.0049	0.0012	0.0251	0.0036	0.0078	
Antimony (Sb)-Dissolved	mg/L	0.006 (2)	ND	ND	<0.00050	<0.00010	<0.00010	<0.00020	0.00082	<0.00010	<0.00010	<0.00010	<0.00010	
Arsenic (As)-Dissolved	mg/L	0.01 (2)	ND	0.000076	-	<0.00050	<0.00050	<0.00050	0.00094	<0.00010	0.00011	<0.00010	0.0001	
Barium (Ba)-Dissolved	mg/L	1.0 (2)	0.0060	0.0052	-	0.0375	0.0098	0.0079	0.00681	0.00503	0.00998	0.00994	0.00837	
Beryllium (Be)-Dissolved	mg/L	0.008 (2)	ND	ND	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	
Bisumuth - Dissolved	mg/L	-	ND	ND	-	<0.00010	<0.00010	<0.00010	0.000601	<0.000050	<0.000050	<0.000050	0.000082	
Boron (B)-Dissolved	mg/L	5.0 (2)	ND	ND	-	0.006	<0.0050	<0.0050	<0.010	<0.010	<0.010	<0.010	<0.010	
Cadmium (Cd)-Dissolved	mg/L	0.005 (2)	ND	0.00002	-	<0.00001	<0.000010	0.000482	0.000484	<0.0000050	0.0000125	0.0000446	0.000186	
Calcium (Ca)-Dissolved	mg/L	-	-	-	-	-	7.46	6.4	6.16	9.37	10.9	9.86	11.7	
Cesium (Cs) - Dissolved	mg/L	-	-	-	-	-	-	-	0.000042	<0.000010	<0.000010	<0.000010	<0.000010	
Chromium (Cr)-Dissolved	mg/L	0.05 - 6.0 (2)	ND	ND	-	<0.0005	<0.00050	<0.00050	0.00021	<0.00010	<0.00010	<0.00010	<0.00010	
Cobalt (Co)-Dissolved	mg/L	0.001 (2)	ND	0.0076	-	<0.00005	<0.00010	<0.00010	0.00025	<0.00010	<0.00010	<0.00010	<0.00010	
Copper (Cu)-Dissolved	mg/L	1.5 (2) AO	0.00066	ND	-	0.0077	0.00035	0.0021	0.00372	<0.00020	0.0066	0.00177	0.00114	
Iron (Fe)-Dissolved	mg/L	6.5 (2)	ND	0.0338		0.011	<0.010	<0.010	0.018	<0.010	0.536	0.022	0.073	
Lead (Pb)-Dissolved	mg/L	0.01 (2)	ND	ND	-	<0.0001	<0.00010	<0.00020	0.000450	<0.000050	0.000302	<0.000050	<0.000050	
Lithium (Li)-Dissolved	mg/L	0.008 (2)	ND	ND	-	0.0004	0.00072	0.00054	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	
Magnesium (Mg)-Dissolved	mg/L	-	0.729	0.68	-	0.742	0.938	0.921	0.895	0.837	0.964	0.874	1.61	
Manganese (Mn)-Dissolved	mg/L	1.5 (2)	0.0963	0.348		0.0237	<0.00020	0.0558	0.0674	0.0067	0.0152	0.0647	0.00344	
Mercury (Hg)-Dissolved	mg/L	0.001 (2)	ND	ND	-	<0.00002	<0.000020	<0.000010	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	
Molybdenum (Mo)-Dissolved	mg/L	0.25 (2)	ND	0.000116	-	0.00014	<0.00010	0.00014	0.000355	0.000122	0.000136	0.000085	<0.000050	
Nickel (Ni)-Dissolved	mg/L	0.08 (2)	-	-	-	0.0005	0.00022	0.00071	0.00122	<0.00050	<0.00050	<0.00050	<0.00050	
Phosphorus - Dissolved	mg/L	-	-	-	-	<0.05	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	
Potassium (K)-Dissolved	mg/L	-	-	-	-	-	1.17	0.93	1.16	0.757	0.759	0.79	1.06	
Rubidium (Rd) - Dissolved	mg/L	-	-	-	-	-	-	-	0.00061	0.00025	0.00027	0.00023	0.00031	
Selenium (Se)-Dissolved	mg/L	0.01 (2)	ND	ND	-	<0.00050	<0.00050	<0.00050	0.000866	<0.000050	<0.000050	<0.000050	0.000058	
Silicon - Dissolved	mg/L	-	ND	ND	-	0.9	<1.0	<1.0	0.718	1.33	2.08	1.33	3.69	
Silver (Ag)-Dissolved	mg/L	0.02 (2)	ND	ND	-	<0.00005	<0.000050	<0.000050	0.000017	<0.000010	<0.000010	<0.000010	<0.000010	
Sodium (Na)-Dissolved	mg/L	200 (2)	1.81	1.52	-	2.34	2.71	2.46	3.13	2.04	1.9	1.93	2.62	
Strontium - Dissolved	mg/L	-	0.0484	0.0503	-	0.0502	0.0614	0.0573	0.0536	0.0591	0.0635	0.0604	0.0729	
Sulfur- Dissolved	mg/L	-	-	-	-	<3.0	<3.0	<3.0	<0.50	<0.50	<0.50	<0.50	0.55	
Tellurium - Dissolved	mg/L	-	-	-	-	<0.00020	<0.00020	<0.00050	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	
Thallium (Tl)-Dissolved	mg/L	-	-	-	-	<0.00002	<0.000020	<0.000020	0.000851	<0.000010	<0.000010	<0.000010	<0.000010	
Thorium - Dissolved	mg/L	-	-	-	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	
Tin (Sn)-Dissolved	mg/L	2.5 (2)	ND	ND	-	<0.00020	<0.00020	<0.00020	0.00235	<0.00010	<0.00010	0.0009	0.00069	
Titanium (Ti)-Dissolved	mg/L	-	-	-	-	-	<0.0050	<0.0050	<0.00030	<0.00030	0.00056	<0.00030	<0.00030	
Tungston (W) - Dissolved	mg/L	0.003 (2)	-	-	-	-	-	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	
Uranium (U)-Dissolved	mg/L	0.020	ND	ND	-	<0.00002	<0.000020	-	<0.000010	<0.000010	0.000011	<0.000010	0.000013	
Vanadium (V)-Dissolved	mg/L	0.020 (2)	ND	ND	-	<0.0010	<0.0010	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	
Zinc (Zn)-Dissolved	mg/L	3.0 (2)	ND	ND	-	0.008	<0.0040	-	0.0038	<0.0010	0.0058	<0.0010	0.002	
Zirconium - Dissolved	mg/L	-	ND	ND	-	<0.00010	<0.00010	-	<0.000060	<0.000060	<0.000060	<0.000060	<0.000060	
Volatile Organic Compounds (Water)				-										
Benzene	mg/L	0.005 (2)	-	-	<0.00050	-	-	-	<0.00050	-	-	-		
Bromodichloromethane	mg/L	0.1 (2)	-	-	<0.0010	-	-	-	<0.0010	-	-	-		
Bromoform	mg/L	0.1 (2)	-	-	<0.0010	-	-	-	<0.0010	-	-	-		
Carbon Tetrachloride	mg/L	0.002 (2)	-	-	<0.00050	-	-	-	<0.00050	-	-	-		
Chlorobenzene	mg/L	0.08 (2)	-	-	<0.0010	-	-	-	<0.0010	-	-	-		
Dibromochloromethane	mg/L	0.1 (2)	-	-	<0.0010	-	-	-	<0.0010	-	-	-		
Chloroethane	mg/L	-	-	-	<0.0010	-	-	-	<0.0010	-	-	-		
Chloroform	mg/L	0.1 (2)	-	-	<0.0010	-	-	-	<0.0010	-	-	-		
Chloromethane	mg/L	-	-	-	<0.0050	-	-	-	<0.0050	-	-	-		
1,2-Dichlorobenzene	mg/L	0.2 (2)	-	-	<0.00070	-	-	-	<0.00050	-	-	-		
1,3-Dichlorobenzene	mg/L	-	-	-	<0.0010	-	-	-	<0.0010	-	-	-		
1,4-Dichlorobenzene	mg/L	0.005 (2)	-	-	<0.0010	-	-	-	<0.0010	-	-	-		
1,1-Dichloroethane	mg/L	0.03 (2)	-	-	<0.0010	-	-	-	<0.0010	-	-	-		
1,2-Dichloroethane	mg/L	0.005 (2)	-	-	<0.0010	-	-	-	<0.0010	-	-	-		
1,1-Dichloroethylene	mg/L	0.014 (2)	-	-	<0.0010	-	-	-	<0.0010	-	-	-		
cis-1,2-Dichloroethylene	mg/L	0.008 (2)	-	-	<0.0010	-	-	-	<0.0010	-	-	-		
trans-1,2-Dichloroethylene	mg/L	0.08 (2)	-	-	<0.0010	-	-	-	<0.0010	-	-	-		
Dichloromethane	mg/L	0.05 (2)	-	-	<0.0050	-	-	-	<0.0050	-	-	-		
1,2-Dichloropropane	mg/L	0.0045 (2)	-	-	<0.0010	-	-	-	<0.0010	-	-	-		
cis-1,3-Dichloropropylene	mg/L	-	-	-	<0.0010	-	-	-	<0.00050	-	-	-		
trans-1,3-Dichloropropylene	mg/L	-	-	-	<0.0010	-	-	-	<0.00050	-	-	-		
1,3-Dichloropropene (cis & trans)	mg/L	0.0015 (2)	-	-	<0.0014	-	-	-	<0.0010	-	-	-		
Ethylbenzene	mg/L	0.14 (2)	-	-	<0.0050	-	-	-	<0.00050	-	-	-		
Methyl t-butyl ether (MTBE)	mg/L	0.095 (2)	-	-	<0.00050	-	-	-	<0.00050	-	-	-		
Styrene	mg/L	0.8 (2)	-	-	<0.00050	-	-	-	<0.00050	-	-	-		
1,1,1,2-Tetrachloroethane	mg/L	0.006 (2)	-	-	<0.0010	-	-	-	<0.0010	-	-	-		
1,1,2,2-Tetrachloroethane	mg/L	0.008 (2)	-	-	<0.0010	-	-	-	<0.00020	-	-	-		
Tetrachloroethylene	mg/L	0.03 (2)	-	-	<0.0010	-	-	-	<0.0010	-	-	-		
Toluene	mg/L	0.06 (2)	-	-	<0.00050	-	-	-	0.00280	-	-	-		
1,1,1-Trichloroethane	mg/L	8 (2)	-	-	<0.0010	-	-	-	<0.0010	-	-	-		
1,1,2-Trichloroethane	mg/L	0.003 (2)	-	-	<0.0010	-	-	-	<0.00050	-	-	-		
Trichloroethylene	mg/L	0.005 (2)	-	-	<0.0010	-	-	-	<0.0010	-	-	-		
Trichlorofluoromethane	mg/L	1 (2)	-	-	<0.0010	-	-	-	<0.0010	-	-	-		
Vinyl Chloride	mg/L	0.002 (2)	-	-	<0.0010	-	-	-	<0.00040	-	-	-		
ortho-Xylene	mg/L	-	-	-	<0.00050	-	-	-	0.00054	-	-	-		
meta- & para-Xylene	mg/L	-	-	-	<0.00050	-	-	-	0.00115	-	-	-		
Xylenes	mg/L	0.09 (2)	-	-	<0.00075	-	-	-	0.00169	-	-	-		

NOTES

(1) BC MoE Approved and Working Water Quality Guidelines, last updated March 2018
(2) BC Contaminated Sites Regulation (CSR) for drinking water, Schedule 3.2, last updated January 2019
(3) All criteria limits for BCWQG - Drinking Quality Guidelines based on Total Metal Concentration except Aluminum (Dissolved)
(4) BC MoE Water Quality Guidelines for Protection of Wildlife
(a) Range based on max pH 8.5 to min pH 6.5 at temperature of 6.0 'C
(b) at pH less than 6.5, limit is determined by regression equation, else limit is 0.1 mg/L.
(c) Limit for dissolved metals, not total metals
(d) Limit dependent upon hardness.
(e) Limit for chromium(VI) - data reported by lab as total chromium - limit assumes 100% chromium VI in sample
(f) Where hardness data was unavailable, 50 mg/L was assumed
(g) Maximum value
(h) Limit dependent upon chloride concentration
(i) Change of 25 mg/L from background for a duration of 24 hours during clear flows. Change of 10% of background during turbid flows

** Criteria exceeds detection limit*
MAC = Maximum Acceptable Concentration
AO = Aesthetic Objective

CSR-DW *BC Contaminated Sites Regulation Water Quality Guidelines for Drinking Water*

Table 8: Groundwater Quality Results Sampling Location MW-4 (E251533)

Date		CSR Standards CSR-DW (2)	26-Mar-19	29-Jun-20	14-Aug-20	03-Nov-20
QA/QC Check			Dry			
Field	**Units**			monitor	monitor	Insufficient water for sample
Conductivity	uS/cm	-	68	68	79	101
pH	pH	-		-	-	-
Dissolved Oxygen	mg/L	-		-	-	-
Temperature	°C	-	5.8	5.8	5.5	5.5
Depth to Water	m	-	25.87	25.83	26.02	25.72
Elevation of Well	m	-				193
Casing Height	m	-				1.14
Analyte	Units					
Conductivity	uS/cm	-				
Hardness (as CaCO3)	mg/L	-		-	-	-
Hardness (as CaCO3), dissolved	mg/L			-	-	-
pH	pH	-		-	-	-
Alkalinity, Total (as CaCO3)	mg/L	-		-	-	-
Ammonia, Total (as N)	mg/L	-		-	-	-
Total Nitrogen as N	mg/L	-		-	-	-
Bromide (Br)	mg/L	-		-	-	-
Chloride (Cl)	mg/L	250 (2)				
Fluoride (F)	mg/L	1.5 (2)		-	-	-
Nitrate (as N)	mg/L	10 (2)		-	-	-
Nitrite (as N)	mg/L	1.0 (2)		-	-	-
Sulfate (SO4)	mg/L	500 (2)		-	-	-
Total Organic Carbon	mg/L	-		-	-	-
BOD	mg/L	-		-	-	-
COD	mg/L	-		-	-	-
Dissolved Metals						
Aluminum (Al)-Dissolved	mg/L	9.5 (2)		-	-	-
Antimony (Sb)-Dissolved	mg/L	0.006(2)		-	-	-
Arsenic (As)-Dissolved	mg/L	0.01(2)		-	-	-
Barium (Ba)-Dissolved	mg/L	1.0(2)		-	-	-
Beryllium (Be)-Dissolved	mg/L	0.008(2)		-	-	-
Bisumuth - Dissolved	mg/L	-		-	-	-
Boron (B)-Dissolved	mg/L	5.0(2)		-	-	-
Cadmium (Cd)-Dissolved	mg/L	0.005(2)		-	-	-
Calcium (Ca)-Dissolved	mg/L	-		-	-	-
Cesium (Cs) - Dissolved	mg/L	-		-	-	-
Chromium (Cr)-Dissolved	mg/L	0.05 - 6.0 (2)		-	-	-
Cobalt (Co)-Dissolved	mg/L	0.001 (2)		-	-	-
Copper (Cu)-Dissolved	mg/L	1.5 (2) AO		-	-	-
Iron (Fe)-Dissolved	mg/L	6.5(2)				
Lead (Pb)-Dissolved	mg/L	0.01(2)		-	-	-
Lithium (Li)-Dissolved	mg/L	0.008 (2)		-	-	-
Magnesium (Mg)-Dissolved	mg/L	-		-	-	-
Manganese (Mn)-Dissolved	mg/L	1.5 (2)				
Mercury (Hg)-Dissolved	mg/L	0.001(2)		-	-	-
Molybdenum (Mo)-Dissolved	mg/L	0.25(2)		-	-	-
Nickel (Ni)-Dissolved	mg/L	0.08 (2)		-	-	-
Phosphorus - Dissolved	mg/L	-		-	-	-
Potassium (K)-Dissolved	mg/L	-		-	-	-
Rubidium (Rd) - Dissolved	mg/L	-		-	-	-
Selenium (Se)-Dissolved	mg/L	0.01 (2)		-	-	-
Silicon - Dissolved	mg/L	-		-	-	-
Silver (Ag)-Dissolved	mg/L	0.02 (2)		-	-	-
Sodium (Na)-Dissolved	mg/L	200(2)		-	-	-
Strontium - Dissolved	mg/L	-		-	-	-
Sulfur- Dissolved	mg/L	-		-	-	-
Tellurium - Dissolved	mg/L	-		-	-	-
Thallium (Tl)-Dissolved	mg/L	-		-	-	-
Thorium - Dissolved	mg/L	-		-	-	-
Tin (Sn)-Dissolved	mg/L	2.5 (2)		-	-	-
Titanium (Ti)-Dissolved	mg/L	-		-	-	-
Tungston (W) - Dissolved	mg/L	0.003 (2)		-	-	-
Uranium (U)-Dissolved	mg/L	0.020		-	-	-
Vanadium (V)-Dissolved	mg/L	0.020 (2)		-	-	-
Zinc (Zn)-Dissolved	mg/L	3.0 (2)		-	-	-
Zirconium - Dissolved	mg/L	-		-	-	-
Volatile Organic Compounds (Water)						
Benzene	mg/L	0.005 (2)		-	-	-
Bromodichloromethane	mg/L	0.1(2)		-	-	-
Bromoform	mg/L	0.1(2)		-	-	-
Carbon Tetrachloride	mg/L	0.002(2)		-	-	-
Chlorobenzene	mg/L	0.08(2)		-	-	-
Dibromochloromethane	mg/L	0.1(2)		-	-	-
Chloroethane	mg/L	-		-	-	-
Chloroform	mg/L	0.1(2)		-	-	-
Chloromethane	mg/L	-		-	-	-
1,2-Dichlorobenzene	mg/L	0.2(2)		-	-	-
1,3-Dichlorobenzene	mg/L	-		-	-	-
1,4-Dichlorobenzene	mg/L	0.005(2)		-	-	-
1,1-Dichloroethane	mg/L	0.03(2)		-	-	-
1,2-Dichloroethane	mg/L	0.005(2)		-	-	-
1,1-Dichloroethylene	mg/L	0.014(2)		-	-	-
cis-1,2-Dichloroethylene	mg/L	0.008(2)		-	-	-
trans-1,2-Dichloroethylene	mg/L	0.08(2)		-	-	-
Dichloromethane	mg/L	0.05(2)		-	-	-
1,2-Dichloropropane	mg/L	0.0045(2)		-	-	-
cis-1,3-Dichloropropylene	mg/L	-		-	-	-
trans-1,3-Dichloropropylene	mg/L	-		-	-	-
1,3-Dichloropropene (cis & trans)	mg/L	0.0015(2)		-	-	-
Ethylbenzene	mg/L	0.14(2)		-	-	-
Methyl t-butyl ether (MTBE)	mg/L	0.095(2)		-	-	-
Styrene	mg/L	0.8(2)		-	-	-
1,1,1,2-Tetrachloroethane	mg/L	0.006(2)		-	-	-
1,1,2,2-Tetrachloroethane	mg/L	0.008(2)		-	-	-
Tetrachloroethylene	mg/L	0.03(2)		-	-	-
Toluene	mg/L	0.06(2)		-	-	-
1,1,1-Trichloroethane	mg/L	8(2)		-	-	-
1,1,2-Trichloroethane	mg/L	0.003(2)		-	-	-
Trichloroethylene	mg/L	0.005(2)		-	-	-
Trichlorofluoromethane	mg/L	1(2)		-	-	-
Vinyl Chloride	mg/L	0.002(2)		-	-	-
ortho-Xylene	mg/L	-		-	-	-
meta- & para-Xylene	mg/L	-		-	-	-
Xylenes	mg/L	0.09(2)		-	-	-

NOTES

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(3) All criteria limits for BCWQG - Drinking Quality Guidelines based on Total Metal Co
(4) BC MoE Water Quality Guidelines for Protection of Wildlife
(a) Range based on max pH 8.5 to min pH 6.5 at temperature of 6.0 'C
(b) at pH less than 6.5, limit is determined by regression equation, else limit is 0.1 mg/L.
(c) Limit for dissolved metals, not total metals
(d) Limit dependent upon hardness.
(e) Limit for chromium(VI) - data reported by lab as total chromium - limit assumes 100%
(f) Where hardness data was unavailable, 50 mg/L was assumed
(g) Maximum value
(h) Limit dependent upon chloride concentration
(i) Change of 25 mg/L from background for a duration of 24 hours during clear flows. Ch

** Criteria exceeds detection limit*
MAC = Maximum Acceptable Concentration
AO = Aesthetic Objective

CSR-DW *BC Contaminated Sites Regulation Water Quali*

Table 9: Groundwater Quality Results Sampling Location MW-7 (E287379)

Date		CSR Standards CSR-DW (2)	22-Oct-12	03-Apr-13	06-Apr-17	27-Mar-19	06-Jul-17	11-Jun-19	26-Jun-19	29-Jun-20	14-Aug-20	04-Nov-20
QA/QC Check												
Field	**Units**					**DRY WELL**		**Dry**	**Dry**	**monitor (almost dry)**	**(almost dry)**	**dry**
Conductivity	uS/cm	-			124		77		205	235	230	
SPC	uS/cm									-	-	-
pH	pH	-	-	-	7.8		8.2			-	-	-
Dissolved Oxygen	mg/L	-	-	-	-		78.3			-	-	-
Temperature	°C	-	-	-	-		5.6		9.1	6.2	6.1	-
Depth to Water	m	-	-	-	-		-		45.26	45.38	45.38	-
Elevation of Well	m	-										230
Casing Height	m	-										0.9
Analyte	Units											
Conductivity	uS/cm	-	59.2									
Hardness (as CaCO3)	mg/L	-	-	67.3	53.2		40.1			-	-	-
Hardness (as CaCO3), dissolved	mg/L									-	-	-
pH	pH	-	8.5	8.6	8.1		8.4			-	-	-
Alkalinity, Total (as CaCO3)	mg/L	-	29.6	38.1	57		58			-	-	-
Ammonia, Total (as N)	mg/L	-	ND	-	<0.03		<0.03			-	-	-
Chloride (Cl)	mg/L	250 (2)	1.3	ND	<1.0		1.3					
Fluoride (F)	mg/L	1.5 (2)	ND	ND	<0.10		0.1			-	-	-
Nitrate (as N)	mg/L	10 (2)	ND	ND	0.061		0.055			-	-	-
Nitrite (as N)	mg/L	1.0 (2)	ND	ND	<0.01		<0.01			-	-	-
Sulfate (SO4)	mg/L	500 (2)	-	1.68	1.4		1.4			-	-	-
Total Organic Carbon	mg/L	-	-	4.89	0.68		0.79			-	-	-
BOD	mg/L	-	-	-	-		-			-	-	-
COD	mg/L	-	-	-	-		-			-	-	-
Dissolved Metals												
Aluminum (Al)-Dissolved	mg/L	9.5 (2)	0.0183	0.0198	0.012		0.0143			-	-	-
Antimony (Sb)-Dissolved	mg/L	0.006(2)	ND	0.000158	<0.00010		0.00039			-	-	-
Arsenic (As)-Dissolved	mg/L	0.01(2)	0.00090	0.00060	<0.00050		<0.00050			-	-	-
Barium (Ba)-Dissolved	mg/L	1.0(2)	0.0056	0.00609	0.0139		0.0129			-	-	-
Beryllium (Be)-Dissolved	mg/L	0.008(2)	ND	ND	<0.00010		<0.00010			-	-	-
Bisumuth - Dissolved	mg/L	-	ND	ND	<0.00010		<0.00010			-	-	-
Boron (B)-Dissolved	mg/L	5.0(2)	ND	ND	0.005		<0.0050			-	-	-
Cadmium (Cd)-Dissolved	mg/L	0.005(2)	0.000017	0.000012	0.00023		0.000011			-	-	-
Calcium (Ca)-Dissolved	mg/L	-	-	-	18.8		15.2			-	-	-
Cesium (Cs)- Dissolved	mg/L	-	-	-	-		-			-	-	-
Chromium (Cr)-Dissolved	mg/L	0.05 - 6.0 (2)	ND	ND	<0.0005		<0.00050			-	-	-
Cobalt (Co)-Dissolved	mg/L	0.001 (2)	ND	0.0001	0.00006		<0.00010			-	-	-
Copper (Cu)-Dissolved	mg/L	1.5 (2) AO	0.00118	0.00049	0.0032		0.00055			-	-	-
Iron (Fe)-Dissolved	mg/L	6.5(2)	ND	0.0069	<0.010		<0.010					
Lead (Pb)-Dissolved	mg/L	0.01(2)	ND	ND	<0.0001		<0.00010			-	-	-
Lithium (Li)-Dissolved	mg/L	0.008 (2)	ND	ND	0.0007		0.00085			-	-	-
Magnesium (Mg)-Dissolved	mg/L	-	0.452	0.47	0.92		0.502			-	-	-
Manganese (Mn)-Dissolved	mg/L	1.5 (2)	ND	0.00082	0.00323		0.00025					
Mercury (Hg)-Dissolved	mg/L	0.001(2)	ND	ND	<0.00002		<0.000020			-	-	-
Molybdenum (Mo)-Dissolved	mg/L	0.25(2)	ND	0.00015	0.0009		0.00015			-	-	-
Nickel (Ni)-Dissolved	mg/L	0.08 (2)	-	-	0.0024		<0.00020			-	-	-
Phosphorus - Dissolved	mg/L	-	-	-	<0.05		<0.050			-	-	-
Potassium (K)-Dissolved	mg/L	-	-	-	0.66		0.57			-	-	-
Rubidium (Rb) - Dissolved	mg/L	-	-	-	-		-			-	-	-
Selenium (Se)-Dissolved	mg/L	0.01 (2)	ND	0.000051	<0.00050		<0.00050			-	-	-
Silicon - Dissolved	mg/L	-	4.24	3.79	4.7		4.3			-	-	-
Silver (Ag)-Dissolved	mg/L	0.02 (2)	ND	ND	<0.00005		<0.000050			-	-	-
Sodium (Na)-Dissolved	mg/L	200(2)	1.55	1.26	1.5		1.48			-	-	-
Strontium - Dissolved	mg/L	-	0.0325	0.0361	0.0668		0.0542			-	-	-
Sulfur- Dissolved	mg/L	-	-	-	<3.0		<3.0			-	-	-
Tellurium - Dissolved	mg/L	-	-	-	<0.00020		<0.00020			-	-	-
Thallium (Tl)-Dissolved	mg/L	-	-	-	<0.00002		<0.000020			-	-	-
Thorium - Dissolved	mg/L	-	-	-	<0.00010		<0.00010			-	-	-
Tin (Sn)-Dissolved	mg/L	2.5 (2)	ND	ND	<0.00020		<0.00020			-	-	-
Titanium (Ti)-Dissolved	mg/L	-	-	-	<0.0050		<0.0050			-	-	-
Tungston (W) - Dissolved	mg/L	0.003 (2)	-	-	-		-			-	-	-
Uranium (U)-Dissolved	mg/L	0.020	ND	0.00002	0.00004		0.000023			-	-	-
Vanadium (V)-Dissolved	mg/L	0.020 (2)	ND	0.00093	<0.0010		<0.0010			-	-	-
Zinc (Zn)-Dissolved	mg/L	3.0 (2)	ND	0.0019	0.0126		<0.0040			-	-	-
Zirconium - Dissolved	mg/L	-	ND	ND	<0.00010		<0.00010			-	-	-

NOTES

(1) BC MoE Approved and Working Water Quality Guidelines, last updated March 2018
(2) BC Contaminated Sites Regulation (CSR) for drinking water, Schedule 3.2, last updated January 2019
(3) All criteria limits for BCWQG - Drinking Quality Guidelines based on Total Metal Concentration except Aluminum (Dissolved)
(4) BC MoE Water Quality Guidelines for Protection of Wildlife
(a) Range based on max pH 8.5 to min pH 6.5 at temperature of 6.0 'C
(b) at pH less than 6.5, limit is determined by regression equation, else limit is 0.1 mg/L.
(c) Limit for dissolved metals, not total metals
(d) Limit dependent upon hardness.
(e) Limit for chromium(VI) - data reported by lab as total chromium - limit assumes 100% chromium VI in sample
(f) Where hardness data was unavailable, 50 mg/L was assumed
(g) Maximum value
(h) Limit dependent upon chloride concentration
(i) Change of 25 mg/L from background for a duration of 24 hours during clear flows. Change of 10% of background during turbid flows

** Criteria exceeds detection limit*
MAC = Maximum Acceptable Concentration
AO = Aesthetic Objective

CSR-DW *BC Contaminated Sites Regulation Water Quality Guidelines for Drinking Water*

Table 10: Groundwater Quality Results Sampling Location MW-8 (E287380)

		CSR Standards CSR-DW (2)	22-Oct-12	03-Apr-13	13-Jun-13	06-Jul-17	03-Oct-17	15-Nov-17	10-Apr-18	18-Jul-18	21-Nov-18	25-Mar-19
QA/QC Check												
Field	**Units**											
Conductivity	uS/cm	-				34	22.4	22.6	22.4	34	34	36
SPC	uS/cm	-										
pH	pH	-	-	-	-	8.2	6.45	6.43	5.98	6.49	7.49	7.13
Dissolved Oxygen	mg/L	-	-	-	-	6.6	-	9.6	11.6	8.1	0.3	11.3
Temperature	°C	-	-	-	-	6.5	5.9	5.5	5.8	6.3	6.1	6.3
Depth to Water	m	-	-	-	-	-	-		10.31	9.95	10.94	11.58
Elevation of Well	m	-										
Casing Height	m	-										
Analyte	Units											
Conductivity	uS/cm	-	27.5				24.8					
Hardness (as CaCO3)	mg/L	-	-	14.1	-	10.6	-	12	11.4	12.5	12.2	12.9
Hardness (as CaCO3), dissolved	mg/L											
pH	pH	-	6.5	6.3	-	6.1	6.2	6.94	7.37	-	-	6.67
Total Suspended Solids	mg/L	-	-	-		-	190	-	-	-	-	-
Total Dissolved Solids	mg/L	-	13	-	-	-	12	-	-	-	-	-
Alkalinity, Total (as CaCO3)	mg/L	-	16	16.5	-	16	-	16.3	16.9	17.8	15.1	17.5
Ammonia, Total (as N)	mg/L	-	ND	-	-	<0.03	<0.03	<0.005	0.0056	0.0089	<0.0050	0.0266
Total Nitrogen as N	mg/L	-	0.311	-	-	-	0.168	-	-	-	-	-
TKN	mg/L	-										
Bromide (Br)	mg/L	-	-	-	-	-	-	-	<0.050	<0.050	<0.050	<0.050
Chloride (Cl)	mg/L	250 (2)	ND	ND	-	2.7	2.2	1.13	1.13	1.4	1.4	<0.50
Fluoride (F)	mg/L	1.5 (2)	ND	ND	-	<0.10	-	0.024	0.023	0.022	0.021	0.027
Nitrate (as N)	mg/L	10 (2)	ND	ND	-	0.17	<0.100	0.016	0.0153	0.0233	0.0225	0.235
Nitrite (as N)	mg/L	1.0 (2)	ND	ND	-	<0.01	-	<0.001	<0.0010	<0.0010	<0.0010	<0.0010
Sulfate (SO4)	mg/L	500 (2)	-	1.31	-	<1.0	<1.0	<0.3	<0.30	<0.30	<0.30	1.08
Total Organic Carbon	mg/L	-	-	2.67	-	<0.50	-	<0.50	0.6	3.31	1.28	3.06
BOD	mg/L	-	-	-	-	-	-	-	-	-	-	-
COD	mg/L	-	-	-	-	-	-	<20	<20	25	<20	<20
Dissolved Metals												
Aluminum (Al)-Dissolved	mg/L	9.5 (2)	ND	0.0033	<0.0050	<0.0050	0.0067	0.0024	0.0036	0.0144	0.004	0.0073
Antimony (Sb)-Dissolved	mg/L	0.006(2)	ND	ND	<0.00050	0.00018	<0.00020	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Arsenic (As)-Dissolved	mg/L	0.01(2)	0.00019	0.000172	-	<0.00050	<0.00050	0.00010	<0.00010	0.00015	0.00011	0.00016
Barium (Ba)-Dissolved	mg/L	1.0(2)	0.0044	0.00416	-	0.0051	<0.0050	0.0103	0.00516	0.00549	0.00508	0.00633
Beryllium (Be)-Dissolved	mg/L	0.008(2)	ND	ND	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Bisumuth - Dissolved	mg/L	-	ND	ND	-	<0.00010	<0.00010	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Boron (B)-Dissolved	mg/L	5.0(2)	ND	ND	-	<0.0050	0.0063	<0.010	<0.010	<0.010	<0.010	<0.010
Cadmium (Cd)-Dissolved	mg/L	0.005(2)	0.000011	0.000012	-	0.000213	0.000029	0.0000439	0.000186	0.000123	0.0000829	0.000282
Calcium (Ca)-Dissolved	mg/L	-	-	-	-	3.15	-	4.09	3.98	4.33	4.28	4.4
Cessium (Cs) -Dissolved	mg/L	-	-	-	-	-	-	-	<0.000010	<0.000010	<0.000010	<0.000010
Chromium (Cr)-Dissolved	mg/L	0.05 - 6.0 (2)	ND	ND	-	<0.00050	<0.00050	0.00021	0.00025	0.00021	0.00018	0.00021
Cobalt (Co)-Dissolved	mg/L	0.001 (2)	ND	0.000011	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Copper (Cu)-Dissolved	mg/L	1.5 (2) AO	0.00058	ND	-	0.00194	<0.00040	<0.00020	0.00097	0.00037	<0.00020	0.00114
Iron (Fe)-Dissolved	mg/L	6.5(2)	ND	ND		<0.010	<0.010	<0.010	<0.010	0.016	<0.010	<0.010
Lead (Pb)-Dissolved	mg/L	0.01(2)	ND	ND	-	<0.00010	<0.00020	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Lithium (Li)-Dissolved	mg/L	0.008 (2)	ND	ND	-	0.00025	0.00018	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Magnesium (Mg)-Dissolved	mg/L	-	0.416	0.37	-	0.27	0.363	0.445	0.366	0.407	0.377	0.463
Manganese (Mn)-Dissolved	mg/L	1.5 (2)	ND	0.0098		<0.00020	0.0011	0.00117	0.00204	0.0101	0.00233	0.00342
Mercury (Hg)-Dissolved	mg/L	0.001(2)	ND	ND	-	<0.000020	<0.000010	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Molybdenum (Mo)-Dissolved	mg/L	0.25(2)	ND	0.000054	-	<0.00010	0.00022	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Nickel (Ni)-Dissolved	mg/L	0.08 (2)	-	-	-	0.00049	<0.00040	<0.00050	0.0005	<0.00050	0.00052	<0.00050
Phosphorus - Dissolved	mg/L	-	-	-	-	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Potassium (K)-Dissolved	mg/L	-	-	-	-	0.48	-	0.254	0.316	0.335	0.274	0.314
Rubidium (Rb) - Dissolved	mg/L	-	-	-	-	-	-	-	0.00045	0.00043	0.00035	0.00045
Selenium (Se)-Dissolved	mg/L	0.01 (2)	ND	0.000059	-	<0.00050	<0.00050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Silicon - Dissolved	mg/L	-	5.93	5.44	-	5.9	6.4	6.27	6.09	5.91	6.32	6.59
Silver (Ag)-Dissolved	mg/L	0.02 (2)	ND	ND	-	<0.000050	<0.000050	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)-Dissolved	mg/L	200(2)	1.68	1.58	-	3.07	2.19	2.33	2.39	2.44	2.4	2.16
Strontium - Dissolved	mg/L	-	0.0368	0.0423	-	0.0425	0.0472	0.0516	0.0525	0.047	0.0513	0.0453
Sulfur- Dissolved	mg/L	-	-	-	-	<3.0	<3.0	<0.50	<0.50	<0.50	<0.50	<0.50
Tellurium - Dissolved	mg/L	-	-	-	-	<0.00020	<0.00050	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Thallium (Tl)-Dissolved	mg/L	-	-	-	-	<0.000020	<0.000020	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Thorium- Dissolved	mg/L	-	-	-	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Tin (Sn)-Dissolved	mg/L	2.5 (2)	ND	ND	-	<0.00020	<0.00020	<0.00010	0.00065	<0.00010	<0.00010	<0.00010
Titanium (Ti)-Dissolved	mg/L	-	-	-	-	<0.0050	-	<0.00030	<0.00030	0.00066	<0.00030	<0.00030
Tungston (W) - Dissolved	mg/L	0.003 (2)	-	-	-	-	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Uranium (U)-Dissolved	mg/L	0.020	ND	ND	-	<0.000020	<0.000020	-	<0.000010	<0.000010	<0.000010	<0.000010
Vanadium (V)-Dissolved	mg/L	0.020 (2)	ND	ND	-	<0.0010	<0.0010	-	<0.00050	<0.00050	<0.00050	<0.00050
Zinc (Zn)-Dissolved	mg/L	3.0 (2)	ND	0.0014	-	0.0064	<0.0040	-	0.0041	<0.0010	<0.0010	0.0033
Zirconium - Dissolved	mg/L	-	ND	ND	-	<0.00010	<0.00010	-	<0.000060	<0.000060	<0.000060	<0.000060
Volatile Organic Compounds (Water)				-								
Benzene	mg/L	0.005 (2)	-	-	<0.00050	-	-	-	-	-	-	-
Bromodichloromethane	mg/L	0.1(2)	-	-	<0.0010	-	-	-	-	-	-	-
Bromoform	mg/L	0.1(2)	-	-	<0.0010	-	-	-	-	-	-	-
Carbon Tetrachloride	mg/L	0.002(2)	-	-	<0.00050	-	-	-	-	-	-	-
Chlorobenzene	mg/L	0.08(2)	-	-	<0.0010	-	-	-	-	-	-	-
Dibromochloromethane	mg/L	0.1(2)	-	-	<0.0010	-	-	-	-	-	-	-
Chloroethane	mg/L	-	-	-	<0.0010	-	-	-	-	-	-	-
Chloroform	mg/L	0.1(2)	-	-	<0.0010	-	-	-	-	-	-	-
Chloromethane	mg/L	-	-	-	<0.0050	-	-	-	-	-	-	-
1,2-Dichlorobenzene	mg/L	0.2(2)	-	-	<0.00070	-	-	-	-	-	-	-
1,3-Dichlorobenzene	mg/L	-	-	-	<0.0010	-	-	-	-	-	-	-
1,4-Dichlorobenzene	mg/L	0.005(2)	-	-	<0.0010	-	-	-	-	-	-	-
1,1-Dichloroethane	mg/L	0.03(2)	-	-	<0.0010	-	-	-	-	-	-	-
1,2-Dichloroethane	mg/L	0.005(2)	-	-	<0.0010	-	-	-	-	-	-	-
1,1-Dichloroethylene	mg/L	0.014(2)	-	-	<0.0010	-	-	-	-	-	-	-
cis-1,2-Dichloroethylene	mg/L	0.008(2)	-	-	<0.0010	-	-	-	-	-	-	-
trans-1,2-Dichloroethylene	mg/L	0.08(2)	-	-	<0.0010	-	-	-	-	-	-	-
Dichloromethane	mg/L	0.05(2)	-	-	<0.0050	-	-	-	-	-	-	-
1,2-Dichloropropane	mg/L	0.0045(2)	-	-	<0.0010	-	-	-	-	-	-	-
cis-1,3-Dichloropropylene	mg/L	-	-	-	<0.0010	-	-	-	-	-	-	-
trans-1,3-Dichloropropylene	mg/L	-	-	-	<0.0010	-	-	-	-	-	-	-
1,3-Dichloropropene (cis & trans)	mg/L	0.0015(2)	-	-	<0.0014	-	-	-	-	-	-	-
Ethylbenzene	mg/L	0.14(2)	-	-	<0.0050	-	-	-	-	-	-	-
Methyl t-butyl ether (MTBE)	mg/L	0.095(2)	-	-	<0.00050	-	-	-	-	-	-	-
Styrene	mg/L	0.8(2)	-	-	<0.00050	-	-	-	-	-	-	-
1,1,1,2-Tetrachloroethane	mg/L	0.006(2)	-	-	<0.0010	-	-	-	-	-	-	-
1,1,2,2-Tetrachloroethane	mg/L	0.008(2)	-	-	<0.0010	-	-	-	-	-	-	-
Tetrachloroethylene	mg/L	0.03(2)	-	-	<0.0010	-	-	-	-	-	-	-
Toluene	mg/L	0.06(2)	-	-	<0.00050	-	-	-	-	-	-	-
1,1,1-Trichloroethane	mg/L	8(2)	-	-	<0.0010	-	-	-	-	-	-	-
1,1,2-Trichloroethane	mg/L	0.003(2)	-	-	<0.0010	-	-	-	-	-	-	-
Trichloroethylene	mg/L	0.005(2)	-	-	<0.0010	-	-	-	-	-	-	-
Trichlorofluoromethane	mg/L	1(2)	-	-	<0.0010	-	-	-	-	-	-	-
Vinyl Chloride	mg/L	0.002(2)	-	-	<0.0010	-	-	-	-	-	-	-
ortho-Xylene	mg/L	-	-	-	<0.00050	-	-	-	-	-	-	-
meta- & para-Xylene	mg/L	-	-	-	<0.00050	-	-	-	-	-	-	-
Xylenes	mg/L	0.09(2)	-	-	<0.00075	-	-	-	-	-	-	-

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(c) Limit for dissolved metals, not total metals
(d) Limit dependent upon hardness.
(e) Limit for chromium(VI) - data reported by lab as total chromium - limit assumes 100% chromium VI in sample
(f) Where hardness data was unavailable, 50 mg/L was assumed
(g) Maximum value
(h) Limit dependent upon chloride concentration
(i) Change of 25 mg/L from background for a duration of 24 hours during clear flows. Change of 10% of background during turbid flows

** Criteria exceeds detection limit*
MAC = Maximum Acceptable Concentration
AO = Aesthetic Objective

CSR-DW *BC Contaminated Sites Regulation Water Quality Guidelines for Drinking Water*

Table 10: Groundwater Quality Results Sampling Location MW-8 (E287380)

		CSR Standards CSR-DW (2)	26-Jun-19	11-Jun-19	29-Jun-20	14-Aug-20	04-Nov-20
QA/QC Check							
Field	**Units**				**monitor**	**monitor**	**sample**
Conductivity	uS/cm	-	34	33	284	109	97.6
SPC	uS/cm	-					152.6
pH	pH	-	7.02		-	-	5.93
Dissolved Oxygen	mg/L	-	11.9		-	-	10
Temperature	°C	-	6.4	6.1	6.7	6.3	6.2
Depth to Water	m	-	11.42	11.41	13.8	12.74	12.00
Elevation of Well	m	-			-	-	202
Casing Height	m	-			-	-	0.8
Analyte	Units						
Conductivity	uS/cm	-					160
Hardness (as CaCO3)	mg/L	-	12.3		-	-	-
Hardness (as CaCO3), dissolved	mg/L				-	-	59.7
pH	pH	-	7.34		-	-	6.70
Total Suspended Solids	mg/L	-	-		-	-	-
Total Dissolved Solids	mg/L	-	-		-	-	-
Alkalinity, Total (as CaCO3)	mg/L	-	16.5		-	-	13.3
Ammonia, Total (as N)	mg/L	-	<0.0050		-	-	0.0089
Total Nitrogen as N	mg/L	-	-		-	-	-
TKN	mg/L	-			-	-	0.141
Bromide (Br)	mg/L	-	<0.050		-	-	-
Chloride (Cl)	mg/L	250 (2)	0.92				5.89
Fluoride (F)	mg/L	1.5 (2)	0.026		-	-	<0.020
Nitrate (as N)	mg/L	10 (2)	0.0895		-	-	12.7
Nitrite (as N)	mg/L	1.0 (2)	<0.0010		-	-	<0.0010
Sulfate (SO4)	mg/L	500 (2)	0.37		-	-	<0.30
Total Organic Carbon	mg/L	-	0.8		-	-	1.84
BOD	mg/L	-	-		-	-	-
COD	mg/L	-	<20		-	-	25
Dissolved Metals							
Aluminum (Al)-Dissolved	mg/L	9.5 (2)	0.0065		-	-	0.179
Antimony (Sb)-Dissolved	mg/L	0.006(2)	<0.00010		-	-	<0.00010
Arsenic (As)-Dissolved	mg/L	0.01(2)	0.00011		-	-	0.00026
Barium (Ba)-Dissolved	mg/L	1.0(2)	0.00624		-	-	0.0267
Beryllium (Be)-Dissolved	mg/L	0.008(2)	<0.00010		-	-	<0.000100
Bisumuth - Dissolved	mg/L	-	<0.000050		-	-	<0.000050
Boron (B)-Dissolved	mg/L	5.0(2)	<0.010		-	-	<0.010
Cadmium (Cd)-Dissolved	mg/L	0.005(2)	0.0002		-	-	0.000109
Calcium (Ca)-Dissolved	mg/L	-	4.26		-	-	20.5
Cessium (Cs) -Dissolved	mg/L	-	<0.000010		-	-	0.000020
Chromium (Cr)-Dissolved	mg/L	0.05 - 6.0 (2)	0.00023		-	-	0.00048
Cobalt (Co)-Dissolved	mg/L	0.001 (2)	<0.00010		-	-	0.00031
Copper (Cu)-Dissolved	mg/L	1.5 (2) AO	0.00077		-	-	0.00253
Iron (Fe)-Dissolved	mg/L	6.5(2)	<0.010				0.358
Lead (Pb)-Dissolved	mg/L	0.01(2)	<0.000050		-	-	0.000171
Lithium (Li)-Dissolved	mg/L	0.008 (2)	<0.0010		-	-	<0.0010
Magnesium (Mg)-Dissolved	mg/L	-	0.407		-	-	2.06
Manganese (Mn)-Dissolved	mg/L	1.5 (2)	0.00218				0.0188
Mercury (Hg)-Dissolved	mg/L	0.001(2)	<0.0000050		-	-	<0.0000050
Molybdenum (Mo)-Dissolved	mg/L	0.25(2)	<0.000050		-	-	<0.000050
Nickel (Ni)-Dissolved	mg/L	0.08 (2)	<0.00050		-	-	0.00128
Phosphorus - Dissolved	mg/L	-	<0.050		-	-	<0.050
Potassium (K)-Dissolved	mg/L	-	0.308		-	-	0.603
Rubidium (Rb) - Dissolved	mg/L	-	0.00036		-	-	0.00079
Selenium (Se)-Dissolved	mg/L	0.01 (2)	<0.000050		-	-	<0.000050
Silicon - Dissolved	mg/L	-	6.19		-	-	6.55
Silver (Ag)-Dissolved	mg/L	0.02 (2)	<0.000010		-	-	<0.000010
Sodium (Na)-Dissolved	mg/L	200(2)	2.34		-	-	4.26
Strontium - Dissolved	mg/L	-	0.0529		-	-	0.272
Sulfur- Dissolved	mg/L	-	<0.50		-	-	<0.50
Tellurium - Dissolved	mg/L	-	<0.00020		-	-	<0.00020
Thallium (Tl)-Dissolved	mg/L	-	<0.000010		-	-	<0.000010
Thorium- Dissolved	mg/L	-	<0.00010		-	-	<0.00010
Tin (Sn)-Dissolved	mg/L	2.5 (2)	<0.00010		-	-	<0.00010
Titanium (Ti)-Dissolved	mg/L	-	<0.00030		-	-	0.00591
Tungston (W) - Dissolved	mg/L	0.003 (2)	<0.00010		-	-	<0.00010
Uranium (U)-Dissolved	mg/L	0.020	<0.000010		-	-	<0.000010
Vanadium (V)-Dissolved	mg/L	0.020 (2)	<0.00050		-	-	<0.00050
Zinc (Zn)-Dissolved	mg/L	3.0 (2)	0.0059		-	-	0.0037
Zirconium - Dissolved	mg/L	-	<0.00020		-	-	<0.00020
Volatile Organic Compounds (Water)							
Benzene	mg/L	0.005 (2)	-	-	-	-	-
Bromodichloromethane	mg/L	0.1(2)	-	-	-	-	-
Bromoform	mg/L	0.1(2)	-	-	-	-	-
Carbon Tetrachloride	mg/L	0.002(2)	-	-	-	-	-
Chlorobenzene	mg/L	0.08(2)	-	-	-	-	-
Dibromochloromethane	mg/L	0.1(2)	-	-	-	-	-
Chloroethane	mg/L	-	-	-	-	-	-
Chloroform	mg/L	0.1(2)	-	-	-	-	-
Chloromethane	mg/L	-	-	-	-	-	-
1,2-Dichlorobenzene	mg/L	0.2(2)	-	-	-	-	-
1,3-Dichlorobenzene	mg/L	-	-	-	-	-	-
1,4-Dichlorobenzene	mg/L	0.005(2)	-	-	-	-	-
1,1-Dichloroethane	mg/L	0.03(2)	-	-	-	-	-
1,2-Dichloroethane	mg/L	0.005(2)	-	-	-	-	-
1,1-Dichloroethylene	mg/L	0.014(2)	-	-	-	-	-
cis-1,2-Dichloroethylene	mg/L	0.008(2)	-	-	-	-	-
trans-1,2-Dichloroethylene	mg/L	0.08(2)	-	-	-	-	-
Dichloromethane	mg/L	0.05(2)	-	-	-	-	-
1,2-Dichloropropane	mg/L	0.0045(2)	-	-	-	-	-
cis-1,3-Dichloropropylene	mg/L	-	-	-	-	-	-
trans-1,3-Dichloropropylene	mg/L	-	-	-	-	-	-
1,3-Dichloropropene (cis & trans)	mg/L	0.0015(2)	-	-	-	-	-
Ethylbenzene	mg/L	0.14(2)	-	-	-	-	-
Methyl t-butyl ether (MTBE)	mg/L	0.095(2)	-	-	-	-	-
Styrene	mg/L	0.8(2)	-	-	-	-	-
1,1,1,2-Tetrachloroethane	mg/L	0.006(2)	-	-	-	-	-
1,1,2,2-Tetrachloroethane	mg/L	0.008(2)	-	-	-	-	-
Tetrachloroethylene	mg/L	0.03(2)	-	-	-	-	-
Toluene	mg/L	0.06(2)	-	-	-	-	-
1,1,1-Trichloroethane	mg/L	8(2)	-	-	-	-	-
1,1,2-Trichloroethane	mg/L	0.003(2)	-	-	-	-	-
Trichloroethylene	mg/L	0.005(2)	-	-	-	-	-
Trichlorofluoromethane	mg/L	1(2)	-	-	-	-	-
Vinyl Chloride	mg/L	0.002(2)	-	-	-	-	-
ortho-Xylene	mg/L	-	-	-	-	-	-
meta- & para-Xylene	mg/L	-	-	-	-	-	-
Xylenes	mg/L	0.09(2)	-	-	-	-	-

NOTES

(1) BC MoE Approved and Working Water Quality Guidelines, last updated March 2018
(2) BC Contaminated Sites Regulation (CSR) for drinking water, Schedule 3.2, last updated January
(3) All criteria limits for BCWQG - Drinking Quality Guidelines based on Total Metal Concentratio
(4) BC MoE Water Quality Guidelines for Protection of Wildlife
(a) Range based on max pH 8.5 to min pH 6.5 at temperature of 6.0 'C
(b) at pH less than 6.5, limit is determined by regression equation, else limit is 0.1 mg/L.
(c) Limit for dissolved metals, not total metals
(d) Limit dependent upon hardness.
(e) Limit for chromium(VI) - data reported by lab as total chromium - limit assumes 100% chromium
(f) Where hardness data was unavailable, 50 mg/L was assumed
(g) Maximum value
(h) Limit dependent upon chloride concentration
(i) Change of 25 mg/L from background for a duration of 24 hours during clear flows. Change of 10

** Criteria exceeds detection limit*
MAC = Maximum Acceptable Concentration
AO = Aesthetic Objective

CSR-DW *BC Contaminated Sites Regulation Water (*

Table 11: Groundwater Quality Results Sampling Location MW-9 (E287381)

		CSR Standards	22-Oct-12	02-Apr-13	06-Jul-17	15-Nov-17	19-Jul-18	20-Nov-18	25-Mar-19	11-Jun-19	26-Jun-19	29-Jun-20	14-Aug-20	03-Nov-20
		CSR-DW (2)										well dry		insufficient water for sample
Field	**Units**											monitor	monitor	
Conductivity	uS/cm	-			43	24.7	28.8	42	43	42	87	56	65	
pH	pH	-	-	-	7.7	7.4	5.99	6.83	7.05		7.95	-	-	-
Dissolved Oxygen	mg/L	-	-	-	8.0	9.0	6.9	3.1	11.6		12.8	-	-	-
Temperature	°C	-	-	-	6.0	4.8	5.5	5.4	5.5	5.5	6	5.8	5.5	5.5
Depth to Water	m	-	-	-		50.41	50.58	51.15	51.86	51.74	51.83	53.61	53.42	52.27
Elevation of well	m	-										-	-	207
Casing height	m	-										-	-	0.9
Analyte	Units													
Conductivity	uS/cm	-	63.7		42									
Hardness (as CaCO3)	mg/L	-	-	20.4	14.6	13	16	16.9	15.2		15.2	-	-	-
Hardness (as CaCO3), dissolved	mg/L											-	-	-
pH	pH	-	6.7	6.9	6.6	7.08	-	-	7.01		7.39	-	-	-
Total Suspended Solids	mg/L	-	-	-	-	-	-	-	-		-	-	-	-
Total Dissolved Solids	mg/L	-	30	-	22	-	-	-	-		-	-	-	-
Alkalinity, Bicarbonate (as CaCO3)	mg/L	-	30.6	-	-	-						-	-	-
Alkalinity, Carbonate (as CaCO3)	mg/L	-	ND	-	-	-						-	-	-
Alkalinity, Hydroxide (as CaCO3)	mg/L	-										-	-	-
Alkalinity, Total (as CaCO3)	mg/L	-	30.6	24.5	20	16.4	25.4	20.9	17.2		17.8	-	-	-
Ammonia, Total (as N)	mg/L	-	ND	-	<0.03	-	0.0162	<0.0050	0.0205		<0.0050	-	-	-
Total Nitrogen as N	mg/L	-	0.213	-	0.149	-	-	-	-		-	-	-	-
Bromide (Br)	mg/L	-	-	-	-	-	-	<0.050	<0.050		<0.050	-	-	-
Chloride (Cl)	mg/L	250 (2)	ND	2.4	<1.0	0.5	<0.50	<0.50	<0.50		0.63			
Fluoride (F)	mg/L	1.5 (2)	ND	ND	<0.10	0.031	0.032	0.026	0.06		0.034	-	-	-
Nitrate (as N)	mg/L	10 (2)	0.022	0.039	0.046	0.0343	0.0205	0.0215	0.0169		0.0228	-	-	-
Nitrite (as N)	mg/L	1.0 (2)	ND	ND	<0.01	<0.001	<0.0010	<0.0010	<0.0010		<0.0010	-	-	-
Sulfate (SO4)	mg/L	500 (2)	-	1.83	1.3	0.98	1.07	0.93	1.21		1.13	-	-	-
Total Organic Carbon	mg/L	-	-	2.67	<0.50	3.06	8.36	2.14	7.25		1.37	-	-	-
BOD	mg/L	-	-	-	-	-	-	-	-		-	-	-	-
COD	mg/L	-	-	-	-	<20	45	<20	23		<20	-	-	-
Dissolved Metals														
Aluminum (Al)-Dissolved	mg/L	9.5 (2)	ND	0.0033	<0.0050	0.0037	0.0427	0.0069	0.0188		0.0034	-	-	-
Antimony (Sb)-Dissolved	mg/L	0.006(2)	ND	0.000137	0.00014	<0.00010	0.00011	0.00013	<0.00010		<0.00010	-	-	-
Arsenic (As)-Dissolved	mg/L	0.01(2)	0.00023	0.000286	<0.00050	0.00022	0.0009	0.00038	0.00062		0.00016	-	-	-
Barium (Ba)-Dissolved	mg/L	1.0(2)	0.0074	0.00512	<0.0050	0.0149	0.00818	0.00573	0.0245		0.00489	-	-	-
Beryllium (Be)-Dissolved	mg/L	0.008(2)	ND	ND	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010		<0.00010	-	-	-
Bisumuth - Dissolved	mg/L	-	ND	ND	<0.00010	<0.000050	<0.000050	<0.000050	<0.000050		<0.000050	-	-	-
Boron (B)-Dissolved	mg/L	5.0(2)	ND	ND	<0.0050	<0.010	<0.010	<0.010	<0.010		<0.010	-	-	-
Cadmium (Cd)-Dissolved	mg/L	0.005(2)	0.000065	0.00015	0.000022	0.0003550	0.000178	0.000771	0.000155		0.0000555	-	-	-
Calcium (Ca)-Dissolved	mg/L	-	-	-	5.04	4.34	5.35	5.7	5.1		5.14	-	-	-
Cessium (Cs) -Dissolved	mg/L	-	-	-	-	<0.000010	0.000012	<0.000010	<0.000010		<0.000010	-	-	-
Chromium (Cr)-Dissolved	mg/L	0.05 - 6.0 (2)	ND	0.000029	<0.00050	0.00021	0.0002	0.00019	0.00017		0.00012	-	-	-
Cobalt (Co)-Dissolved	mg/L	0.001 (2)	ND	0.00047	<0.00010	<0.00010	0.00075	0.00015	0.00023		<0.00010	-	-	-
Copper (Cu)-Dissolved	mg/L	1.5 (2) AO	0.00086	ND	0.00025	0.00064	0.00081	0.00202	0.00282		0.0006	-	-	-
Iron (Fe)-Dissolved	mg/L	6.5(2)	ND	ND	<0.010	<0.010	0.312	0.021	0.044		<0.010			
Lead (Pb)-Dissolved	mg/L	0.01(2)	ND	ND	<0.00010	<0.000050	0.00012	<0.000050	0.000157		<0.000050	-	-	-
Lithium (Li)-Dissolved	mg/L	0.008 (2)	ND	ND	0.00051	<0.0010	<0.0010	<0.0010	<0.0010		<0.0010	-	-	-
Magnesium (Mg)-Dissolved	mg/L	-	0.924	0.55	0.496	0.532	0.651	0.652	0.605		0.583	-	-	-
Manganese (Mn)-Dissolved	mg/L	1.5 (2)	0.0048	0.0038	<0.00020	0.01530	0.234	0.0258	0.0565		0.00028			
Mercury (Hg)-Dissolved	mg/L	0.001(2)	ND	ND	<0.000020	<0.0000050	<0.0000050	<0.0000050	<0.0000050		<0.0000050	-	-	-
Molybdenum (Mo)-Dissolved	mg/L	0.25(2)	ND	0.000096	<0.00010	0.000084	0.000156	0.000057	0.000093		0.000061	-	-	-
Nickel (Ni)-Dissolved	mg/L	0.08 (2)	-	-	0.00046	<0.00050	0.00056	<0.00050	<0.00050		<0.00050	-	-	-
Phosphorus (P)- Dissovled	mg/L	-	-	-	<0.050	<0.050	<0.050	<0.050	<0.050		<0.050	-	-	-
Potassium (K)-Dissolved	mg/L	-	-	-	0.33	0.285	0.323	0.371	0.364		0.334	-	-	-
Rubidium (Rb) -Dissolved	mg/L	-	-	-	-	<0.00020	0.00032	0.00025	0.00033		<0.00020	-	-	-
Selenium (Se)-Dissolved	mg/L	0.01 (2)	ND	0.000053	<0.00050	<0.000050	<0.000050	<0.000050	<0.000050		<0.000050	-	-	-
Silicon - Dissolved	mg/L	-	4.10	4.74	6.00	5.89	5.94	5.98	6.12		5.79	-	-	-
Silver (Ag)-Dissolved	mg/L	0.02 (2)	ND	ND	<0.000050	<0.000010	<0.000010	<0.000010	<0.000010		<0.000010	-	-	-
Sodium (Na)-Dissolved	mg/L	200(2)	2.21	1.95	1.76	1.670	1.77	1.84	1.52		1.67	-	-	-
Strontium - Dissolved	mg/L	-	0.0480	0.0328	0.0244	0.0235	0.0303	0.0335	0.0328		0.0351	-	-	-
Sulfur- Dissolved	mg/L	-	-	-	<3.0	<0.50	<0.50	<0.50	<0.50		<0.50	-	-	-
Tellium (Te) - Dissolved	mg/L	-	-	-	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020		<0.00020	-	-	-
Thallium (Tl)-Dissolved	mg/L	-	-	-	<0.000020	<0.000010	<0.000010	<0.000010	<0.000010		<0.000010	-	-	-
Thorium (Th)- Dissolved	mg/L	-	-	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010		<0.00010	-	-	-
Tin (Sn)-Dissolved	mg/L	2.5 (2)	ND	ND	<0.00020	<0.00010	<0.00010	0.00091	<0.00010		<0.00010	-	-	-
Titanium (Ti)-Dissolved	mg/L	-	-	-	<0.0050	<0.00030	0.00305	<0.00030	0.00061		<0.00030	-	-	-
Tungston (W) - Dissolved	mg/L	0.003 (2)	-	-	-	<0.00010	<0.00010	<0.00010	<0.00010		<0.00010	-	-	-
Uranium (U)-Dissolved	mg/L	0.020	ND	ND	<0.000020	<0.000010	<0.000010	<0.000010	<0.000010		<0.000010	-	-	-
Vanadium (V)-Dissolved	mg/L	0.020 (2)	ND	0.00072	<0.0010	<0.00050	<0.00050	<0.00050	<0.00050		<0.00050	-	-	-
Zinc (Zn)-Dissolved	mg/L	3.0 (2)	ND	0.0022	<0.0040	0.0013	0.0018	0.0032	0.0075		0.0015	-	-	-
Zirconium - Dissolved	mg/L	-	ND	ND	<0.00010	<0.000060	<0.000060	<0.000060	<0.000060		<0.00020	-	-	-
Volatile Organic Compounds (Water)				-										
Benzene	mg/L	0.005 (2)	-	-	-	<0.00050	-	-	-	-	-	-	-	-
Bromodichloromethane	mg/L	0.1(2)	-	-	-	<0.0010	-	-	-	-	-	-	-	-
Bromoform	mg/L	0.1(2)	-	-	-	<0.0010	-	-	-	-	-	-	-	-
Carbon Tetrachloride	mg/L	0.002(2)	-	-	-	<0.00050	-	-	-	-	-	-	-	-
Chlorobenzene	mg/L	0.08(2)	-	-	-	<0.0010	-	-	-	-	-	-	-	-
Dibromochloromethane	mg/L	0.1(2)	-	-	-	<0.0010	-	-	-	-	-	-	-	-
Chloroethane	mg/L	-	-	-	-	<0.0010	-	-	-	-	-	-	-	-
Chloroform	mg/L	0.1(2)	-	-	-	<0.0010	-	-	-	-	-	-	-	-
Chloromethane	mg/L	-	-	-	-	<0.0050	-	-	-	-	-	-	-	-
1,2-Dichlorobenzene	mg/L	0.2(2)	-	-	-	<0.00050	-	-	-	-	-	-	-	-
1,3-Dichlorobenzene	mg/L	-	-	-	-	<0.0010	-	-	-	-	-	-	-	-
1,4-Dichlorobenzene	mg/L	0.005(2)	-	-	-	<0.0010	-	-	-	-	-	-	-	-
1,1-Dichloroethane	mg/L	0.03(2)	-	-	-	<0.0010	-	-	-	-	-	-	-	-
1,2-Dichloroethane	mg/L	0.005(2)	-	-	-	<0.0010	-	-	-	-	-	-	-	-
1,1-Dichloroethylene	mg/L	0.014(2)	-	-	-	<0.0010	-	-	-	-	-	-	-	-
cis-1,2-Dichloroethylene	mg/L	0.008(2)	-	-	-	<0.0010	-	-	-	-	-	-	-	-
trans-1,2-Dichloroethylene	mg/L	0.08(2)	-	-	-	<0.0010	-	-	-	-	-	-	-	-
Dichloromethane	mg/L	0.05(2)	-	-	-	<0.0050	-	-	-	-	-	-	-	-
1,2-Dichloropropane	mg/L	0.0045(2)	-	-	-	<0.0010	-	-	-	-	-	-	-	-
cis-1,3-Dichloropropylene	mg/L	-	-	-	-	<0.00050	-	-	-	-	-	-	-	-
trans-1,3-Dichloropropylene	mg/L	-	-	-	-	<0.00050	-	-	-	-	-	-	-	-
1,3-Dichloropropene (cis & trans)	mg/L	0.0015(2)	-	-	-	<0.0010	-	-	-	-	-	-	-	-
Ethylbenzene	mg/L	0.14(2)	-	-	-	<0.00050	-	-	-	-	-	-	-	-
Methyl t-butyl ether (MTBE)	mg/L	0.095(2)	-	-	-	<0.00050	-	-	-	-	-	-	-	-
Styrene	mg/L	0.8(2)	-	-	-	<0.00050	-	-	-	-	-	-	-	-
1,1,1,2-Tetrachloroethane	mg/L	0.006(2)	-	-	-	<0.0010	-	-	-	-	-	-	-	-
1,1,2,2-Tetrachloroethane	mg/L	0.008(2)	-	-	-	<0.00020	-	-	-	-	-	-	-	-
Tetrachloroethylene	mg/L	0.03(2)	-	-	-	<0.0010	-	-	-	-	-	-	-	-
Toluene	mg/L	0.06(2)	-	-	-	0.00646	-	-	-	-	-	-	-	-
1,1,1-Trichloroethane	mg/L	8(2)	-	-	-	<0.0010	-	-	-	-	-	-	-	-
1,1,2-Trichloroethane	mg/L	0.003(2)	-	-	-	<0.00050	-	-	-	-	-	-	-	-
Trichloroethylene	mg/L	0.005(2)	-	-	-	<0.0010	-	-	-	-	-	-	-	-
Trichlorofluoromethane	mg/L	1(2)	-	-	-	<0.0010	-	-	-	-	-	-	-	-
Vinyl Chloride	mg/L	0.002(2)	-	-	-	<0.00040	-	-	-	-	-	-	-	-
ortho-Xylene	mg/L	-	-	-	-	<0.00050	-	-	-	-	-	-	-	-
meta- & para-Xylene	mg/L	-	-	-	-	<0.00050	-	-	-	-	-	-	-	-
Xylenes	mg/L	0.09(2)	-	-	-	<0.00075	-	-	-	-	-	-	-	-

NOTES

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(4) BC MoE Water Quality Guidelines for Protection of Wildlife
(5) BC Contaminated Sites Regulation (CSR) for drinking water, Schedule 3.2
(a) Range based on max pH 8.5 to min pH 6.5 at temperature of 6.0 'C
(b) at pH less than 6.5, limit is determined by regression equation, else limit is 0.1 mg/L.
(c) Limit for dissolved metals, not total metals
(d) Limit dependent upon hardness.
(e) Limit for chromium(VI) - data reported by lab as total chromium - limit assumes 100% chromium VI in sample
(f) Where hardness data was unavailable, 50 mg/L was assumed
(g) Maximum value
(h) Limit dependent upon chloride concentration
(i) Change of 25 mg/L from background for a duration of 24 hours during clear flows. Change of 10% of background during turbid flows

** Criteria exceeds detection limit*
MAC = Maximum Acceptable Concentration
AO = Aesthetic Objective
CSR-DW *BC Contaminated Sites Regulation Water Quality Guidelines for Drinking Water*

Table 12: Groundwater Quality Results Sampling Location MW-5 (E251534)

		CSR Standards	22-Oct-12	03-Apr-13	13-Jun-13	05-Apr-17	11-Jun-19	29-Jun-20	14-Aug-20	04-Nov-20
		CSR-DW (2)						Well locked, no access	Well locked, no access	Well locked, no access
Field	**Units**							monitor	monitor	
Conductivity	uS/cm	-				116				
pH	pH	-	-	-	-	7.4		-	-	-
Dissolved Oxygen	mg/L	-	-	-	-	-		-	-	-
Temperature	°C	-	-	-	-	-		-	-	-
Depth to Water	m	-	-	-	-	-		-	-	-
Well Elevation	m							-	-	206
Casing Height	m							-	-	-
Analyte	Units									
Conductivity	uS/cm	-	102			116				
Hardness (as CaCO3)	mg/L	-	-	52.3	-	-		-	-	-
Hardness (as CaCO3), dissolved	mg/L							-	-	-
pH	pH	-	7.5	7.3	-	7.4		-	-	-
Total Suspended Solids	mg/L	-	-	-		7.7		-	-	-
Total Dissolved Solids	mg/L	-	48	-	-	70		-	-	-
Alkalinity, Total (as CaCO3)	mg/L	-	53.1	57.8	-	-		-	-	-
Ammonia, Total (as N)	mg/L	-	ND	-	-	<0.03		-	-	-
Chloride (Cl)	mg/L	-	ND	ND	<0.50	<1.0				
Fluoride (F)	mg/L	250 (2)	ND	ND	-	<0.1		-	-	-
Nitrate (as N)	mg/L	1.5 (2)	ND	0.021	-	-		-	-	-
Nitrite (as N)	mg/L	10 (2)	ND	ND	-	<0.01		-	-	-
Sulfate (SO4)	mg/L	1.0 (2)	ND	2.03	-	-		-	-	-
Total Organic Carbon	mg/L	500 (2)	-	ND	-	<0.50		-	-	-
BOD	mg/L	-	-		-	-		-	-	-
COD	mg/L	-	-	-	-	-		-	-	-
Dissolved Metals										
Aluminum (Al)-Dissolved	mg/L	9.5 (2)	ND	0.0036	<0.0050	<0.0050		-	-	-
Antimony (Sb)-Dissolved	mg/L	0.006(2)	ND	0.000106	<0.00050	<0.00010		-	-	-
Arsenic (As)-Dissolved	mg/L	0.01(2)	ND	0.000074	<0.00050	<0.00050		-	-	-
Barium (Ba)-Dissolved	mg/L	1.0(2)	0.0060	0.0044	-	<0.0050		-	-	-
Beryllium (Be)-Dissolved	mg/L	0.008(2)	ND	ND	-	<0.00010		-	-	-
Bisumuth - Dissolved	mg/L	-	ND	ND	-	<0.00010		-	-	-
Boron (B)-Dissolved	mg/L	5.0(2)	ND	ND	-	0.004		-	-	-
Cadmium (Cd)-Dissolved	mg/L	0.005(2)	ND	0.000016	-	<0.00001		-	-	-
Calcium (Ca)-Dissolved	mg/L	-	6.40	18.20	-	18.8		-	-	-
Cesium (Cs)- Dissolved	mg/L	-	-	-	-	-		-	-	-
Chromium (Cr)-Dissolved	mg/L	0.05 - 6.0 (2)	-	-	-	-		-	-	-
Cobalt (Co)-Dissolved	mg/L	0.001 (2)	ND	ND	-	<0.00005		-	-	-
Copper (Cu)-Dissolved	mg/L	1.5 (2) AO	0.00066	0.00678	-	0.0034		-	-	-
Iron (Fe)-Dissolved	mg/L	6.5(2)	ND	ND		0.01				
Lead (Pb)-Dissolved	mg/L	0.01(2)	ND	ND	-	<0.0001		-	-	-
Lithium (Li)-Dissolved	mg/L	0.008 (2)	ND	0.0008	-	0.0009		-	-	-
Magnesium (Mg)-Dissolved	mg/L	-	0.729	1.29	-	1.35		-	-	-
Manganese (Mn)-Dissolved	mg/L	1.5 (2)	0.0963	0.0115		0.0757				
Mercury (Hg)-Dissolved	mg/L	0.001(2)	ND	ND	-	<0.00002		-	-	-
Molybdenum (Mo)-Dissolved	mg/L	0.25(2)	ND	ND	-	<0.00010		-	-	-
Nickel (Ni)-Dissolved	mg/L	0.08 (2)	ND	0.0129	-	0.005		-	-	-
Phosphorus - Dissolved	mg/L	-	-	-	-	<0.05		-	-	-
Potassium (K)-Dissolved	mg/L	-	-	-	-	0.46		-	-	-
Rubidium (Rb) - Dissolved	mg/L	-	-	-	-	-		-	-	-
Selenium (Se)-Dissolved	mg/L	0.01 (2)	-	-	-	-		-	-	-
Silicon - Dissolved	mg/L	-	ND	3.9	-	4.1		-	-	-
Silver (Ag)-Dissolved	mg/L	0.02 (2)	ND	ND	-	<0.00005		-	-	-
Sodium (Na)-Dissolved	mg/L	200(2)	1.81	1.51	-	1.62		-	-	-
Strontium - Dissolved	mg/L	-	0.0484	0.0705	-	0.0694		-	-	-
Sulfur- Dissolved	mg/L	-	ND	ND	-	<3.0		-	-	-
Tellurium - Dissolved	mg/L	-	-	-	-	<0.00020		-	-	-
Thallium (Tl)-Dissolved	mg/L	-	-	-	-	<0.00002		-	-	-
Thorium - Dissovled	mg/L	-	-	-	-	<0.00010		-	-	-
Tin (Sn)-Dissolved	mg/L	2.5 (2)	-	-	-	<0.00020		-	-	-
Titanium (Ti)-Dissolved	mg/L	-	ND	ND	-	<0.0050		-	-	-
Tungston (W) - Dissolved	mg/L	0.003 (2)	-	-	-	-		-	-	-
Uranium (U)-Dissolved	mg/L	0.020	-	-	-	-		-	-	-
Vanadium (V)-Dissolved	mg/L	0.020 (2)	ND	ND	-	<0.0010		-	-	-
Zinc (Zn)-Dissolved	mg/L	3.0 (2)	ND	0.0703	-	0.0426		-	-	-
Zirconium - Dissolved	mg/L	-	ND	ND	-	<0.00010		-	-	-
Volatile Organic Compounds (Water)										
Benzene	mg/L	0.005 (2)	-	-	<0.00050		-	-	-	-
Bromodichloromethane	mg/L	0.1(2)	-	-	<0.0010	-	-	-	-	-
Bromoform	mg/L	0.1(2)	-	-	<0.0010	-	-	-	-	-
Carbon Tetrachloride	mg/L	0.002(2)	-	-	<0.00050	-	-	-	-	-
Chlorobenzene	mg/L	0.08(2)	-	-	<0.0010	-	-	-	-	-
Dibromochloromethane	mg/L	0.1(2)	-	-	<0.0010	-	-	-	-	-
Chloroethane	mg/L	-	-	-	<0.0010	-	-	-	-	-
Chloroform	mg/L	0.1(2)	-	-	<0.0010	-	-	-	-	-
Chloromethane	mg/L	-	-	-	<0.0050	-	-	-	-	-
1,2-Dichlorobenzene	mg/L	0.2(2)	-	-	<0.00070	-	-	-	-	-
1,3-Dichlorobenzene	mg/L	-	-	-	<0.0010	-	-	-	-	-
1,4-Dichlorobenzene	mg/L	0.005(2)	-	-	<0.0010	-	-	-	-	-
1,1-Dichloroethane	mg/L	0.03(2)	-	-	<0.0010	-	-	-	-	-
1,2-Dichloroethane	mg/L	0.005(2)	-	-	<0.0010	-	-	-	-	-
1,1-Dichloroethylene	mg/L	0.014(2)	-	-	<0.0010	-	-	-	-	-
cis-1,2-Dichloroethylene	mg/L	0.008(2)	-	-	<0.0010	-	-	-	-	-
trans-1,2-Dichloroethylene	mg/L	0.08(2)	-	-	<0.0010	-	-	-	-	-
Dichloromethane	mg/L	0.05(2)	-	-	<0.0050	-	-	-	-	-
1,2-Dichloropropane	mg/L	0.0045(2)	-	-	<0.0010	-	-	-	-	-
cis-1,3-Dichloropropylene	mg/L	-	-	-	<0.0010	-	-	-	-	-
trans-1,3-Dichloropropylene	mg/L	-	-	-	<0.0010	-	-	-	-	-
1,3-Dichloropropene (cis & trans)	mg/L	0.0015(2)	-	-	<0.0014	-	-	-	-	-
Ethylbenzene	mg/L	0.14(2)	-	-	<0.0050	-	-	-	-	-
Methyl t-butyl ether (MTBE)	mg/L	0.095(2)	-	-	<0.00050	-	-	-	-	-
Styrene	mg/L	0.8(2)	-	-	<0.00050	-	-	-	-	-
1,1,1,2-Tetrachloroethane	mg/L	0.006(2)	-	-	<0.0010	-	-	-	-	-
1,1,2,2-Tetrachloroethane	mg/L	0.008(2)	-	-	<0.0010	-	-	-	-	-
Tetrachloroethylene	mg/L	0.03(2)	-	-	<0.0010	-	-	-	-	-
Toluene	mg/L	0.06(2)	-	-	<0.00050	-	-	-	-	-
1,1,1-Trichloroethane	mg/L	8(2)	-	-	<0.0010	-	-	-	-	-
1,1,2-Trichloroethane	mg/L	0.003(2)	-	-	<0.0010	-	-	-	-	-
Trichloroethylene	mg/L	0.005(2)	-	-	<0.0010	-	-	-	-	-
Trichlorofluoromethane	mg/L	1(2)	-	-	<0.0010	-	-	-	-	-
Vinyl Chloride	mg/L	0.002(2)	-	-	<0.0010	-	-	-	-	-
ortho-Xylene	mg/L	-	-	-	<0.00050	-	-	-	-	-
meta- & para-Xylene	mg/L	-	-	-	<0.00050	-	-	-	-	-
Xylenes	mg/L	0.09(2)	-	-	<0.00075	-	-	-	-	-

NOTES

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(5) BC Contaminated Sites Regulation (CSR) for drinking water, Schedule 3.2
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(d) Limit dependent upon hardness.
(e) Limit for chromium(VI) - data reported by lab as total chromium - limit assumes 100% chromium VI in sample
(f) Where hardness data was unavailable, 50 mg/L was assumed
(g) Maximum value
(h) Limit dependent upon chloride concentration
(i) Change of 25 mg/L from background for a duration of 24 hours during clear flows. Change of 10% of background during turbid flows

** Criteria exceeds detection limit*
MAC = Maximum Acceptable Concentration
AO = Aesthetic Objective

CSR-DW *BC Contaminated Sites Regulation Water Quality Guidelines for Drinking Water*

Table 13: Groundwater Quality Results Sampling Location MW-10 (E287382)

		CSR Standards CSR-DW (2)	22-Oct-12	02-Apr-13	11-Jun-19	29-Jun-20	14-Aug-20	04-Nov-20
						monitor	monitor	monitor
Field	**Units**							
Conductivity	uS/cm	-			113	152	126	223
SPC	uS/cm							-
pH	pH	-	-	-		-	-	-
Dissolved Oxygen	mg/L	-	-	-		-	-	-
Temperature	°C	-	-	-	6.1	6.1	5.8	5.9
Depth to Water	m	-	-	-	29	29.04	28.66	29
Elevation of Well	m	-				-	-	207
Casing Height	m	-				-	-	0.88
Analyte	Units							
Conductivity	uS/cm	-	37.1					
Hardness (as CaCO3)	mg/L	-	-	90.4		-	-	-
Hardness (as CaCO3), dissolved	mg/L					-	-	-
pH	pH	-	6.9	7		-	-	-
Total Suspended Solids	mg/L	-	-	-		-	-	-
Total Dissolved Solids	mg/L	-	17	-		-	-	-
Alkalinity, Total (as CaCO3)	mg/L	-	17.6	21.7		-	-	-
Ammonia, Total (as N)	mg/L	-	ND	-		-	-	-
Total Nitrogen as N	mg/L	-	0.622	-		-	-	-
Bromide (Br)	mg/L	-	-	-		-	-	-
Chloride (Cl)	mg/L	250 (2)	ND	ND				
Fluoride (F)	mg/L	1.5 (2)	ND	ND		-	-	-
Nitrate (as N)	mg/L	10 (2)	0.023	0.038		-	-	-
Nitrite (as N)	mg/L	1.0 (2)	ND	ND		-	-	-
Sulfate (SO4)	mg/L	500 (2)	-	1.59		-	-	-
Total Organic Carbon	mg/L	-	-	1.53		-	-	-
BOD	mg/L	-	-	-		-	-	-
COD	mg/L	-	-	-		-	-	-
Dissolved Metals								
Aluminum (Al)-Dissolved	mg/L	9.5 (2)	0.0058	0.0138	-	-	-	-
Antimony (Sb)-Dissolved	mg/L	0.006 (2)	ND	ND	-	-	-	-
Arsenic (As)-Dissolved	mg/L	0.01 (2)	0.00021	0.000167	-	-	-	-
Barium (Ba)-Dissolved	mg/L	1.0 (2)	0.0069	0.00541	-	-	-	-
Beryllium (Be)-Dissolved	mg/L	0.008 (2)	ND	ND	-	-	-	-
Bisumuth - Dissolved	mg/L	-	ND	ND	-	-	-	-
Boron (B)-Dissolved	mg/L	5.0 (2)	ND	ND	-	-	-	-
Cadmium (Cd)-Dissolved	mg/L	0.005 (2)	0.00114	0.000021	-	-	-	-
Calcium (Ca)-Dissolved	mg/L	-	-	-	-	-	-	-
Cesium (Cs)- Dissolved	mg/L	-	-	-	-	-	-	-
Chromium (Cr)-Dissolved	mg/L	0.05 - 6.0 (2)	ND	0.00061	-	-	-	-
Cobalt (Co)-Dissolved	mg/L	0.001 (2)	ND	0.000018	-	-	-	-
Copper (Cu)-Dissolved	mg/L	1.5 (2) AO	0.00267	0.00028	-	-	-	-
Iron (Fe)-Dissolved	mg/L	6.5 (2)	0.0107	0.0263				
Lead (Pb)-Dissolved	mg/L	0.01 (2)	ND	ND	-	-	-	-
Lithium (Li)-Dissolved	mg/L	0.008 (2)	ND	ND	-	-	-	-
Magnesium (Mg)-Dissolved	mg/L	-	0.956	0.77	-	-	-	-
Manganese (Mn)-Dissolved	mg/L	1.5 (2)	0.0036	0.00104				
Mercury (Hg)-Dissolved	mg/L	0.001 (2)	ND	ND	-	-	-	-
Molybdenum (Mo)-Dissolved	mg/L	0.25 (2)	ND	0.000135	-	-	-	-
Nickel (Ni)-Dissolved	mg/L	0.08 (2)	-	-	-	-	-	-
Phosphorus - Dissolved	mg/L	-	-	-	-	-	-	-
Potassium (K)-Dissolved	mg/L	-	-	-	-	-	-	-
Rubidium (Rb) - Dissolved	mg/L	-	-	-	-	-	-	-
Selenium (Se)-Dissolved	mg/L	0.01 (2)	0.00016	0.00004	-	-	-	-
Silicon - Dissolved	mg/L	-	5.70	5.20	-	-	-	-
Silver (Ag)-Dissolved	mg/L	0.02 (2)	ND	ND	-	-	-	-
Sodium (Na)-Dissolved	mg/L	200 (2)	3.65	1.68	-	-	-	-
Strontium - Dissolved	mg/L	-	0.0390	0.0295	-	-	-	-
Sulfur- Dissolved	mg/L	-	-	-	-	-	-	-
Tellurium - Dissolved	mg/L	-	-	-	-	-	-	-
Thallium (Tl)-Dissolved	mg/L	-	-	-	-	-	-	-
Thorium - Dissolved	mg/L	-	-	-	-	-	-	-
Tin (Sn)-Dissolved	mg/L	2.5 (2)	ND	0.00029	-	-	-	-
Titanium (Ti)-Dissolved	mg/L	-	-	-	-	-	-	-
Tungston (W) - Dissolved	mg/L	0.003 (2)	-	-	-	-	-	-
Uranium (U)-Dissolved	mg/L	0.020	0.00046	0.000009	-	-	-	-
Vanadium (V)-Dissolved	mg/L	0.020 (2)	ND	0.00075	-	-	-	-
Zinc (Zn)-Dissolved	mg/L	3.0 (2)	0.0065	ND	-	-	-	-
Zirconium - Dissolved	mg/L	-	ND	ND	-	-	-	-

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(f) Where hardness data was unavailable, 50 mg/L was assumed
(g) Maximum value
(h) Limit dependent upon chloride concentration
(i) Change of 25 mg/L from background for a duration of 24 hours during clear flows. Change of 10% of background during turbid flows

** Criteria exceeds detection limit*
MAC = Maximum Acceptable Concentration
AO = Aesthetic Objective

CSR-DW *BC Contaminated Sites Regulation Water Quality Guidelines for Drinking Water*

Table 14: Groundwater Quality Results Sampling Location MW-12 (E287384)

		CSR Standards CSR-DW (2)	22-Oct-12	03-Apr-13	19-Jul-18	25-Mar-19	11-Jun-19	29-Jun-20	14-Aug-20	04-Nov-20
Data QA/QC Check								monitor	monitor	monitor
Field	**Units**									
Conductivity	uS/cm	-				62.8	163	148	172	210
pH	pH	-	-	-	-	6.9		-	-	-
Dissolved Oxygen	mg/L	-	-	-	-	11.3		-	-	-
Temperature	°C	-	-	-	-	5.3	5.4	5.5	5.3	5.5
Depth to Water	m	-	-	-	-	43.96	43.84	44.84	43.72	44.38
Elevation of Well	m	-						-	-	218
Casing Height	m	-						-	-	0.85
Analyte	Units									
Conductivity	uS/cm	-	140							
Hardness (as CaCO3)	mg/L	-	-	76.5	50.9	53.8	-	-	-	-
Hardness (as CaCO3), dissolved	mg/L						-	-	-	-
pH	pH	-	8	7.9	-	7.84	-	-	-	-
Alkalinity, Total (as CaCO3)	mg/L	-	72.3	75.5	70.5	51.2	-	-	-	-
Ammonia, Total (as N)	mg/L	-	ND	-	<0.0050	0.0112	-	-	-	-
Total Nitrogen as N	mg/L	-	0.105	-		-	-	-	-	-
Bromide (Br)	mg/L	-				<0.050	-	-	-	-
Chloride (Cl)	mg/L	250 (2)	1	1.3	<0.50	<0.50				
Fluoride (F)	mg/L	1.5 (2)	ND	ND	0.059	0.046	-	-	-	-
Nitrate (as N)	mg/L	10 (2)	0.026	0.041	0.0271	0.0247	-	-	-	-
Nitrite (as N)	mg/L	1.0 (2)	ND	ND	<0.0010	<0.0010	-	-	-	-
Sulfate (SO4)	mg/L	500 (2)	-	2.24	1.02	1.1	-	-	-	-
Total Organic Carbon	mg/L	-	-	4.01	1.7	2.29	-	-	-	-
COD	mg/L	-	-	-	<20	<20	-	-	-	-
Dissolved Metals										
Aluminum (Al)-Dissolved	mg/L	9.5 (2)	0.0043	0.0074	0.0072	0.0059	-	-	-	-
Antimony (Sb)-Dissolved	mg/L	0.006(2)	ND	0.000334	<0.00010	<0.00010	-	-	-	-
Arsenic (As)-Dissolved	mg/L	0.01(2)	ND	0.000142	<0.00010	0.00018	-	-	-	-
Barium (Ba)-Dissolved	mg/L	1.0(2)	0.0143	0.0155	0.0156	0.0154	-	-	-	-
Beryllium (Be)-Dissolved	mg/L	0.008(2)	ND	ND	<0.00010	<0.00010	-	-	-	-
Bisumuth - Dissolved	mg/L	-	ND	ND	<0.000050	<0.000050	-	-	-	-
Boron (B)-Dissolved	mg/L	5.0(2)	ND	ND	<0.010	<0.010	-	-	-	-
Cadmium (Cd)-Dissolved	mg/L	0.005(2)	0.000020	0.000054	0.000144	0.000017	-	-	-	-
Calcium (Ca)-Dissolved	mg/L	-	-	-	18	19.3	-	-	-	-
Cesium (Cs)- Dissolved	mg/L	-	-	-	<0.000010	<0.000010	-	-	-	-
Chromium (Cr)-Dissolved	mg/L	0.05 - 6.0 (2)	ND	0.00139	0.00045	0.0004	-	-	-	-
Cobalt (Co)-Dissolved	mg/L	0.001 (2)	ND	0.000037	<0.00010	<0.00010	-	-	-	-
Copper (Cu)-Dissolved	mg/L	1.5 (2) AO	0.00085	0.0013	0.00044	<0.00020	-	-	-	-
Iron (Fe)-Dissolved	mg/L	6.5(2)	ND	0.0148	0.011	0.011				
Lead (Pb)-Dissolved	mg/L	0.01(2)	ND	ND	<0.000050	<0.000050	-	-	-	-
Lithium (Li)-Dissolved	mg/L	0.008 (2)	ND	0.00066	<0.0010	<0.0010	-	-	-	-
Magnesium (Mg)-Dissolved	mg/L	-	2.00	1.74	1.45	1.39	-	-	-	-
Manganese (Mn)-Dissolved	mg/L	1.5 (2)	0.0016	0.00378	0.00205	0.0055				
Mercury (Hg)-Dissolved	mg/L	0.001(2)	ND	ND	<0.0000050	0.0000113	-	-	-	-
Molybdenum (Mo)-Dissolved	mg/L	0.25(2)	ND	0.0002	0.00009	0.000165	-	-	-	-
Nickel (Ni)-Dissolved	mg/L	0.08 (2)	-	-	<0.00050	<0.00050	-	-	-	-
Phosphorus - Dissolved	mg/L	-	-	-	<0.050	<0.050	-	-	-	-
Potassium (K)-Dissolved	mg/L	-	-	-	0.42	0.357	-	-	-	-
Rubidium (Rb) - Dissolved	mg/L	-	-	-	0.00036	0.00043	-	-	-	-
Selenium (Se)-Dissolved	mg/L	0.01 (2)	ND	0.000061	<0.000050	0.000063	-	-	-	-
Silicon - Dissolved	mg/L	-	5.91	5.17	5.29	5.74	-	-	-	-
Silver (Ag)-Dissolved	mg/L	0.02 (2)	ND	ND	<0.000010	<0.000010	-	-	-	-
Sodium (Na)-Dissolved	mg/L	200(2)	2.11	1.92	1.65	1.52	-	-	-	-
Strontium - Dissolved	mg/L	-	0.0758	0.0782	0.0757	0.0804	-	-	-	-
Sulfur- Dissolved	mg/L	-	-	-	<0.50	<0.50	-	-	-	-
Tellurium - Dissolved	mg/L	-	-	-	<0.00020	<0.00020	-	-	-	-
Thallium (Tl)-Dissolved	mg/L	-	-	-	<0.000010	<0.000010	-	-	-	-
Thorium - Dissolved	mg/L	-	-	-	<0.00010	<0.00010	-	-	-	-
Tin (Sn)-Dissolved	mg/L	2.5 (2)	ND	ND	0.00054	<0.00010	-	-	-	-
Titanium (Ti)-Dissolved	mg/L	-	-	-	<0.00030	<0.00030	-	-	-	-
Tungston (W) - Dissolved	mg/L	0.003 (2)	-	-	<0.00010	<0.00010	-	-	-	-
Uranium (U)-Dissolved	mg/L	0.020	ND	0.000018	<0.000010	0.000021	-	-	-	-
Vanadium (V)-Dissolved	mg/L	0.020 (2)	ND	0.00068	<0.00050	<0.00050	-	-	-	-
Zinc (Zn)-Dissolved	mg/L	3.0 (2)	ND	ND	0.0015	<0.0010	-	-	-	-
Zirconium - Dissolved	mg/L	-	ND	ND	<0.000060	<0.000060	-	-	-	-

NOTES

(1) BC MoE Approved and Working Water Quality Guidelines, last updated March 2018
(2) BC Contaminated Sites Regulation (CSR) for drinking water, Schedule 3.2, last updated January 2019
(3) All criteria limits for BCWQG - Drinking Quality Guidelines based on Total Metal Concentration except Aluminum (Dissolved)
(4) BC MoE Water Quality Guidelines for Protection of Wildlife
(5) BC Contaminated Sites Regulation (CSR) for drinking water, Schedule 3.2
(a) Range based on max pH 8.5 to min pH 6.5 at temperature of 6.0 'C
(b) at pH less than 6.5, limit is determined by regression equation, else limit is 0.1 mg/L.
(c) Limit for dissolved metals, not total metals
(d) Limit dependent upon hardness.
(e) Limit for chromium(VI) - data reported by lab as total chromium - limit assumes 100% chromium VI in sample
(f) Where hardness data was unavailable, 50 mg/L was assumed
(g) Maximum value
(h) Limit dependent upon chloride concentration
(i) Change of 25 mg/L from background for a duration of 24 hours during clear flows. Change of 10% of background during turbid flows

** Criteria exceeds detection limit*
MAC = Maximum Acceptable Concentration
AO = Aesthetic Objective

CSR-DW *BC Contaminated Sites Regulation Water Quality Guidelines for Drinking Water*

Table 15: Surface Water Quality Results Sampling Location SW-01 (Onion Lake)

		BC ENV Guidelines	22-Oct-12	2-Apr-17	5-Jul-17	26-Sep-17	26-Sep-17		8-Nov-17	17-Jul-18	17-Jul-18		19-Nov-18	29-Mar-19	25-Jun-19	25-Jun-19		18-Jun-20	16-Jul-20	6-Nov-20
		BCWQG-AW (1)												frozen						
Field	**Units**					Sample	Duplicate	RPD		Sample	Duplicate	RPD				duplicate	RPD	Monitor	Sample	Monitor
Conductivity	uS/cm	-	-	-	28.5	25.7	25.7	0.00%	19.9	25.9	-	-	18.7	frozen	22.9		-	19.8	20.1	14.4
pH	pH	-	-	-	6.3	8.1	8.1	0.00%	7.9	7.5	-	-	7.8	frozen	7.9		-	7.72	7.79	7.33
Temperature	°C	-	-	-	20	15.7	15.7	0.00%	5.4	20.2	-	-	7	frozen	18.6		-	16.1	16	7.3
Dissolved Oxygen	mg/L	-	-	-	6.49	11.6	11.6	0.00%	9.7	0.6	-	-	7.1	frozen	7.5		-	5	5	8.9
Analyte	Units																			
Conductivity	uS/cm	-	33.7	14.1	30.3	30.8	30.5	0.98%	-	-	-	-	-	frozen	-	-	-	-	22.4	-
Hardness (as CaCO3)	mg/L	-	3.9	1.4	2.95	3.55	3.55	0.00%	2.81	2.48	2.46	0.40%	2.67	frozen	2.49	2.49	0.00%	-	2.28	-
pH	pH	6.5-9.0	6.3	6.6	6.8	6.7	6.6	1.50%	6.8	6.9	6.6	2.16%	6.7	frozen	6.5	6.61	0.61%	-	6.21	-
Total Suspended Solids	mg/L	25 mg/L (backgr. 25-250 mg/l)) (i)	-	-	2	2.3	<1.0	-	-	-	-	-	-	frozen			-	-	-	-
Total Dissolved Solids	mg/L	-	16	21	20	50	27	59.74%	-	-	-	-	-	frozen			-	-	-	-
Alkalinity, Total (as CaCO3)	mg/L	-	3.9	2.3	4	3	3	0.00%	-	-	-	-	-	frozen			-	-	-	-
Ammonia, Total (as N)	mg/L	0.681-28.7 (a)	ND	0.03	<0.03	<0.03	<0.03	-	<0.0050	0.006	0.0092	21.05%	<0.0050	frozen	<0.0050	<0.0050	-	-	<0.0050	-
Total Nitrogen as N	mg/L	-	-	0.108	0.051	0.161	0.15	7.07%	-	-	-	-	-	frozen			-	-	-	-
Bromide (Br)	mg/L	-	-	-	-	-	-	-	<0.050	-	-	-	<0.050	frozen	<0.050	<0.050	-	-	<0.50	-
Chloride (Cl)	mg/L	600	10.3	3.9	6.9	7.1	6.9	2.86%	6.85	6.22	6.64	3.27%	6.14		5.69	6.00	2.65%		4.9	
Fluoride (F)	mg/L	0.4-1.87 (d)	ND	ND	<0.10	<0.1	<0.10	-	0.027	0.023	0.022	2.22%	0.025	frozen	0.025	0.032	12.28%	-	0.026	-
Nitrate (as N)	mg/L	32.8	ND	ND	<0.01	0.017	0.014	19.35%	<0.0050	<0.0050	<0.0050	-	<0.0050	frozen	<0.0050	<0.0050	-	-	<0.0050	-
Nitrite (as N)	mg/L	0.06-0.6 (h)	ND	ND	<0.01	<0.01	<0.01	-	<0.0010	<0.0010	<0.0010	-	<0.0010	frozen	<0.0010	<0.0010	-	-	<0.0010	-
Sulfate (SO4)	mg/L	128-429 (d)	0.62	1.1	<1.0	<1.0	<1.0	-	0.31	<0.30	<0.30	-	<0.30	frozen	<0.30	0.30	-	-	0.31	-
Total Organic Carbon	mg/L	+/- 20% of background	2.15	0.65	<0.50	1.68	1.76	4.65%	-	-	-	-	-	frozen			-	-	-	-
BOD	mg/L	-	-	ND	<4.0	<4.0	<4.0	-	<2.0	<2.0	<2.0	-	<2.0	frozen	<2.0	<2.0	-	-	<2.0	-
COD	mg/L	-	-	-	-	-	-	-	<20	<20	<20	-	<20	frozen	<20	<20	-	-	20	-
Total Metals																				
Aluminum (Al)-Total	mg/L	-	0.0065	0.0058	0.0142	0.021	0.0068	102.16%	0.0489	0.0105	0.0085	10.53%	0.0067	frozen	0.0256	0.0115	38.01%	-	0.0064	-
Antimony (Sb)-Total	mg/L	0.009	ND	ND	<0.00010	<0.00020	<0.00020	-	<0.00010	<0.00010	<0.00010	-	<0.00010	frozen	<0.00010	<0.00010	-	-	<0.00010	-
Arsenic (As)-Total	mg/L	0.005	ND	ND	<0.00050	<0.00050	<0.00050	-	0.00010	0.00012	0.00012	0.00%	<0.00010	frozen	0.00022	0.00017	12.82%	-	0.00016	-
Barium (Ba)-Total	mg/L	1	0.0127	0.0041	<0.0050	0.0051	<0.0050	-	0.00647	0.00533	0.00508	2.40%	0.00559	frozen	0.00506	0.00464	4.33%	-	0.00393	-
Beryllium (Be)-Total	mg/L	0.00013	ND	ND	<0.00010	<0.00010	<0.00010	-	<0.00010	<0.00010	<0.00010	-	<0.00010	frozen	<0.00010	<0.00010	-	-	<0.000100	-
Bismuth	mg/L	-	ND	ND	<0.00010	<0.00010	<0.00010	-	<0.000050	<0.000050	<0.000050	-	<0.000050	frozen	<0.000050	<0.000050	-	-	<0.000050	-
Boron (B)-Total	mg/L	1.2	ND	ND	0.007	0.0059	0.0053	10.71%	<0.010	<0.010	<0.010	-	<0.010	frozen	<0.010	<0.010	-	-	<0.010	-
Cadmium (Cd)-Total	mg/L	-	0.000056	0.000014	<0.000010	<0.000010	<0.000010	-	0.0000209	<0.0000050	<0.0000050	-	<0.0000050	frozen	0.0000128	0.0000075	-	-	<0.0000050	-
Calcium (Ca)-Total	mg/L	<4 sensitive to acid input	1.22	0.434	1	1.16	1.16	0.00%	0.912	0.824	0.823	0.06%	0.905	frozen	0.791	0.842	3.12%	-	0.788	-
Cessium (Cs) - Total	mg/L	-	-	ND	-	-	-	-	0.000011	<0.000010	<0.000010	-	<0.000010	frozen	<0.000010	<0.000010	-	-	<0.000010	-
Chromium (Cr)-Total	mg/L	0.001 (e)	ND	ND	<0.00050	<0.00050	<0.00050	-	<0.00010	<0.00010	<0.00010	-	<0.00010	frozen	<0.00010	<0.00010	-	-	<0.00010	-
Cobalt (Co)-Total	mg/L	0.11	ND	0.00025	<0.00010	<0.00010	<0.00010	-	<0.00010	<0.00010	<0.00010	-	<0.00010	frozen	<0.00010	<0.00010	-	-	<0.00010	-
Copper (Cu)-Total	mg/L	0.0032-0.0396 (d,f)	0.00106	0.00025	<0.00020	<0.00040	<0.00040	-	<0.00050	<0.00050	<0.00050	-	0.00069	frozen	<0.00050	<0.00050	-	-	<0.00050	-
Iron (Fe)-Total	mg/L	1	0.0304	0.0165	0.011	0.022	0.015	37.84%	0.089	0.010	<0.010	-	0.028	frozen	0.031	<0.010	-	-	<0.010	-
Lead (Pb)-Total	mg/L	0.011-0.402 (d,f)	ND	ND	<0.00010	<0.00020	<0.00020	-	0.000108	<0.000050	<0.000050	-	<0.000050	frozen	0.000127	<0.000050	-	-	<0.000050	-
Lithium (Li)-Total	mg/L	-	ND	ND	0.0001	0.00012	0.0001	18.18%	<0.0010	<0.0010	<0.0010	-	<0.0010	frozen	<0.0010	<0.0010	-	-	<0.0010	-
Magnesium (Mg)-Total	mg/L	-	0.209	0.076	0.144	0.161	0.155	3.80%	0.149	0.135	0.127	3.05%	0.130	frozen	0.120	0.115	2.13%	-	0.120	-
Manganese (Mn)-Total	mg/L	0.8-3.4 (d,f)	0.0211	0.0078	0.00787	0.0147	0.0135	8.51%	0.0602	0.0116	0.0107	4.04%	0.0394	frozen	0.0233	0.0177	13.66%	-	0.0108	-
Mercury (Hg)-Total	mg/L	0.0001	ND	ND	<0.000020	<0.000010	<0.000010	-	<0.000025	<0.0000050	<0.0000050	-	<0.0000050	frozen	<0.0000050	<0.0000050	-	-	<0.0000050	-
Molybdenum (Mo)-Total	mg/L	2	ND	ND	<0.00010	<0.00010	<0.00010	-	<0.000050	<0.000050	<0.000050	-	<0.000050	frozen	<0.000050	<0.000050	-	-	<0.000050	-
Nickel (Ni)-Total	mg/L	0.025-0.15 (d,f)	ND	ND	<0.00020	<0.00040	<0.00040	-	<0.00050	<0.00050	<0.00050	-	<0.00050	frozen	<0.00050	<0.00050	-	-	<0.00050	-
Phosphorus - Total	mg/L	0.005-0.015 (lakes only)	ND	-	<0.050	<0.050	<0.050	-	<0.050	<0.050	<0.050	-	<0.050	frozen	<0.050	<0.050	-	-	<0.050	-
Potassium (K)-Total	mg/L	-	0.270	0.128	0.17	0.19	0.19	0.00%	0.228	0.154	0.144	3.36%	0.146	frozen	0.142	0.147	1.73%	-	0.136	-
Rubidium (Rb) - Total	mg/L	-	-	-	-	-	-	-	0.00035	0.00026	0.00023	6.12%	0.00030	frozen	0.00027	0.00023	8.00%	-	0.00025	-
Selenium (Se)-Total	mg/L	0.002	ND	ND	<0.00050	<0.00050	<0.00050	-	<0.000050	<0.000050	<0.000050	-	<0.000050	frozen	<0.000050	<0.000050	-	-	<0.000050	-
Silicon - Total	mg/L	-	0.486	ND	<1.0	<1.0	<1.0	-	0.13	<0.10	<0.10	-	0.19	frozen	0.11	0.10	-	-	0.11	-
Silver (Ag)-Total	mg/L	0.0001-0.003 (d)	ND	ND	0.000055	<0.000050	<0.000050	-	<0.000010	<0.000010	<0.000010	-	<0.000010	frozen	<0.000010	<0.000010	-	-	<0.000010	-
Sodium (Na)-Total	mg/L	-	5.53	2	4.16	4.63	4.49	3.07%	4.32	3.83	3.72	1.46%	3.89	frozen	3.44	3.45	0.15%	-	3.13	-
Strontium - Total	mg/L	-	0.0116	0.0034	0.0075	0.0076	0.0073	4.03%	0.00777	0.00669	0.00655	1.06%	0.00755	frozen	0.00669	0.00670	0.07%	-	0.00601	-
Sulfur - Total	mg/L	-	ND	ND	<3.0	<3.0	<3.0	-	<0.50	<0.50	<0.50	-	<0.50	frozen	<0.50	<0.50	-	-	<0.50	-
Tellurium - Total	mg/L	-	-	-	<0.00020	<0.00050	<0.00050	-	<0.00020	<0.00020	<0.00020	-	<0.00020	frozen	<0.00020	<0.00020	-	-	<0.00020	-
Thallium (Tl)-Total	mg/L	0.0008	ND	ND	<0.000020	<0.000020	<0.000020	-	<0.000010	<0.000010	<0.000010	-	<0.000010	frozen	<0.000010	<0.000010	-	-	<0.000010	-
Thorium - Total	mg/L	-	-	-	<0.00010	<0.00010	<0.00010	-	<0.00010	<0.00010	<0.00010	-	<0.00010	frozen	<0.00010	<0.00010	-	-	<0.00010	-
Tin (Sn)-Total	mg/L	-	ND	ND	<0.00020	<0.00020	<0.00020	-	<0.00010	<0.00010	<0.00010	-	<0.00010	frozen	<0.00010	<0.00010	-	-	<0.00010	-
Titanium (Ti)-Total	mg/L	-	ND	ND	<0.0050	<0.0050	<0.0050	-	<0.00030	<0.00030	<0.00030	-	<0.00030	frozen	<0.00030	<0.00030	-	-	<0.00030	-
Tungsten (W) - Total	mg/L	-	-	-	-	-	-	-	<0.00010	<0.00010	<0.00010	-	<0.00010	frozen	<0.00010	<0.00010	-	-	<0.00010	-
Uranium (U)-Total	mg/L	0.0085	ND	ND	<0.000020	<0.000020	<0.000020	-	<0.000010	<0.000010	<0.000010	-	<0.000010	frozen	<0.000010	<0.000010	-	-	<0.000010	-
Vanadium (V)-Total	mg/L	-	ND	ND	<0.0010	<0.0010	<0.0010	-	<0.00050	<0.00050	<0.00050	-	<0.00050	frozen	<0.00050	<0.00050	-	-	<0.00050	-
Zinc (Zn)-Total	mg/L	0.033-0.34 (d,f)	ND	ND	<0.0040	0.005	<0.0040	-	<0.0030	<0.0030	<0.0030	-	<0.0030	frozen	<0.0030	<0.0030	-	-	<0.0030	-
Zirconium - Total	mg/L	-	ND	ND	<0.00010	<0.00010	<0.00010	-	<0.000060	<0.000060	<0.000060	-	<0.000060	frozen	<0.00020	<0.00020	-	-	<0.00020	-
Dissolved Metals																				
Aluminum (Al)-Dissolved	mg/L	0.023-0.1 (b,c)	0.0034	0.0038	<0.0050	<0.0050	<0.0050	-	<0.0010	0.0037	0.0036	1.37%	0.0015	frozen	0.0039	0.0037	2.63%	-	0.0022	-
Antimony (Sb)-Dissolved	mg/L	-	ND	ND	<0.00010	<0.00020	<0.00020	-	<0.00010	<0.00010	<0.00010	-	<0.00010	frozen	<0.00010	<0.00010	-	-	<0.00010	-
Arsenic (As)-Dissolved	mg/L	-	ND	0.00005	<0.00050	<0.00050	<0.00050	-	0.00014	<0.00010	<0.00010	-	<0.00010	frozen	<0.00010	<0.00010	-	-	0.00010	-
Barium (Ba)-Dissolved	mg/L	-	0.0128	0.0045	<0.0050	<0.0050	<0.0050	-	0.00515	0.00475	0.00466	0.96%	0.00553	frozen	0.00460	0.00460	0.00%	-	0.00358	-
Beryllium (Be)-Dissolved	mg/L	-	ND	ND	<0.00010	<0.00010	<0.00010	-	<0.00010	<0.00010	<0.00010	-	<0.00010	frozen	<0.00010	<0.00010	-	-	<0.000100	-
Bisumuth - Dissolved	mg/L	-	ND	ND	<0.00010	<0.00010	<0.00010	-	<0.000050	<0.000050	<0.000050	-	<0.000050	frozen	<0.000050	<0.000050	-	-	<0.000050	-
Boron (B)-Dissolved	mg/L	-	ND	ND	<0.0050	<0.0050	<0.0050	-	<0.010	<0.010	<0.010	-	<0.010	frozen	<0.010	<0.010	-	-	<0.010	-
Cadmium (Cd)-Dissolved	mg/L	0.000027 - 0.00280 (d, f)	0.00110	0.00001	<0.000010	<0.000010	<0.000010	-	0.0000051	<0.0000050	<0.0000050	-	<0.0000050	frozen	<0.0000050	0.0000052	-	-	<0.0000050	-
Cessium (Cs) - Dissovled	mg/L	-	-	-	-	-	-	-	0.887	0.791	0.792	0.06%	0.854	frozen	0.796	0.802	0.38%	-	0.727	-
Calcium (Ca)-Dissolved	mg/L	-	1.22	0.43	0.98	1.09	1.06	2.79%	<0.000010	<0.000010	<0.000010	-	<0.000010	frozen	<0.000010	<0.000010	-	-	<0.000010	-
Chromium (Cr)-Dissolved	mg/L	-	ND	ND	<0.00050	<0.00050	<0.00050	-	<0.00010	<0.00010	<0.00010	-	<0.00010	frozen	<0.00010	<0.00010	-	-	<0.00010	-
Cobalt (Co)-Dissolved	mg/L	-	ND	0.00001	<0.00010	<0.00010	<0.00010	-	<0.00010	<0.00010	<0.00010	-	<0.00010	frozen	<0.00010	<0.00010	-	-	<0.00010	-
Copper (Cu)-Dissolved	mg/L	-	0.00098	ND	<0.00020	<0.00040	<0.00040	-	<0.00020	<0.00020	<0.00020	-	<0.00020	frozen	<0.00020	<0.00020	-	-	0.00037	-
Iron (Fe)-Dissolved	mg/L	0.35	0.0101	ND	0.01	<0.010	<0.010	-	<0.010	<0.010	<0.010	-	<0.010	frozen	<0.010	<0.010	-	-	<0.010	-
Lead (Pb)-Dissolved	mg/L	-	ND	ND	<0.00010	<0.00020	<0.00020	-	<0.000050	<0.000050	<0.000050	-	<0.000050	frozen	<0.000050	<0.000050	-	-	<0.000050	-
Lithium (Li)-Dissolved	mg/L	-	ND	ND	<0.00010	<0.00010	<0.00010	-	<0.0010	<0.0010	<0.0010	-	<0.0010	frozen	<0.0010	<0.0010	-	-	<0.0010	-
Magnesium (Mg)-Dissolved	mg/L	-	0.207	ND	0.124	0.153	0.146	4.68%	0.145	0.122	0.118	1.67%	0.131	frozen	0.121	0.119	0.83%	-	0.114	-
Manganese (Mn)-Dissolved	mg/L	-	0.0157	ND	0.00533	0.00377	0.00355	6.01%	0.00767	0.00730	0.00673	4.06%	0.02730	frozen	0.01890	0.0252	14.29%	-	0.00536	-
Mercury (Hg)-Dissolved	mg/L	-	ND	ND	-	<0.000010	<0.000010	-	<0.0000050	<0.0000050	<0.0000050	-	<0.0000050	frozen	<0.0000050	<0.0000050	-	-	<0.0000050	-
Molybdenum (Mo)-Dissolved	mg/L	-	ND	ND	<0.00010	<0.00010	<0.00010	-	<0.000050	<0.000050	<0.000050	-	<0.000050	frozen	<0.000050	<0.000050	-	-	<0.000050	-
Nickel (Ni)-Dissolved	mg/L	-	ND	ND	<0.00020	<0.00040	<0.00040	-	<0.00050	<0.00050	<0.00050	-	<0.00050	frozen	<0.00050	<0.00050	-	-	<0.00050	-
Phosphorus - Dissovled	mg/L	-	-	ND	<0.050	<0.050	<0.050	-	<0.050	<0.050	<0.050	-	<0.050	frozen	<0.050	<0.050	-	-	<0.050	-
Potassium (K)-Dissolved	mg/L	-	0.243	-	0.12	0.19	0.19	0.00%	0.187	0.131	0.143	4.38%	0.154	frozen	0.145	0.138	2.47%	-	0.124	-
Rubidum (Rb) - Dissolved	mg/L	-	-	ND	-	-	-	-	0.00027	0.00025	0.00023	4.17%	0.00025	frozen	0.00025	0.00025	0.00%	-	0.00020	-
Selenium (Se)-Dissolved	mg/L	-	ND	ND	<0.00050	<0.00050	<0.00050	-	<0.000050	<0.000050	<0.000050	-	<0.000050	frozen	<0.000050	<0.000050	-	-	<0.000050	-
Silicon - Dissolved	mg/L	-	0.478	ND	<1.0	<1.0	<1.0	-	0.066	<0.050	<0.050	-	0.110	frozen	0.096	0.075	-	-	0.100	-
Silver (Ag)-Dissolved	mg/L	-	ND	ND	<0.000050	<0.000050	<0.000050	-	<0.000010	<0.000010	<0.000010	-	<0.000010	frozen	<0.000010	<0.000010	-	-	<0.000010	-
Sodium (Na)-Dissolved	mg/L	-	5.48	1.99	3.75	4.5	4.33	3.85%	4.44	3.67	3.62	0.69%	3.83	frozen	3.61	3.42	2.70%	-	3.07	-
Strontium - Dissolved	mg/L	-	0.0115	0.0039	0.0064	0.0073	0.0072	1.38%	0.00759	0.00637	0.00645	0.62%	0.00762	frozen	0.00626	0.00613	1.05%	-	0.00578	-
Sulfur- Dissolved	mg/L	-	ND	ND	<3.0	<3.0	<3.0	-	<0.50	<0.50	<0.50	-	<0.50	frozen	<0.50	<0.50	-	-	<0.50	-
Tellurium - Dissolved	mg/L	-	-	ND	<0.00020	<0.00050	<0.00050	-	<0.00020	<0.00020	<0.00020	-	<0.00020	frozen	<0.00020	<0.00020	-	-	<0.00020	-
Thallium (Tl)-Dissolved	mg/L	-	ND	ND	<0.000020	<0.000020	<0.000020	-	<0.000010	<0.000010	<0.000010	-	<0.000010	frozen	<0.000010	<0.000010	-	-	<0.000010	-
Thorium - Dissovled	mg/L	-	-	ND	<0.00010	<0.00010	<0.00010	-	<0.00010	<0.00010	<0.00010	-	<0.00010	frozen	<0.00010	<0.00010	-	-	<0.00010	-
Tin (Sn)-Dissolved	mg/L	-	ND	ND	<0.00020	<0.00020	<0.00020	-	<0.00010	<0.00010	<0.00010	-	<0.00010	frozen	<0.00010	<0.00010	-	-	<0.00010	-
Titanium (Ti)-Dissolved	mg/L	-	ND	ND	<0.0050	<0.0050	<0.0050	-	<0.00030	<0.00030	<0.00030	-	<0.00030	frozen	<0.00030	<0.00030	-	-	<0.00030	-
Tungsten (W) - Dissolved	mg/L	-	-	-	-	-	-	-	<0.00010	<0.00010	<0.00010	-	<0.00010	frozen	<0.00010	<0.00010	-	-	<0.00010	-
Uranium (U)-Dissolved	mg/L	-	ND	ND	<0.000020	<0.000020	<0.000020	-	<0.000010	<0.000010	<0.000010	-	<0.000010	frozen	<0.000010	<0.000010	-	-	<0.000010	-
Vanadium (V)-Dissolved	mg/L	-	ND	ND	<0.0010	<0.0010	<0.0010	-	<0.00050	<0.00050	<0.00050	-	<0.00050	frozen	<0.00050	<0.00050	-	-	<0.00050	-
Zinc (Zn)-Dissolved	mg/L	-	0.0067	0.0047	0.0041	0.0054	<0.0040	-	<0.0010	<0.0010	<0.0010	-	<0.0010	frozen	<0.0010	<0.0010	-	-	<0.0010	-
Zirconium - Dissolved	mg/L	-	ND	ND	<0.00010	<0.00010	<0.00010	-	<0.000060	<0.000060	<0.000060	-	<0.000060	frozen	<0.00020	<0.00020	-	-	<0.00020	-

NOTES

(1) BC MoE Approved and Working Water Quality Guidelines, last updated March 2018
(2) BC Contaminated Sites Regulation (CSR) for protection of aquatic life or drinking water, Schedule 3.2, last updated July 2018
(3) All criteria limits for BCWQG - Aquatic Life Guidelines based on Total Metal Concentration except Aluminum (Dissolved) and Cadmium (Dissolved)
(4) BC MoE Water Quality Guidelines for Protectionof Wildlife
(a) Range based on max pH 8.5 to min pH 6.5 at temperature of 6.0 'C
(b) at pH less than 6.5, limit is determined by regression equation, else limit is 0.1 mg/L.
(c) Limit for dissolved metals, not total metals
(d) Limit dependent upon hardness.
(e) Limit for chromium(VI) - data reported by lab as total chromium - limit assumes 100% chromium VI in sample
(f) Where hardness data was unavailable, 50 mg/L was assumed
(g) Maximum value
(h) Limit dependent upon chloride concentration
(i) Change of 25 mg/L from background for a duration of 24 hours during clear flows. Change of 10% of background during turbid flows
** Criteria exceeds detection limit*
MAC = Maximum Acceptable Concentration
AO = Aesthetic Objective

BCWQG-AW *BC MoE Quality Guidelines for Protection of Aquatic Life*

Table 16: Surface Water Quality Results Sampling Location SW-02 (Upper Clearwater Lake)

		BC ENV Guidelines	22-Oct-12	2-Apr-13	6-Apr-17	5-Jul-17	26-Sep-17	8-Nov-17	17-Jul-18	19-Nov-18	29-Mar-19	29-Mar-19	25-Jun-19	18-Jun-20	16-Jul-20	6-Nov-20
		BCWQG-AW (1)														
Field	**Units**											**duplicate**		**monitor**	**sample**	**monitor**
Conductivity	uS/cm	-	-	-	137.5	28.8	113	97.9	124.1	98.3	96.2		123.3	119.1	119	95.7
pH	pH	-	-	-	7.7	8.3	8.3	8.1	7.9	7.3	7.6		8	7.08	7.97	8
Temperature	°C	-	-	-	5.2	6.8	11.4	5.3	14.5	5.8	4.7		15	13.9	13.9	6.3
Dissolved Oxygen	mg/L	-	-	-	-	2.5	13.6	9.4	4.2	6.1	8.4		9.3	5.2	5.1	10.3
Flow Rate	m/s										0.09					
Analyte	Units															
Conductivity	uS/cm	-	154	154	148	164	161	-	-	-	-	-	-	-	156	-
Hardness (as CaCO3)	mg/L	-	74.8	75.6	69.4	76.6	77.8	78	75.3	74.4	79.3	79	80.6	-	73	-
pH	pH	6.5-9.0	7.8	8	7.9	8.1	8.1	8.2	8.3	8.2	8.1	8.1	8.18	-	8.13	-
Total Suspended Solids	mg/L	25 mg/L (backgr. 25-250 mg/l)) (i)	-	ND	<1.0	<1.0	<1.0	-	-	-	-	-	-	-	-	-
Total Dissolved Solids	mg/L	-	73	105	89	79	93	-	-	-	-	-	-	-	-	-
Alkalinity, Total (as CaCO3)	mg/L	-	77	75.7	73	80	79	-	-	-	-	-	-	-	-	-
Ammonia, Total (as N)	mg/L	2.0-26.5 (a)	ND	ND	<0.03	<0.03	<0.03	<0.0050	0.0053	0.0097	<0.0050	<0.0050	<0.0050	-	0.0062	-
Total Nitrogen as N	mg/L	-	-	0.048	0.094	<0.0500	0.0715	-	-	-	-	-		-	-	-
Bromide (Br)	mg/L	-	-	-	-	-	-	<0.050	-	<0.050	<0.050	<0.050	<0.050	-	<0.50	-
Chloride (Cl)	mg/L	600, MAC	1.8	1.1	<1.0	1.2	1	1.2	0.84	0.84	0.88	0.89	0.88		0.87	
Fluoride (F)	mg/L	0.7-1.9 (d)	ND	ND	<0.1	<0.10	<0.10	0.052	0.049	0.049	0.048	0.052	0.049	-	0.05	-
Nitrate (as N)	mg/L	32.8	ND	ND	<0.01	<0.010	0.012	0.0133	<0.0050	<0.0050	0.0175	0.0168	0.0116	-	<0.0050	-
Nitrite (as N)	mg/L	0.06-0.6 (h)	ND	ND	<0.01	<0.01	<0.01	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-	<0.0010	-
Sulfate (SO4)	mg/L	128-429 (d)	2.57	4.25	2.5	2.8	2.3	2.56	2.23	2.1	2.24	2.21	2.32	-	2.37	-
Total Organic Carbon	mg/L	+/- 20% of background	ND	ND	<0.5	<0.50	0.89	-	-	-	-	-		-	-	-
BOD	mg/L	-	ND	ND	<4.0	<4.0	<4.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	-	<2.0	-
COD	mg/L	-	-	-	-	-	-	<20	<20	<20	<20	<20	<20	-	<20	-
Total Metals																
Aluminum (Al)-Total	mg/L	-	ND	0.0052	<0.0050	<0.0050	<0.0050	<0.0030	0.0033	0.0069	<0.0030	<0.0030	<0.0030	-	<0.0030	-
Antimony (Sb)-Total	mg/L	0.009	ND	ND	<0.00010	<0.00010	<0.00020	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	<0.00010	-
Arsenic (As)-Total	mg/L	0.005	0.00191	0.00182	0.00167	0.00193	0.00193	0.00193	0.00209	0.00205	0.00197	0.00193	0.00210	-	0.00206	-
Barium (Ba)-Total	mg/L	1	0.0219	0.0198	0.0217	0.0238	0.0213	0.0224	0.02480	0.02350	0.02480	0.02220	0.0222	-	0.0224	-
Beryllium (Be)-Total	mg/L	0.00013	ND	ND	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	<0.000100	-
Bismuth	mg/L	-	ND	ND	<0.00010	<0.00010	<0.00010	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	-	<0.000050	-
Boron (B)-Total	mg/L	1.2	ND	ND	0.006	0.0115	0.0087	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	-	<0.010	-
Cadmium (Cd)-Total	mg/L	-	0.000025	0.000011	<0.00001	<0.000010	<0.000010	<0.0000050	<0.0000050	0.0000614	<0.0000050	0.0000072	0.0000151	-	<0.0000050	-
Calcium (Ca)-Total	mg/L	<4 sensitive to acid input	26.2	26	24.8	27.1	28	27.9	26.7	26.0	28.5	26.6	26.3	-	27.1	-
Cessium (Cs) - Total	mg/L	-	-	-	-	-	-	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	-	<0.000010	-
Chromium (Cr)-Total	mg/L	0.001 (e)	ND	ND	<0.0005	<0.00050	0.00069	0.00032	0.00041	0.00035	0.00035	0.00034	0.00037	-	0.00039	-
Cobalt (Co)-Total	mg/L	0.11	ND	ND	<0.00005	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	<0.00010	-
Copper (Cu)-Total	mg/L	0.0032-0.0396 (d,f)	0.00093	ND	<0.0002	<0.00020	<0.00040	<0.00050	<0.00050	0.00072	<0.00050	<0.00050	<0.00050	-	<0.00050	-
Iron (Fe)-Total	mg/L	1	ND	0.0171	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	-	<0.010	-
Lead (Pb)-Total	mg/L	0.011-0.402 (d,f)	ND	ND	<0.0001	<0.00010	<0.00020	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	-	<0.000050	-
Lithium (Li)-Total	mg/L	-	ND	ND	0.0011	0.00123	0.00118	0.0011	0.0011	0.0011	0.0011	0.0011	0.0012	-	0.0012	-
Magnesium (Mg)-Total	mg/L	-	2.25	0.0012	1.88	2.14	2.25	2.32	2.200	2.040	2.260	2.040	2.01	-	2.07	-
Manganese (Mn)-Total	mg/L	0.8-3.4 (d,f)	ND	2.06	0.00048	0.00038	0.00044	0.00077	0.0013	0.0013	0.0005	0.0005	0.00043		0.00046	
Mercury (Hg)-Total	mg/L	0.0001	ND	ND	<0.00002	<0.000020	<0.000010	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	-	<0.0000050	-
Molybdenum (Mo)-Total	mg/L	2	ND	ND	0.00028	0.00031	0.00029	0.000283	0.000292	0.000295	0.000276	0.000296	0.000271	-	0.000277	-
Nickel (Ni)-Total	mg/L	0.025-0.15 (d,f)	ND	ND	<0.0002	<0.00020	<0.00040	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	<0.00050	-
Phosphorus - Total	mg/L	0.005-0.015 (lakes only)	-	-	<0.05	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	-	<0.050	-
Potassium (K)-Total	mg/L	-	0.886	0.783	0.72	0.83	0.86	0.819	0.824	1.110	0.826	0.786	0.822	-	0.802	-
Rubidium (Rb) -Total	mg/L	-	-	-	-	-	-	0.00036	0.00034	0.00061	0.00036	0.00036	0.00031	-	0.00035	-
Selenium (Se)-Total	mg/L	0.002	0.00013	ND	<0.00050	<0.00050	<0.00050	0.000143	0.000126	0.000129	0.000107	0.000112	0.000107	-	0.000131	-
Silicon - Total	mg/L	-	4.58	4.98	4.9	5	5	5.02	4.78	4.94	5.30	4.67	5.03	-	4.76	-
Silver (Ag)-Total	mg/L	0.0001-0.003 (d)	ND	ND	<0.00005	0.000066	<0.000050	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	-	<0.000010	-
Sodium (Na)-Total	mg/L	-	1.89	1.88	1.71	1.92	2.01	1.91	2.15	2.04	1.95	1.98	1.86	-	1.79	-
Strontium - Total	mg/L	-	0.0992	0.0946	0.0912	0.105	0.0928	0.0993	0.09970	0.10300	0.10400	0.10600	0.0975	-	0.0949	-
Sulfur - Total	mg/L	-	ND	ND	<3.0	<3.0	<3.0	0.87	0.67	0.61	0.84	0.97	0.71	-	1.09	-
Tellurium - Total	mg/L	-	-	-	<0.00020	<0.00020	<0.00050	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	-	<0.00020	-
Thallium (Tl)-Total	mg/L	0.0008	ND	ND	<0.00002	<0.000020	<0.000020	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	-	<0.000010	-
Thorium - Total	mg/L	-	-	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	<0.00010	-
Tin (Sn)-Total	mg/L	-	ND	ND	<0.00020	<0.00020	<0.00020	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	<0.00010	-
Titanium (Ti)-Total	mg/L	-	ND	ND	<0.0050	<0.0050	<0.0050	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	-	<0.00030	-
Tungsten (W) - Total	mg/L	-	-	-	-	-	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	<0.00010	-
Uranium (U)-Total	mg/L	0.0085	0.00011	0.00011	0.00009	0.000122	0.000104	0.000094	0.000104	0.000113	0.0001	0.000106	0.000108	-	0.000115	-
Vanadium (V)-Total	mg/L	-	ND	ND	<0.0010	0.0012	0.0011	0.00095	0.00126	0.00112	0.00113	0.00118	0.00111	-	0.00131	-
Zinc (Zn)-Total	mg/L	0.033-0.34 (d,f)	ND	ND	<0.0040	<0.0040	<0.0040	<0.0030	<0.0030	0.004	<0.0030	<0.0030	<0.0030	-	<0.0030	-
Zirconium - Total	mg/L	-	ND	ND	<0.00010	<0.00010	<0.00010	<0.000060	<0.000060	<0.000060	<0.000060	<0.000060	<0.00020	-	<0.00020	-
Dissolved Metals																
Aluminum (Al)-Dissolved	mg/L	0.023-0.1 (b,c)	0.0445	ND	<0.0050	<0.0050	<0.0050	<0.0010	<0.0010	0.0011	<0.0010	0.0012	0.0014	-	0.0016	-
Antimony (Sb)-Dissolved	mg/L	-	ND	ND	<0.00010	<0.00010	<0.00020	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	<0.00010	-
Arsenic (As)-Dissolved	mg/L	-	0.00198	0.00156	0.00173	0.00184	0.00198	0.00186	0.00194	0.00211	0.00199	0.00195	0.00196	-	0.00204	-
Barium (Ba)-Dissolved	mg/L	-	0.0221	0.0189	0.0203	0.021	0.0212	0.0231	0.02290	0.02280	0.02300	0.02270	0.0226	-	0.0228	-
Beryllium (Be)-Dissolved	mg/L	-	ND	ND	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	<0.000100	-
Bisumuth - Dissolved	mg/L	-	ND	ND	<0.00010	<0.00010	<0.00010	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	-	<0.000050	-
Boron (B)-Dissolved	mg/L	-	ND	ND	<0.004	0.0056	0.0064	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	-	<0.010	-
Cadmium (Cd)-Dissolved	mg/L	0.000027 - 0.00280 (d, f)	ND	0.000007	<0.00001	<0.000010	<0.000010	0.0000273	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	-	<0.0000050	-
Calcium (Ca)-Dissolved	mg/L	-	26.0	24.9	24.7	24.1	27.4	27.6	26.700	26.200	28.300	28.200	28.6	-	25.8	-
Cessium (Cs) - Dissolved	mg/L	-	-	ND	-	-	-	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	-	<0.000010	-
Chromium (Cr)-Dissolved	mg/L	-	ND	ND	<0.0005	<0.00050	<0.00050	0.00032	0.0004	0.0003	0.00032	0.00033	0.00037	-	0.00036	-
Cobalt (Co)-Dissolved	mg/L	-	ND	ND	<0.00005	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	<0.00010	-
Copper (Cu)-Dissolved	mg/L	-	0.00157	ND	<0.0002	<0.00020	<0.00040	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	-	<0.00020	-
Iron (Fe)-Dissolved	mg/L	0.35	ND	ND	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	-	<0.010	-
Lead (Pb)-Dissolved	mg/L	-	ND	ND	<0.0001	<0.00010	<0.00020	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	-	<0.000050	-
Lithium (Li)-Dissolved	mg/L	-	ND	0.00097	0.001	0.00102	0.00114	<0.0010	0.001	0.001	0.0011	0.0011	0.0011	-	0.0011	-
Magnesium (Mg)-Dissolved	mg/L	-	2.30	1.92	1.86	1.9	2.28	2.21	2.070	2.170	2.110	2.070	2.22	-	2.06	-
Manganese (Mn)-Dissolved	mg/L	-	ND	0.00041	<0.00020	<0.00020	0.00031	<0.00010	0.00028	0.00069	0.00039	0.00050	0.00028	-	0.00033	-
Mercury (Hg)-Dissolved	mg/L	-	ND	ND	<0.00002	-	<0.000010	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	-	<0.0000050	-
Molybdenum (Mo)-Dissolved	mg/L	-	ND	0.000282	0.00027	0.00028	0.00029	0.000284	0.00028	0.000283	0.000269	0.000268	0.000286	-	0.000270	-
Nickel (Ni)-Dissolved	mg/L	-	ND	ND	<0.0002	<0.00020	<0.00040	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	<0.00050	-
Phosphorus - Dissolved	mg/L	-	-	-	<0.05	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	-	<0.050	-
Potassium (K)-Dissolved	mg/L	-	0.899	0.77	0.73	0.71	0.85	0.893	0.796	0.838	0.820	0.809	0.784	-	0.786	-
Rubidium (Rb) -Dissolved	mg/L	-	-	-	-	-	-	0.00037	0.00032	0.00037	0.00035	0.00032	0.00032	-	0.00030	-
Selenium (Se)-Dissolved	mg/L	-	0.00015	0.000111	<0.00050	<0.00050	<0.00050	0.000114	0.000098	0.000115	0.000139	0.000162	0.000129	-	0.000163	-
Silicon - Dissolved	mg/L	-	4.49	4.28	5	4.6	5.1	4.67	4.500	4.780	4.650	4.440	4.70	-	4.61	-
Silver (Ag)-Dissolved	mg/L	-	ND	ND	<0.00005	<0.000050	<0.000050	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	-	<0.000010	-
Sodium (Na)-Dissolved	mg/L	-	1.93	1.68	1.68	1.71	2.02	2.21	1.85	2.04	1.94	1.80	1.85	-	1.82	-
Strontium - Dissolved	mg/L	-	0.0988	0.0946	0.0881	0.0907	0.0957	0.106	0.09870	0.10200	0.10000	0.09460	0.104	-	0.0960	-
Sulfur- Dissolved	mg/L	-	ND	ND	<3.0	<3.0	<3.0	0.59	0.63	0.71	0.52	<0.50	0.63	-	1.00	-
Tellurium - Dissolved	mg/L	-	-	ND	<0.00020	<0.00020	<0.00050	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	-	<0.00020	-
Thallium (Tl)-Dissolved	mg/L	-	ND	ND	<0.00002	<0.000020	<0.000020	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	-	<0.000010	-
Thorium - Dissovled	mg/L	-	-	ND	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	<0.00010	-
Tin (Sn)-Dissolved	mg/L	-	ND	ND	<0.00020	<0.00020	<0.00020	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	<0.00010	-
Titanium (Ti)-Dissolved	mg/L	-	ND	ND	<0.0050	<0.0050	<0.0050	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	-	<0.00030	-
Tungsten (W) - Dissolved	mg/L	-	-	-	-	-	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	<0.00010	-
Uranium (U)-Dissolved	mg/L	-	0.00012	ND	0.00009	0.000109	0.0001	0.000104	0.000102	0.000108	0.000107	0.000095	0.000095	-	0.000109	-
Vanadium (V)-Dissolved	mg/L	-	ND	0.00116	<0.0010	<0.0010	<0.0010	0.00097	0.00099	0.001	0.00101	0.00096	0.00107	-	0.00112	-
Zinc (Zn)-Dissolved	mg/L	-	ND	0.002	<0.0040	<0.0040	<0.0040	0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-	<0.0010	-
Zirconium - Dissolved	mg/L	-	ND	ND	<0.00010	<0.00010	<0.00010	<0.000060	<0.000060	<0.000060	<0.000060	<0.000060	<0.00020	-	<0.00020	-

NOTES

(1) BC MoE Approved and Working Water Quality Guidelines, last updated March 2018
(2) BC Contaminated Sites Regulation (CSR) for protection of aquatic life or drinking water, Schedule 3.2, last updated July 2018
(3) All criteria limits for BCWQG - Aquatic Life Guidelines based on Total Metal Concentration except Aluminum (Dissolved) and Cadmium (Dissolved)
(4) BC MoE Water Quality Guidelines for Protectionof Wildlife
(a) Range based on max pH 8.5 to min pH 6.5 at temperature of 6.0 'C
(b) at pH less than 6.5, limit is determined by regression equation, else limit is 0.1 mg/L.
(c) Limit for dissolved metals, not total metals
(d) Limit dependent upon hardness.
(e) Limit for chromium(VI) - data reported by lab as total chromium - limit assumes 100% chromium VI in sample
(f) Where hardness data was unavailable, 50 mg/L was assumed
(g) Maximum value
(h) Limit dependent upon chloride concentration
(i) Change of 25 mg/L from background for a duration of 24 hours during clear flows. Change of 10% of background during turbid flows
** Criteria exceeds detection limit*
MAC = Maximum Acceptable Concentration
AO = Aesthetic Objective

BCWQG-AW *BC MoE Quality Guidelines for Protection of Aquatic Life*

Table 17: Surface Water Quality Results Sampling Location SW-03 (Lower Clearwater Lake)

		BC ENV Guidelines BCWQG-AW (1)	22-Oct-12	02-Apr-13	06-Apr-17	05-Jul-17	26-Sep-17	08-Nov-17	12-Apr-18	12-Apr-18		17-Jul-18	19-Nov-18	29-Mar-19	25-Jun-19	18-Jun-20	16-Jul-20	06-Nov-20
Field	**Units**								Sample	Duplicate	RPD					**monitor**	**sample**	**monitor**
Conductivity	uS/cm	-	-	-	140	141	111	92	91	-	-	126	95	81.2	122.2	114.2	113.8	88.7
pH	pH	-	-	-	7.6	7.5	8.2	8.0	7.6	-	-	7.9	7.6	7.7	8.05	7.42	7.33	7.51
Temperature	°C	-	-	-	7	14.1	11	4.2	5.2	-	-	15.4	5.3	5	15.5	13.2	13.2	5.9
Dissolved Oxygen	mg/L	-	-	-	-	-	14.2	12	16.3	-	-	1	5.4	11.2	10.9	5.7	5.4	11.7
Flow Rate	m/s													0.08				
Analyte	Units																	
Conductivity	uS/cm	-	149	151	145	161	158	-	-	-	-	-	-			-	152	-
Hardness (as CaCO3)	mg/L	-	72.8	73.3	68	75.4	73.1	78.7	70.2	71.4	0.85%	73.9	72.4	67.1	79.6	-	69.3	-
pH	pH	6.5-9.0	7.48	7.9	8	8.1	7.9	8.2	8.2	8.3	0.79%	8.2	8.2	8.0	8.17	-	8.06	-
Total Suspended Solids	mg/L	25 mg/L (backgr. 25-250 mg/l)) (i)	-	ND	1.1	1.8	<1.0	-	-	-	-	-	-	-		-	-	-
Total Dissolved Solids	mg/L	-	71	104	82	78	91	-	-	-	-	-	-	-		-	-	-
Alkalinity, Total (as CaCO3)	mg/L	-	-	75.2	71	78	76	-	-	-	-	-	-	-		-	-	-
Ammonia, Total (as N)	mg/L	2.0-26.5 (a)	ND	ND	<0.03	<0.03	<0.03	<0.0050	0.0063	0.0054	7.69%	<0.0050	<0.0050	<0.0050	0.0054	-	<0.0050	-
Total Nitrogen as N	mg/L	-	-	0.049	<0.0200	0.121	<0.0500	-	-	-	-	-	-	-	-	-	-	-
Bromide (Br)	mg/L	-	-	-	-	-	-	<0.050	<0.050	<0.050	-	-	<0.050	<0.050	<0.050	-	<0.050	-
Chloride (Cl)	mg/L	600, MAC	1.7	1.3	1.1	1.4	1.1	0.97	0.86	0.88	1.15%	0.87	0.90	0.85	1.11		0.91	
Fluoride (F)	mg/L	0.7-1.9 (d)	ND	ND	<0.1	<0.10	<0.10	0.05	0.047	0.048	1.05%	0.047	0.047	0.045	0.061	-	0.05	-
Nitrate (as N)	mg/L	32.8	0.036	0.032	<0.01	<0.010	0.012	0.0164	0.0089	0.0081	4.71%	<0.0050	0.0069	0.012	0.0063	-	<0.0050	-
Nitrite (as N)	mg/L	0.06-0.6 (h)	ND	ND	<0.01	<0.01	<0.01	<0.0010	<0.0010	<0.0010	-	<0.0010	<0.0010	<0.0010	<0.0010	-	<0.0010	-
Sulfate (SO4)	mg/L	128-429 (d)	2.63	3.38	2.6	2.8	2.4	2.5	2.21	2.22	0.23%	2.25	2.12	2.04	2.36	-	2.37	-
Total Organic Carbon	mg/L	+/- 20% of background	1.09	ND	<0.50	<0.50	0.65	-	<0.50	<0.50	-	-	-	-	-	-	-	-
BOD	mg/L	-	ND	ND	<4.0	<4.0	<4.0	<2.0	<2.0	<2.0	-	2.5	<2.0	<2.0	<2.0	-	<2.0	-
COD	mg/L	-	-	-	-	-	-	<20	<20	<20	-	<20	<20	<20	<20	-	<20	-
Total Metals																		
Aluminum (Al)-Total	mg/L	-	0.0032	0.0043	0.0056	0.0146	<0.0050	<0.0030	0.0051	0.0037	15.91%	0.0040	0.0039	0.0098	0.0048		0.0038	
Antimony (Sb)-Total	mg/L	0.009	ND	ND	<0.00010	0.0001	<0.00020	<0.00010	<0.00010	<0.00010	-	<0.00010	<0.00010	<0.00010	<0.00010	-	<0.00010	-
Arsenic (As)-Total	mg/L	0.005	0.00179	0.00185	0.00155	0.00186	0.00195	0.00184	0.00165	0.00169	1.20%	0.00196	0.00181	0.00160	0.00199	-	0.00206	-
Barium (Ba)-Total	mg/L	1	0.0219	0.0225	0.0187	0.0218	0.0215	0.0215	0.01990	0.01910	2.05%	0.02110	0.02160	0.01970	0.0191	-	0.0202	-
Beryllium (Be)-Total	mg/L	0.00013	ND	ND	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	<0.00010	<0.00010	<0.00010	<0.00010	-	<0.000100	-
Bismuth - Total	mg/L	-	ND	ND	<0.00010	<0.00010	<0.00010	<0.000050	<0.000050	<0.000050	-	<0.000050	<0.000050	<0.000050	<0.000050	-	<0.000050	-
Boron (B)-Total	mg/L	1.2	ND	ND	0.007	0.0072	0.0083	<0.010	<0.010	<0.010	-	<0.010	<0.010	<0.010	<0.010	-	<0.010	-
Cadmium (Cd)-Total	mg/L	-	ND	ND	<0.00001	<0.000010	<0.000010	<0.0000050	<0.0000050	<0.0000050	-	<0.0000050	<0.0000050	0.0000065	<0.0000050	-	<0.0000050	-
Calcium (Ca)-Total	mg/L	<4 sensitive to acid input	25.5	26.7	24.2	26.7	30.3	27.5	23.8	24.2	0.83%	26.2	24.8	23.8	26.0	-	26.7	-
Cesium (Cs) - Total	mg/L	-	-	-	-	-	-	<0.000010	<0.000010	<0.000010	-	<0.000010	<0.000010	<0.000010	<0.000010	-	<0.000010	-
Chromium (Cr)-Total	mg/L	0.001 (e)	ND	ND	<0.0005	<0.00050	0.00066	0.00034	0.00045	0.00044	1.12%	0.00044	0.0003	0.00031	0.00039	-	0.00034	-
Cobalt (Co)-Total	mg/L	0.11	ND	ND	<0.00005	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	<0.00010	<0.00010	<0.00010	<0.00010	-	<0.00010	-
Copper (Cu)-Total	mg/L	0.0032-0.0396 (d,f)	0.00074	ND	<0.0002	<0.00020	<0.00040	<0.00050	<0.00050	<0.00050	-	<0.00050	<0.00050	<0.00050	<0.00050	-	<0.00050	-
Iron (Fe)-Total	mg/L	1	0.0069	0.0091	0.011	0.023	<0.010	<0.010	<0.010	<0.010	-	<0.010	<0.010	0.015	<0.010	-	<0.010	-
Lead (Pb)-Total	mg/L	0.011-0.402 (d,f)	ND	ND	<0.0001	<0.00010	<0.00020	<0.000050	<0.000050	<0.000050	-	<0.000050	<0.000050	<0.000050	<0.000050	-	<0.000050	-
Lithium (Li)-Total	mg/L	-	ND	ND	0.001	0.00122	0.00125	<0.0010	0.0012	0.0013	4.00%	0.0011	0.0011	<0.0010	0.0012	-	0.0012	-
Magnesium (Mg)-Total	mg/L	-	2.21	2.15	1.85	2.09	2.4	2.34	1.840	1.830	0.27%	2.110	2.010	1.910	1.99	-	2.07	-
Manganese (Mn)-Total	mg/L	0.8-3.4 (d,f)	ND	ND	0.00075	0.00113	0.00105	0.00051	0.0007	0.0006	2.29%	0.0010	0.0007	0.0016	0.00108		0.00103	
Mercury (Hg)-Total	mg/L	0.0001	ND	ND	<0.00002	<0.000020	<0.000010	<0.0000050	<0.0000050	<0.0000050	-	<0.0000050	<0.0000050	<0.0000050	<0.0000050	-	<0.0000050	-
Molybdenum (Mo)-Total	mg/L	2	ND	ND	0.00029	0.00032	0.00032	0.000275	0.000283	0.000285	0.35%	0.000287	0.00031	0.000257	0.000302	-	0.000352	-
Nickel (Ni)-Total	mg/L	0.025-0.15 (d,f)	ND	ND	<0.0002	<0.00020	<0.00040	<0.00050	<0.00050	<0.00050	-	<0.00050	<0.00050	<0.00050	<0.00050	-	<0.00050	-
Phosphorus - Total	mg/L	0.005-0.015 (lakes only)	-	-	<0.05	<0.050	<0.050	<0.050	<0.050	<0.050	-	<0.050	<0.050	<0.050	<0.050	-	<0.050	-
Potassium (K)-Total	mg/L	-	0.880	0.814	0.71	0.84	0.93	0.813	0.724	0.716	0.56%	0.800	0.824	0.700	0.806	-	0.819	-
Rubidium (Rb) - Total	mg/L	-	-	ND	-	-	-	0.00033	0.00033	0.00031	3.13%	0.00029	0.00031	0.00029	0.00031	-	0.00035	-
Selenium (Se)-Total	mg/L	0.002	0.00013	ND	<0.00050	<0.00050	<0.00050	0.000133	0.000136	0.000068	33.33%	0.000095	0.000091	0.00012	0.000143	-	0.000185	-
Silicon - Total	mg/L	-	4.70	5.13	4.8	5	5.2	5.07	4.64	4.67	0.32%	4.60	4.96	4.51	5.12	-	4.83	-
Silver (Ag)-Total	mg/L	0.0001-0.003 (d)	ND	ND	<0.00005	<0.000050	<0.000050	<0.000010	<0.000010	<0.000010	-	<0.000010	<0.000010	<0.000010	<0.000010	-	<0.000010	-
Sodium (Na)-Total	mg/L	-	1.91	1.89	1.73	2.01	2.23	1.95	1.73	1.67	1.76%	1.89	1.86	1.77	1.88	-	1.85	-
Strontium - Total	mg/L	-	0.0961	0.0983	0.0894	0.101	0.1	0.0962	0.09330	0.09330	0.00%	0.09780	0.10300	0.08840	0.0983	-	0.0961	-
Sulfur - Total	mg/L	-	ND	ND	<3.0	<3.0	<3.0	0.87	1.07	0.88	9.74%	0.87	0.76	0.7	0.77	-	0.95	-
Tellurium - Total	mg/L	-	-	-	<0.00020	<0.00020	<0.00050	<0.00020	<0.00020	<0.00020	-	<0.00020	<0.00020	<0.00020	<0.00020	-	<0.00020	-
Thallium (Tl)-Total	mg/L	0.0008	ND	ND	<0.00002	<0.000020	<0.000020	<0.000010	<0.000010	<0.000010	-	<0.000010	<0.000010	<0.000010	<0.000010	-	<0.000010	-
Thorium - Total	mg/L	-	-	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	<0.00010	<0.00010	<0.00010	<0.00010	-	<0.00010	-
Tin (Sn)-Total	mg/L	-	ND	ND	<0.00020	<0.00020	<0.00020	<0.00010	<0.00010	<0.00010	-	<0.00010	<0.00010	<0.00010	<0.00010	-	<0.00010	-
Titanium (Ti)-Total	mg/L	-	ND	ND	<0.0050	<0.0050	<0.0050	<0.00030	<0.00030	<0.00030	-	<0.00030	<0.00030	<0.00030	<0.00030	-	<0.00030	-
Tungsten (W) - Total	mg/L	-	-	-	-	-	-	<0.00010	<0.00010	<0.00010	-	<0.00010	<0.00010	<0.00010	<0.00010	-	<0.00010	-
Uranium (U)-Total	mg/L	0.0085	0.00011	ND	0.0001	0.000128	0.000113	0.000099	0.000112	0.000106	2.75%	0.000108	0.000116	0.000094	0.000116	-	0.000118	-
Vanadium (V)-Total	mg/L	-	ND	ND	<0.0010	0.0012	0.0011	0.00092	0.00104	0.001	1.96%	0.00125	0.00103	0.00102	0.00109	-	0.00123	-
Zinc (Zn)-Total	mg/L	0.033-0.34 (d,f)	ND	ND	<0.0040	<0.0040	0.0046	<0.0030	<0.0030	<0.0030	-	<0.0030	<0.0030	<0.0030	<0.0030	-	<0.0030	-
Zirconium - Total	mg/L	-	ND	ND	<0.00010	0.00058	<0.00010	<0.000060	<0.000060	<0.000060	-	0.000077	<0.000060	<0.000060	<0.00020	-	<0.00020	-
Dissolved Metals																		
Aluminum (Al)-Dissolved	mg/L	0.023-0.1 (b,c)	ND	ND	<0.0050	<0.0050	<0.0050	<0.0010	0.0024	0.0022	4.35%	0.002	0.0022	0.0059	0.0021	-	0.002	-
Antimony (Sb)-Dissolved	mg/L	-	ND	ND	<0.00010	<0.00010	<0.00020	<0.00010	<0.00010	<0.00010	-	<0.00010	<0.00010	<0.00010	<0.00010	-	<0.00010	-
Arsenic (As)-Dissolved	mg/L	-	0.00185	0.00159	0.00159	0.00174	0.00174	0.00182	0.00167	0.00173	1.76%	0.00188	0.00190	0.00164	0.00188	-	0.00197	-
Barium (Ba)-Dissolved	mg/L	-	0.0215	0.0208	0.018	0.0197	0.0195	0.0228	0.02010	0.02050	0.99%	0.02050	0.02060	0.01910	0.0200	-	0.0203	-
Beryllium (Be)-Dissolved	mg/L	-	ND	ND	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	<0.00010	<0.00010	<0.00010	<0.00010	-	<0.000100	-
Bismuth - Dissolved	mg/L	-	ND	ND	<0.00010	<0.00010	<0.00010	<0.000050	<0.000050	<0.000050	-	<0.000050	<0.000050	<0.000050	<0.000050	-	<0.000050	-
Boron (B)-Dissolved	mg/L	-	ND	ND	<0.004	<0.0050	0.0058	<0.010	<0.010	<0.010	-	<0.010	0.011	<0.010	<0.010	-	<0.010	-
Cadmium (Cd)-Dissolved	mg/L	0.000027 - 0.00280 (d, f)	ND	ND	<0.00001	<0.000010	<0.000010	<0.0000050	<0.0000050	<0.0000050	-	<0.0000050	<0.0000050	<0.0000050	<0.0000050	-	<0.0000050	-
Calcium (Ca)-Dissolved	mg/L	-	24.9	24.1	23.4	23.8	25.7	28.0	24.900	25.400	0.99%	26.200	25.700	23.800	28.2	-	24.4	-
Cesium (Cs) - Dissolved	mg/L	-	-	-	-	-	-	<0.000010	<0.000010	<0.000010	-	<0.000010	<0.000010	<0.000010	<0.000010	-	<0.000010	-
Chromium (Cr)-Dissolved	mg/L	-	ND	ND	<0.0005	0.00062	<0.00050	0.00028	0.00031	0.00031	0.00%	0.0004	0.00034	0.00028	0.00036	-	0.00034	-
Cobalt (Co)-Dissolved	mg/L	-	ND	ND	<0.00005	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	<0.00010	<0.00010	<0.00010	<0.00010	-	<0.00010	-
Copper (Cu)-Dissolved	mg/L	-	0.00083	0.00073	<0.0002	<0.00020	<0.00040	<0.00020	<0.00020	<0.00020	-	<0.00020	<0.00020	<0.00020	<0.00020	-	<0.00020	-
Iron (Fe)-Dissolved	mg/L	0.35	0.0060	ND	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	-	<0.010	<0.010	0.012	<0.010	-	<0.010	-
Lead (Pb)-Dissolved	mg/L	-	ND	0.000395	<0.0001	<0.00010	<0.00020	<0.000050	<0.000050	<0.000050	-	<0.000050	<0.000050	<0.000050	<0.000050	-	<0.000050	-
Lithium (Li)-Dissolved	mg/L	-	ND	0.00102	0.001	0.00104	0.00107	<0.0010	0.001	0.001	0.00%	<0.0010	0.0011	<0.0010	0.0011	-	0.0011	-
Magnesium (Mg)-Dissolved	mg/L	-	2.22	1.92	1.82	1.87	2.15	2.15	1.950	1.930	0.52%	2.030	2.030	1.870	2.21	-	2.03	-
Manganese (Mn)-Dissolved	mg/L	-	ND	0.00014	0.00026	0.00022	0.00034	<0.00010	0.00053	0.00052	0.95%	0.00054	0.00066	0.00093	0.0007	-	0.00062	-
Mercury (Hg)-Dissolved	mg/L	-	ND	ND	<0.00002	-	<0.000010	<0.0000050	<0.0000050	<0.0000050	-	<0.0000050	<0.0000050	<0.0000050	<0.0000050	-	<0.0000050	-
Molybdenum (Mo)-Dissolved	mg/L	-	ND	0.000282	0.0003	0.00031	0.00027	0.000303	0.000296	0.000282	2.42%	0.000273	0.000301	0.000258	0.000273	-	0.00034	-
Nickel (Ni)-Dissolved	mg/L	-	ND	ND	<0.0002	<0.00020	<0.00040	<0.00050	<0.00050	<0.00050	-	<0.00050	<0.00050	<0.00050	<0.00050	-	<0.00050	-
Phosphorus - Dissolved	mg/L	-	-	-	<0.05	<0.050	<0.050	<0.050	<0.050	<0.050	-	<0.050	<0.050	<0.050	<0.050	-	<0.050	-
Potassium (K)-Dissolved	mg/L	-	0.875	0.770	0.7	0.72	0.82	0.798	0.765	0.756	0.59%	0.790	0.792	0.716	0.813	-	0.794	-
Rubidium (Rb) - Dissolved	mg/L	-	-	-	-	-	-	0.00028	0.00027	0.00035	12.90%	0.00029	0.00028	0.00027	0.00033	-	0.00034	-
Selenium (Se)-Dissolved	mg/L	-	0.00014	0.000111	<0.00050	<0.00050	<0.00050	0.000134	0.000127	0.000111	6.72%	0.00015	0.000114	0.000118	0.000137	-	0.000159	-
Silicon - Dissolved	mg/L	-	4.58	4.28	4.8	4.6	4.9	4.55	4.680	4.630	0.54%	4.630	4.580	4.120	4.68	-	4.71	-
Silver (Ag)-Dissolved	mg/L	-	ND	ND	<0.00005	<0.000050	<0.000050	<0.000010	<0.000010	<0.000010	-	<0.000010	<0.000010	<0.000010	<0.000010	-	<0.000010	-
Sodium (Na)-Dissolved	mg/L	-	1.92	1.68	1.69	1.79	2	2.06	1.74	1.76	0.57%	1.87	1.96	1.74	1.99	-	1.83	-
Strontium - Dissolved	mg/L	-	0.0950	0.0946	0.0864	0.0896	0.0922	0.102	0.09360	0.09480	0.64%	0.09770	0.10200	0.08710	0.0955	-	0.0947	-
Sulfur- Dissolved	mg/L	-	ND	ND	<3.0	<3.0	<3.0	0.54	0.84	0.78	3.70%	0.62	0.84	<0.50	0.65	-	0.92	-
Tellurium - Dissolved	mg/L	-	-	-	<0.00020	<0.00020	<0.00050	<0.00020	<0.00020	<0.00020	-	<0.00020	<0.00020	<0.00020	<0.00020	-	<0.00020	-
Thallium (Tl)-Dissolved	mg/L	-	ND	ND	<0.00002	<0.000020	<0.000020	<0.000010	<0.000010	<0.000010	-	<0.000010	<0.000010	<0.000010	<0.000010	-	<0.000010	-
Thorium - Dissolved	mg/L	-	-	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	<0.00010	<0.00010	<0.00010	<0.00010	-	<0.00010	-
Tin (Sn)-Dissolved	mg/L	-	ND	ND	<0.00011	<0.00020	<0.00020	<0.00010	<0.00010	<0.00010	-	<0.00010	<0.00010	<0.00010	<0.00010	-	<0.00010	-
Titanium (Ti)-Dissolved	mg/L	-	ND	ND	<0.00012	<0.0050	<0.0050	<0.00030	<0.00030	<0.00030	-	<0.00030	<0.00030	<0.00030	<0.00030	-	<0.00030	-
Tungsten (W) - Dissovled	mg/L	-	-	-	-	-	-	<0.00010	<0.00010	<0.00010	-	<0.00010	<0.00010	<0.00010	<0.00010	-	<0.00010	-
Uranium (U)-Dissolved	mg/L	-	0.00011	0.000108	<0.00013	0.000117	0.000099	0.000111	0.000107	0.000105	0.94%	0.000103	0.00011	0.000097	0.0001	-	0.000116	-
Vanadium (V)-Dissolved	mg/L	-	ND	0.00116	<0.00014	<0.0010	<0.0010	0.00092	0.00094	0.00095	0.53%	0.00096	0.00091	0.00089	0.00106	-	0.00104	-
Zinc (Zn)-Dissolved	mg/L	-	ND	0.0016	<0.00015	<0.0040	<0.0040	<0.0010	<0.0010	<0.0010	-	<0.0010	<0.0010	<0.0010	<0.0010	-	<0.0010	-
Zirconium - Dissolved	mg/L	-	ND	ND	<0.00016	<0.00010	<0.00010	<0.000060	<0.000060	<0.000060	-	<0.000060	<0.000060	<0.000060	<0.00020	-	<0.00020	-

NOTES

(1) BC MoE Approved and Working Water Quality Guidelines, last updated March 2018
(2) BC Contaminated Sites Regulation (CSR) for protection of aquatic life or drinking water, Schedule 3.2, last updated July 2018
(3) All criteria limits for BCWQG - Aquatic Life Guidelines based on Total Metal Concentration except Aluminum (Dissolved) and Cadmium (Dissolved)
(4) BC MoE Water Quality Guidelines for Protectionof Wildlife
(a) Range based on max pH 8.5 to min pH 6.5 at temperature of 6.0 'C
(b) at pH less than 6.5, limit is determined by regression equation, else limit is 0.1 mg/L.
(c) Limit for dissolved metals, not total metals
(d) Limit dependent upon hardness.
(e) Limit for chromium(VI) - data reported by lab as total chromium - limit assumes 100% chromium VI in sample
(f) Where hardness data was unavailable, 50 mg/L was assumed
(g) Maximum value
(h) Limit dependent upon chloride concentration
(i) Change of 25 mg/L from background for a duration of 24 hours during clear flows. Change of 10% of background during turbid flows
** Criteria exceeds detection limit*
MAC = Maximum Acceptable Concentration
AO = Aesthetic Objective

BCWQG-AW	*BC MoE Quality Guidelines for Protection of Aquatic Life*

Table 18: Surface Water Quality Results Sampling Location SW-04 (Creek from Onion Lake at FSR)

		BC MoE Guidelines	05-Jul-17	26-Sep-17	08-Nov-17	12-Apr-18	17-Jul-18	19-Nov-18	29-Mar-19	25-Jun-19	18-Jun-20	16-Jul-20	09-Nov-20
		BCWQG-AW (1)											
Field	**Units**										**monitor**	**sample**	**monitor**
Conductivity	uS/cm	-	97	70	44	56	85	50	45	69.5	71	75	30.5
pH	pH	-	6.5	7.6	7.8	7.5	7.2	7.8	7.3	6.82	7.16	7.4	6.78
Temperature	°C	-	11.8	10	2.3	2.5	16.8	4.4	1.5	11.1	9.8	10.6	3.6
Dissolved Oxygen	mg/L	-	9.41	14.1	13.7	13.4	1.9	10.8	13.2	9.8	7.9	5.9	11.4
Flow Rate	m/s								0.2				
Analyte	Units												
Conductivity	uS/cm	-	105	104	-	-	-	-			-	105	-
Hardness (as CaCO3)	mg/L	-	42.3	42.3	28.1	26.4	39.4	27.7	25.5	31.8	-	33.9	-
pH	pH	6.5-9.0	7.5	7.6	7.9	7.7	7.9	7.8	7.5	7.7	-	7.56	-
Total Suspended Solids	mg/L	25 mg/L (backgr. 25-250 mg/l)) (i)	<1.0	<1.0	-	-	-	-	-		-	-	-
Total Dissolved Solids	mg/L	-	53	76	-	-	-	-	-		-	-	-
Alkalinity, Total (as CaCO3)	mg/L	-	42	40	-	-	-	-	-		-	-	-
Ammonia, Total (as N)	mg/L	2.0-26.5 (a)	<0.03	<0.03	<0.0050	0.0058	<0.0050	<0.0050	<0.0050	<0.0050	-	0.0053	-
Total Nitrogen as N	mg/L	-	<0.0500	0.066	<0.050	-	-	-	-		-	-	-
Bromide (Br)	mg/L	-	-	-	-	<0.050	-	<0.050	<0.050	<0.050	-	<0.050	-
Chloride (Cl)	mg/L	600, MAC	6.1	6.1	4.13	13.8	10.8	7.02	9.61	11	-	11.5	-
Fluoride (F)	mg/L	0.7-1.9 (d)	<0.10	<0.10	0.038	0.035	0.039	0.038	0.037	0.053	-	0.045	-
Nitrate (as N)	mg/L	32.8	<0.01	<0.01	<0.0050	0.0054	0.0842	<0.0050	0.024	0.0158	-	0.0137	-
Nitrite (as N)	mg/L	0.06-0.6 (h)	<0.01	<0.01	<0.0010	<0.0010	<0.0010	<0.0010	0.0015	<0.0010	-	<0.0010	-
Sulfate (SO4)	mg/L	128-429 (d)	1.7	1.4	1.22	0.87	<0.30	0.9	0.87	0.94	-	1.11	-
Total Organic Carbon	mg/L	+/- 20% of background	<0.50	1.53	-	1.94	-	-	-		-	-	-
BOD	mg/L	-	<4.0	<4.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	-	<2.0	-
COD	mg/L	-	-	-	<20	<20	<20	<20	<20	<20	-	29	-
Total Metals													
Aluminum (Al)-Total	mg/L	-	0.0061	0.0166	0.0140	0.0353	0.3660	0.0257	0.0331	0.0159	-	0.11	-
Antimony (Sb)-Total	mg/L	0.009	<0.00010	<0.00020	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	<0.00010	-
Arsenic (As)-Total	mg/L	0.005	0.00184	0.00192	0.00135	0.00104	0.00461	0.00133	0.00103	0.00163	-	0.00211	-
Barium (Ba)-Total	mg/L	1	0.0121	0.0129	0.00997	0.01060	0.02680	0.01040	0.01090	0.0138	-	0.017	-
Beryllium (Be)-Total	mg/L	0.00013	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	<0.000100	-
Bismuth	mg/L	-	<0.00010	<0.00010	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	-	<0.000050	-
Boron (B)-Total	mg/L	1.2	<0.0050	0.0117	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	-	<0.010	-
Cadmium (Cd)-Total	mg/L	-	<0.000010	<0.000010	<0.0000050	<0.0000050	0.0000151	<0.0000050	<0.0000050	<0.0000050	-	<0.0000050	-
Calcium (Ca)-Total	mg/L	<4 sensitive to acid input	12.6	15.1	11.3	8.4	14.8	10.0	8.5	11.6	-	12.3	-
Cesium (Cs) - Total	mg/L	-	-	-	<0.000010	<0.000010	0.000022	<0.000010	<0.000010	<0.000010	-	<0.000010	-
Chromium (Cr)-Total	mg/L	0.001 (e)	<0.00050	0.00053	0.00015	0.00018	0.00073	0.00019	0.00014	<0.00010	-	0.00024	-
Cobalt (Co)-Total	mg/L	0.11	<0.00010	<0.00010	<0.00010	<0.00010	0.00037	<0.00010	<0.00010	<0.00010	-	<0.00010	-
Copper (Cu)-Total	mg/L	0.0032-0.0396 (d,f)	<0.00020	<0.00040	<0.00050	<0.00050	0.00073	<0.00050	<0.00050	<0.00050	-	<0.00050	-
Iron (Fe)-Total	mg/L	1	<0.010	0.064	0.025	0.055	0.795	0.068	0.056	0.049	-	0.25	-
Lead (Pb)-Total	mg/L	0.011-0.402 (d,f)	<0.00010	<0.00020	<0.000050	<0.000050	0.000325	<0.000050	<0.000050	<0.000050	-	0.000099	-
Lithium (Li)-Total	mg/L	-	0.00039	0.00047	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-	<0.0010	-
Magnesium (Mg)-Total	mg/L	-	0.934	1.12	0.853	0.714	1.210	0.856	0.720	0.912	-	1.02	-
Manganese (Mn)-Total	mg/L	0.8-3.4 (d,f)	0.00109	0.0154	0.00606	0.0094	0.2440	0.0174	0.0109	0.0193		0.059	
Mercury (Hg)-Total	mg/L	0.0001	-	<0.000010	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	-	<0.0000050	-
Molybdenum (Mo)-Total	mg/L	2	0.00021	0.00023	0.000163	0.000141	0.000242	0.000121	0.000128	0.000144	-	0.000193	-
Nickel (Ni)-Total	mg/L	0.025-0.15 (d,f)	<0.00020	<0.00040	<0.00050	<0.00050	0.00059	<0.00050	<0.00050	<0.00050	-	<0.00050	-
Phosphorus - Total	mg/L	0.005-0.015 (lakes only)	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	-	<0.050	-
Potassium (K)-Total	mg/L	-	0.43	0.72	0.509	0.520	0.544	0.511	0.502	0.363	-	0.572	-
Rubidium (Rb) - Total	mg/L	-	-	-	0.00043	0.00048	0.00064	0.00051	0.00046	0.00038	-	0.00056	-
Selenium (Se)-Total	mg/L	0.002	<0.00050	<0.00050	0.000055	0.00005	0.000169	<0.000050	<0.000050	<0.000050	-	<0.000050	-
Silicon - Total	mg/L	-	4.2	4.6	4.19	3.34	4.65	4.17	3.79	4.85	-	4.63	-
Silver (Ag)-Total	mg/L	0.0001-0.003 (d)	<0.000050	<0.000050	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	-	<0.000010	-
Sodium (Na)-Total	mg/L	-	4.17	4.57	3.58	7.70	6.97	4.29	5.79	6.24	-	7.02	-
Strontium - Total	mg/L	-	0.0542	0.0594	0.0461	0.04320	0.06900	0.04820	0.04180	0.0563	-	0.0616	-
Sulfur - Total	mg/L	-	<3.0	<3.0	0.51	0.5	<0.50	<0.50	<0.50	<0.50	-	<0.50	-
Tellurium - Total	mg/L	-	<0.00020	<0.00050	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	-	<0.00020	-
Thallium (Tl)-Total	mg/L	0.0008	<0.000020	<0.000020	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	-	<0.000010	-
Thorium - Total	mg/L	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	<0.00010	-
Tin (Sn)-Total	mg/L	-	<0.00020	<0.00020	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	<0.00010	-
Titanium (Ti)-Total	mg/L	-	<0.0050	<0.0050	<0.00030	0.00062	0.00970	0.00047	0.00073	<0.00030	-	0.00282	-
Tungsten (W) - Total	mg/L	-	-	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	<0.00010	-
Uranium (U)-Total	mg/L	0.0085	0.000047	0.000033	0.000025	0.000023	0.000195	0.000021	0.000021	0.000016	-	0.000055	-
Vanadium (V)-Total	mg/L	-	<0.0010	<0.0010	<0.00050	0.00054	0.00263	0.00052	0.00069	0.00055	-	0.00103	-
Zinc (Zn)-Total	mg/L	0.033-0.34 (d,f)	<0.0040	<0.0040	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	-	<0.0030	-
Zirconium - Total	mg/L	-	<0.00010	<0.00010	<0.000060	<0.000060	<0.000060	<0.000060	<0.000060	<0.00020	-	<0.00020	-
Dissolved Metals													
Aluminum (Al)-Dissolved	mg/L	0.023-0.1 (b,c)	0.0168	0.0071	0.0123	0.0261	0.0061	0.0134	0.0204	0.0077	-	0.016	-
Antimony (Sb)-Dissolved	mg/L	-	<0.00010	<0.00020	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	<0.00010	-
Arsenic (As)-Dissolved	mg/L	-	0.0021	0.00181	0.00129	0.00095	0.00163	0.00124	0.00099	0.00138	-	0.00139	-
Barium (Ba)-Dissolved	mg/L	-	0.0136	0.0117	0.0103	0.01190	0.01540	0.01030	0.01010	0.0138	-	0.0155	-
Beryllium (Be)-Dissolved	mg/L	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	<0.000100	-
Bisumuth - Dissolved	mg/L	-	<0.00010	<0.00010	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	-	<0.000050	-
Boron (B)-Dissolved	mg/L	-	0.0058	0.0067	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	-	<0.010	-
Cadmium (Cd)-Dissolved	mg/L	0.000027 - 0.00280 (d, f)	<0.000010	<0.000010	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	-	<0.0000050	-
Calcium (Ca)-Dissolved	mg/L	-	15.2	13.4	9.80	9.310	14.100	9.650	8.950	11.2	-	11.9	-
Cesium (Cs) -Dissolved	mg/L	-	-	-	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	-	<0.000010	-
Chromium (Cr)-Dissolved	mg/L	-	<0.00050	<0.00050	0.00013	0.00011	0.00014	0.00015	0.00013	<0.00010	-	0.00011	-
Cobalt (Co)-Dissolved	mg/L	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	<0.00010	-
Copper (Cu)-Dissolved	mg/L	-	<0.00020	<0.00040	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	-	0.00037	-
Iron (Fe)-Dissolved	mg/L	0.35	0.045	0.032	0.013	0.022	0.018	0.032	0.033	0.026	-	0.049	-
Lead (Pb)-Dissolved	mg/L	-	<0.00010	<0.00020	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	-	<0.000050	-
Lithium (Li)-Dissolved	mg/L	-	0.00051	0.0004	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-	<0.0010	-
Magnesium (Mg)-Dissolved	mg/L	-	1.06	1.05	0.893	0.775	1.020	0.879	0.758	0.915	-	1.01	-
Manganese (Mn)-Dissolved	mg/L	-	0.0119	0.00588	0.00247	0.00378	0.00734	0.00841	0.00706	0.0148	-	0.0134	-
Mercury (Hg)-Dissolved	mg/L	-	<0.000020	<0.000010	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	-	<0.0000050	-
Molybdenum (Mo)-Dissolved	mg/L	-	0.00023	0.00022	0.000153	0.000112	0.000197	0.000144	0.00014	0.000149	-	0.000168	-
Nickel (Ni)-Dissolved	mg/L	-	<0.00020	<0.00040	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	<0.00050	-
Phosphorus - Dissolved	mg/L	-	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	-	<0.050	-
Potassium (K)-Dissolved	mg/L	-	0.51	0.66	0.487	0.571	0.498	0.514	0.531	0.343	-	0.564	-
Rubidium (Rb) - Dissolved	mg/L	-	-	-	0.00038	0.00045	0.00044	0.00047	0.00041	0.00037	-	0.0005	-
Selenium (Se)-Dissolved	mg/L	-	<0.00050	<0.00050	<0.000050	<0.000050	0.000057	<0.000050	<0.000050	<0.000050	-	<0.000050	-
Silicon - Dissolved	mg/L	-	4.6	4.4	4.01	3.430	4.280	4.170	3.470	4.40	-	4.44	-
Silver (Ag)-Dissolved	mg/L	-	<0.000050	<0.000050	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	-	<0.000010	-
Sodium (Na)-Dissolved	mg/L	-	4.7	4.34	3.82	8.00	6.55	4.40	6.22	6.21	-	7.24	-
Strontium - Dissolved	mg/L	-	0.0627	0.0567	0.0474	0.04400	0.06490	0.04840	0.04050	0.0578	-	0.0579	-
Sulfur- Dissolved	mg/L	-	<3.0	<3.0	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	-	<0.50	-
Tellurium - Dissolved	mg/L	-	<0.00020	<0.00050	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	-	<0.00020	-
Thallium (Tl)-Dissolved	mg/L	-	<0.000020	<0.000020	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	-	<0.000010	-
Thorium - Dissovled	mg/L	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	<0.00010	-
Tin (Sn)-Dissolved	mg/L	-	<0.00020	<0.00020	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	<0.00010	-
Titanium (Ti)-Dissolved	mg/L	-	<0.0050	<0.0050	<0.00030	<0.00030	<0.00030	<0.00030	0.00031	<0.00030	-	<0.00030	-
Tungsten (W) - Dissolved	mg/L	-	-	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	<0.00010	-
Uranium (U)-Dissolved	mg/L	-	0.000062	0.000027	0.000026	0.000017	0.000031	0.00002	0.000017	0.000013	-	0.000022	-
Vanadium (V)-Dissolved	mg/L	-	<0.0010	<0.0010	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	<0.00050	-
Zinc (Zn)-Dissolved	mg/L	-	<0.0040	<0.0040	<0.0010	<0.0010	0.001	<0.0010	<0.0010	<0.0010	-	<0.0010	-
Zirconium - Dissolved	mg/L	-	<0.00010	<0.00010	<0.000060	<0.000060	<0.000060	<0.000060	<0.000060	<0.00020	-	<0.00020	-

NOTES

(1) BC MoE Approved and Working Water Quality Guidelines, last updated March 2018
(2) BC Contaminated Sites Regulation (CSR) for protection of aquatic life or drinking water, Schedule 3.2, last updated July 2018
(3) All criteria limits for BCWQG - Aquatic Life Guidelines based on Total Metal Concentration except Aluminum (Dissolved) and Cadmium (Dissolved)
(4) BC MoE Water Quality Guidelines for Protectionof Wildlife
(a) Range based on max pH 8.5 to min pH 6.5 at temperature of 6.0 'C
(b) at pH less than 6.5, limit is determined by regression equation, else limit is 0.1 mg/L.
(c) Limit for dissolved metals, not total metals
(d) Limit dependent upon hardness.
(e) Limit for chromium(VI) - data reported by lab as total chromium - limit assumes 100% chromium VI in sample
(f) Where hardness data was unavailable, 50 mg/L was assumed
(g) Maximum value
(h) Limit dependent upon chloride concentration
(i) Change of 25 mg/L from background for a duration of 24 hours during clear flows. Change of 10% of background during turbid flows
** Criteria exceeds detection limit*
MAC = Maximum Acceptable Concentration
AO = Aesthetic Objective

BCWQG-AW *BC MoE Quality Guidelines for Protection of Aquatic Life*

Table 19: Surface Water Quality Results Sampling Location SW-05 (Clearwater Creek at FSR)

		BC MoE Guidelines BCWQG-AW (1)	05-Jul-17	26-Sep-17	08-Nov-17	12-Apr-18	17-Jul-18	19-Nov-18	19-Nov-18		29-Mar-19	25-Jun-19	18-Jun-20	16-Jul-20	16-Jul-20		09-Nov-20
Field	**Units**							Sample	Duplicate	RPD			Monitor	Sample	Duplicate	RPD	Monitor
Conductivity	uS/cm	-	148	106	93	91	117	97	-	-	91	115.0	107.7	106.7	-	-	88.2
pH	pH	-	6	8.1	8.0	7.5	7.7	6.8	-	-	7.0	7.82	7.55	7.72	-	-	7.69
Temperature	°C	-	11.8	9.1	4.1	4.6	12.1	5.2	-	-	4.1	12.2	10.1	10.1	-	-	4.7
Dissolved Oxygen	mg/L	-	9.41	15.5	13.5	13.1	5.3	9.3	-	-	12.8	10.8	8.3	4.6	-	-	11.8
Depth to water												-	-	-	-	-	-
Flow Rate	m/s										0.57	0.984			-	-	
Analyte	Units																
Conductivity	uS/cm	-	162	162	-	-	-	-	-	-	-		-	160	155	-	-
Hardness (as CaCO3)	mg/L	-	73.9	82.7	72.8	74.8	73.6	72.1	72.1	0.00%	70	79	-	71.1	69.9	0.85%	-
pH	pH	6.5-9.0	7.9	8	8.2	7.9	6.6	8.1	8.2	0.37%	8.0	8.18	-	8.02	8.02	0.00%	-
Total Suspended Solids	mg/L	25 mg/L (backgr. 25-250 mg/l)) (i)	3.3	2.4	-	-	-	-	-	-	-		-	-	-	-	-
Total Dissolved Solids	mg/L	-	78	94	-	-	-	-	-	-	-		-	-	-	-	-
Alkalinity, Bicarbonate (as CaCO3)	mg/L	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-
Alkalinity, Carbonate (as CaCO3)	mg/L	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-
Alkalinity, Hydroxide (as CaCO3)	mg/L	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-
Alkalinity, Total (as CaCO3)	mg/L	-	78	78	-	-	-	-	-	-	-		-	-	-	-	-
Ammonia, Total (as N)	mg/L	2.0-26.5 (a)	<0.03	<0.03	<0.0050	0.0057	<0.0050	<0.0050	<0.0050	-	<0.0050	<0.0050	-	<0.0050	<0.0050	-	-
Total Nitrogen as N	mg/L	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-
Bromide (Br)	mg/L	-	-	-	<0.050	<0.050		<0.050	<0.050	-	<0.050	<0.050	-	<0.050	<0.050	-	-
Chloride (Cl)	mg/L	600, MAC	1.5	1.4	1.37	1.05	1.05	1.12	1.12	0.00%	0.89	1.16		1.1	1.1	0.00%	
Fluoride (F)	mg/L	0.7-1.9 (d)	<0.10	<0.1	0.056	0.052	0.051	0.053	0.05	2.91%	0.052	0.060	-	0.055	0.055	0.00%	-
Nitrate (as N)	mg/L	32.8	<0.010	0.014	0.0179	0.0129	<0.0050	0.0188	0.0161	7.74%	0.0168	<0.0050	-	<0.0050	<0.0050	-	-
Nitrite (as N)	mg/L	0.06-0.6 (h)	<0.01	<0.01	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-	<0.0010	<0.010	-	<0.0010	<0.0010	-	-
Sulfate (SO4)	mg/L	128-429 (d)	3.1	2.7	2.86	2.66	2.54	2.48	2.39	1.85%	2.21	2.56	-	2.8	2.79	0.18%	-
Total Organic Carbon	mg/L	+/- 20% of background	<0.50	0.88	-	0.54		-	-	-	-	-	-	-	-	-	-
BOD	mg/L	-	<4.0	<4.0	<2.0	<2.0	<2.0	<2.0	<2.0	-	<2.0	<2.0	-	<2.0	<2.0	-	-
COD	mg/L	-	-	-	<20	<20	<20	<20	<20	-	<20	<20	-	<20	<20	-	-
Total Metals																	
Aluminum (Al)-Total	mg/L	-	0.0104	0.0076	0.0607	0.0067	0.0064	0.0073	0.0070	2.10%	0.0095	0.0060	-	0.0066	0.0059	5.60%	-
Antimony (Sb)-Total	mg/L	0.009	<0.00010	<0.00020	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	<0.00010	<0.00010	-	<0.00010	<0.00010	-	-
Arsenic (As)-Total	mg/L	0.005	0.00184	0.00181	0.00197	0.00173	0.00202	0.00178	0.00186	2.20%	0.00193	0.00208	-	0.00192	0.00189	0.79%	-
Barium (Ba)-Total	mg/L	1	0.0213	0.0205	0.0213	0.01890	0.02130	0.02120	0.02050	1.68%	0.02220	0.0203	-	0.0201	0.02	0.25%	-
Beryllium (Be)-Total	mg/L	0.00013	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	<0.00010	<0.00010	-	<0.000100	<0.000100	-	-
Bismuth	mg/L	-	<0.00010	<0.00010	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	-	<0.000050	<0.000050	-	<0.000050	<0.000050	-	-
Boron (B)-Total	mg/L	1.2	0.0104	0.0099	<0.010	<0.010	<0.010	<0.010	<0.010	-	<0.010	<0.010	-	<0.010	<0.010	-	-
Cadmium (Cd)-Total	mg/L	-	<0.000010	<0.000010	0.0000294	<0.0000050	<0.0000050	<0.0000050	<0.0000050	-	0.0000072	<0.0000050	-	<0.0000050	<0.0000050	-	-
Calcium (Ca)-Total	mg/L	<4 sensitive to acid input	25.8	28.9	27.5	23.1	25.8	24.7	26.2	2.95%	26.6	25.7	-	25.8	26.5	1.34%	-
Cessium (Cs) - Total	mg/L	-	-	-	0.000011	<0.000010	<0.000010	<0.000010	<0.000010	-	<0.000010	<0.000010	-	<0.000010	<0.000010	-	-
Chromium (Cr)-Total	mg/L	0.001 (e)	<0.00050	0.00068	0.00046	0.00034	0.00046	0.00036	0.00037	1.37%	0.00034	0.00036	-	0.00034	0.00038	5.56%	-
Cobalt (Co)-Total	mg/L	0.11	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	<0.00010	<0.00010	-	<0.00010	<0.00010	-	-
Copper (Cu)-Total	mg/L	0.0032-0.0396 (d,f)	<0.00020	<0.00040	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	<0.00050	<0.00050	-	<0.00050	<0.00050	-	-
Iron (Fe)-Total	mg/L	1	0.01	0.01	0.086	<0.010	0.010	<0.010	<0.010	-	<0.010	<0.010	-	0.019	<0.010	-	-
Lead (Pb)-Total	mg/L	0.011-0.402 (d,f)	<0.00010	<0.00020	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	-	<0.000050	<0.000050	-	<0.000050	<0.000050	-	-
Lithium (Li)-Total	mg/L	-	0.00122	0.00122	0.0011	0.0011	0.0011	0.0011	0.001	4.76%	0.0011	0.0012	-	0.0012	0.0012	0.00%	-
Magnesium (Mg)-Total	mg/L	-	2.28	2.55	2.65	2.190	2.440	2.280	2.200	1.79%	2.040	2.29	-	2.32	2.32	0.00%	-
Manganese (Mn)-Total	mg/L	0.8-3.4 (d,f)	0.00133	0.00146	0.00659	0.0006	0.0015	0.0012	0.0014	6.42%	0.0005	0.00142		0.00138	0.00131	2.60%	-
Mercury (Hg)-Total	mg/L	0.0001	<0.000020	<0.000010	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	-	<0.0000050	<0.0000050	-	<0.0000050	<0.0000050	-	-
Molybdenum (Mo)-Total	mg/L	2	0.0004	0.00038	0.000336	0.000354	0.000393	0.00038	0.000372	1.06%	0.000296	0.000387	-	0.000379	0.000388	1.17%	-
Nickel (Ni)-Total	mg/L	0.025-0.15 (d,f)	<0.00020	<0.00040	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	<0.00050	<0.00050	-	<0.00050	<0.00050	-	-
Phosphorus - Total	mg/L	0.005-0.015 (lakes only)	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	-	<0.050	<0.050	-	<0.050	<0.050	-	-
Potassium (K)-Total	mg/L	-	0.89	0.99	0.981	0.859	0.920	0.936	0.896	2.18%	0.786	0.933	-	0.91	0.909	0.05%	-
Rubidium (Rb)- Total	mg/L	-	-	-	0.00040	0.00029	0.00033	0.00034	0.00038	5.56%	0.00036	0.00031	-	0.00034	0.0003	6.25%	-
Selenium (Se)-Total	mg/L	0.002	<0.00050	<0.00050	0.000151	0.000102	0.000151	0.000118	0.000124	2.48%	0.000112	0.000121	-	0.000142	0.000183	12.62%	-
Silicon - Total	mg/L	-	4.9	5	4.81	4.65	4.73	4.78	4.69	0.95%	4.67	4.94	-	4.86	4.86	0.00%	-
Silver (Ag)-Total	mg/L	0.0001-0.003 (d)	0.000062	<0.000050	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	-	<0.000010	<0.000010	-	<0.000010	<0.000010	-	-
Sodium (Na)-Total	mg/L	-	2.07	2.31	2.32	2.11	2.16	2.15	2.19	0.92%	1.98	2.13	-	2.1	2.06	0.96%	-
Strontium - Total	mg/L	-	0.104	0.0995	0.101	0.09660	0.10300	0.10200	0.09940	1.29%	0.10600	0.105	-	0.1	0.101	0.50%	-
Sulfur - Total	mg/L	-	3.2	<3.0	1.05	0.71	0.81	0.78	0.55	17.29%	0.97	0.90	-	1.06	1.22	7.02%	-
Tellurium - Total	mg/L	-	<0.00020	<0.00050	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	-	<0.00020	<0.00020	-	<0.00020	<0.00020	-	-
Thallium (Tl)-Total	mg/L	0.0008	<0.000020	<0.000020	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	-	<0.000010	<0.000010	-	<0.000010	<0.000010	-	-
Thorium - Total	mg/L	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	<0.00010	<0.00010	-	<0.00010	<0.00010	-	-
Tin (Sn)-Total	mg/L	-	<0.00020	<0.00020	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	<0.00010	<0.00010	-	<0.00010	<0.00010	-	-
Titanium (Ti)-Total	mg/L	-	<0.0050	<0.0050	<0.0021	<0.00030	<0.00030	<0.00030	<0.00030	-	<0.00030	<0.00030	-	<0.00030	<0.00030	-	-
Tungsten (W) - Total	mg/L	-	-	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	<0.00010	<0.00010	-	<0.00010	<0.00010	-	-
Uranium (U)-Total	mg/L	0.0085	0.000164	0.000147	0.000148	0.000138	0.000156	0.000166	0.000155	3.43%	0.000157	0.00016	-	0.000162	0.00016	0.62%	-
Vanadium (V)-Total	mg/L	-	0.0012	0.001	0.00106	0.00109	0.00118	0.00097	0.00095	1.04%	0.00109	0.00108	-	0.00107	0.00104	1.42%	-
Zinc (Zn)-Total	mg/L	0.033-0.34 (d,f)	<0.0040	<0.0040	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	-	<0.0030	<0.0030	-	<0.0030	<0.0030	-	-
Zirconium - Total	mg/L	-	<0.00010	<0.00010	<0.000060	<0.000060	<0.000060	<0.000060	<0.000060	-	<0.000060	<0.00020	-	<0.00020	<0.00020	-	-
Dissolved Metals																	
Aluminum (Al)-Dissolved	mg/L	0.023-0.1 (b,c)	<0.0050	<0.0050	0.0044	0.0056	0.0026	0.0032	0.00310	1.59%	0.00120	0.0024	-	0.0035	0.0037	2.78%	-
Antimony (Sb)-Dissolved	mg/L	-	<0.00010	<0.00020	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	<0.00010	<0.00010	-	<0.00010	<0.00010	-	-
Arsenic (As)-Dissolved	mg/L	-	0.00172	0.00183	0.00181	0.00176	0.00185	0.00185	0.00199	3.65%	0.00195	0.00200	-	0.00194	0.00194	0.00%	-
Barium (Ba)-Dissolved	mg/L	-	0.0194	0.0199	0.0219	0.02130	0.02000	0.02100	0.0201	2.19%	0.0227	0.0205	-	0.0205	0.0204	0.24%	-
Beryllium (Be)-Dissolved	mg/L	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	<0.00010	<0.00010	-	<0.000100	<0.000100	-	-
Bisumuth - Dissolved	mg/L	-	<0.00010	<0.00010	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	-	<0.000050	<0.000050	-	<0.000050	<0.000050	-	-
Boron (B)-Dissolved	mg/L	-	0.0052	0.0073	<0.010	<0.010	<0.010	<0.010	<0.010	-	<0.010	<0.010	-	<0.010	<0.010	-	-
Cadmium (Cd)-Dissolved	mg/L	0.000027 - 0.00280 (d, f)	<0.000010	<0.000010	0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	-	<0.0000050	<0.0000050	-	<0.0000050	<0.0000050	-	-
Calcium (Ca)-Dissolved	mg/L	-	23	26.5	25.2	26.200	25.800	25.100	25.1	0.00%	28.2	27.6	-	24.7	24.2	1.02%	-
Cessium (Cs) - Dissolved	mg/L	-	-	-	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	-	<0.000010	<0.000010	-	<0.000010	<0.000010	-	-
Chromium (Cr)-Dissolved	mg/L	-	<0.00050	<0.00050	0.00035	0.00051	0.00033	0.00036	0.00031	7.46%	0.00033	0.00037	-	0.00034	0.00035	1.45%	-
Cobalt (Co)-Dissolved	mg/L	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	<0.00010	<0.00010	-	<0.00010	<0.00010	-	-
Copper (Cu)-Dissolved	mg/L	-	<0.00020	<0.00040	0.00033	<0.00020	0.00025	<0.00020	<0.00020	-	<0.00020	<0.00020	-	<0.00020	<0.00020	-	-
Iron (Fe)-Dissolved	mg/L	0.35	<0.010	<0.010	<0.010	<0.010	<0.010	0.012	<0.010	-	<0.010	<0.010	-	<0.010	<0.010	-	-
Lead (Pb)-Dissolved	mg/L	-	<0.00010	<0.00020	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	-	<0.000050	<0.000050	-	<0.000050	<0.000050	-	-
Lithium (Li)-Dissolved	mg/L	-	0.00101	0.00114	<0.0010	0.0011	0.001	0.001	0.001	0.00%	<0.0010	0.0011	-	0.0011	0.0012	4.35%	-
Magnesium (Mg)-Dissolved	mg/L	-	2	2.54	2.38	2.250	2.210	2.270	2.27	0.00%	2.2	2.47	-	2.31	2.32	0.22%	-
Manganese (Mn)-Dissolved	mg/L	-	<0.00020	0.00038	<0.00010	0.00033	0.00073	0.00221	0.00056	59.57%	0.0064	0.0005	-	0.00052	0.00045	7.22%	-
Mercury (Hg)-Dissolved	mg/L	-	-	<0.000010	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	-	<0.0000050	<0.0000050	-	<0.0000050	<0.0000050	-	-
Molybdenum (Mo)-Dissolved	mg/L	-	0.00038	0.00039	0.000395	0.000367	0.00036	0.000379	0.000	0.66%	0.000	0.000387	-	0.000391	0.000389	0.26%	-
Nickel (Ni)-Dissolved	mg/L	-	<0.00020	<0.00040	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	<0.00050	<0.00050	-	<0.00050	<0.00050	-	-
Phosphorus - Dissolved	mg/L	-	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	-	<0.050	<0.050	-	<0.050	<0.050	-	-
Potassium (K)-Dissolved	mg/L	-	0.78	0.96	0.925	0.893	0.881	0.906	0.893	0.72%	0.809	0.910	-	0.922	0.915	0.38%	-
Rubidium (Rb)-Dissovled	mg/L	-	-	-	0.00040	0.00034	0.00034	0.00029	0.00032	4.92%	0.00032	0.00033	-	0.0003	0.00038	11.76%	-
Selenium (Se)-Dissolved	mg/L	-	<0.00050	<0.00050	0.000120	0.000138	0.000158	0.000141	0.00	7.63%	0.00	0.000150	-	0.000146	0.000119	10.19%	-
Silicon - Dissolved	mg/L	-	4.6	5	4.60	4.640	4.540	4.570	4.68000	1.19%	4.44000	4.63	-	4.71	4.79	0.84%	-
Silver (Ag)-Dissolved	mg/L	-	<0.000050	<0.000050	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	-	<0.000010	<0.000010	-	<0.000010	<0.000010	-	-
Sodium (Na)-Dissolved	mg/L	-	1.86	2.32	2.41	2.01	2.05	2.17	2.11	1.40%	1.8	2.18	-	2.06	2.08	0.48%	-
Strontium - Dissolved	mg/L	-	0.091	0.101	0.103	0.10000	0.10000	0.10200	0.101	0.49%	0.0946	0.104	-	0.0999	0.0984	0.76%	-
Sulfur- Dissolved	mg/L	-	<3.0	<3.0	0.79	0.83	0.85	0.85	0.79	3.66%	<0.50	0.74	-	1.15	1.1	2.22%	-
Tellurium - Dissolved	mg/L	-	<0.00020	<0.00050	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	-	<0.00020	<0.00020	-	<0.00020	<0.00020	-	-
Thallium (Tl)-Dissolved	mg/L	-	<0.000020	<0.000020	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	-	<0.000010	<0.000010	-	<0.000010	<0.000010	-	-
Thorium - Dissovled	mg/L	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	<0.00010	<0.00010	-	<0.00010	<0.00010	-	-
Tin (Sn)-Dissolved	mg/L	-	<0.00020	<0.00020	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	<0.00010	<0.00010	-	<0.00010	<0.00010	-	-
Titanium (Ti)-Dissolved	mg/L	-	<0.0050	<0.0050	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	-	<0.00030	<0.00030	-	<0.00030	<0.00030	-	-
Tungsten (W) -Dissovled	mg/L	-	-	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	<0.00010	<0.00010	-	<0.00010	<0.00010	-	-
Uranium (U)-Dissolved	mg/L	-	0.00015	0.000135	0.000149	0.000148	0.000144	0.000144	0.000144	0.00%	0.000139	0.000139	-	0.000156	0.000153	0.97%	-
Vanadium (V)-Dissolved	mg/L	-	<0.0010	<0.0010	0.00088	0.00091	0.00086	0.00087	0.00088	0.57%	0.000095	0.00103	-	0.00101	0.00097	2.02%	-
Zinc (Zn)-Dissolved	mg/L	-	<0.0040	0.0043	0.0011	<0.0010	<0.0010	<0.0010	<0.0010	-	<0.0010	<0.0010	-	<0.0010	0.0011	-	-
Zirconium - Dissolved	mg/L	-	<0.00010	<0.00010	<0.000060	<0.000060	<0.000060	<0.000060	<0.000060	-	<0.000060	<0.00020	-	<0.00020	<0.00020	-	-

NOTES

(1) BC MoE Approved and Working Water Quality Guidelines, last updated March 2018
(2) BC Contaminated Sites Regulation (CSR) for protection of aquatic life or drinking water, Schedule 3.2, last updated July 2018
(3) All criteria limits for BCWQG - Aquatic Life Guidelines based on Total Metal Concentration except Aluminum (Dissolved) and Cadmium (Dissolved)
(4) BC MoE Water Quality Guidelines for Protectionof Wildlife
(a) Range based on max pH 8.5 to min pH 6.5 at temperature of 6.0 'C
(b) at pH less than 6.5, limit is determined by regression equation, else limit is 0.1 mg/L.
(c) Limit for dissolved metals, not total metals
(d) Limit dependent upon hardness.
(e) Limit for chromium(VI) - data reported by lab as total chromium - limit assumes 100% chromium VI in sample
(f) Where hardness data was unavailable, 50 mg/L was assumed
(g) Maximum value
(h) Limit dependent upon chloride concentration
(i) Change of 25 mg/L from background for a duration of 24 hours during clear flows. Change of 10% of background during turbid flows
** Criteria exceeds detection limit*
MAC = Maximum Acceptable Concentration
AO = Aesthetic Objective

BCWQG-AW *BC MoE Quality Guidelines for Protection of Aquatic Life*

Table 20: Forceman Ridge Precipitation and Leachate Generation Rates

Design Precipitation		
Global Warming Factor	15%	
Design Average Precipitation	1986	mm/year
Design Extreme Ratio	1.4	
Design Extreme Precipitation	2781	mm/year
Leachate Production (HELP)		
Average Condition		
Active Areas	1413	mm/year
Temporary Closed Areas	353	mm/year
Geomembrane Capped Areas	0.43	mm/year
Extreme Condition		
Active Areas	1957	mm/year
Temporary Closed Areas	489	mm/year
Geomembrane Capped Areas	0.86	mm/year

Table 21: Leachate Water Quality Results Sampling Location F5, Sand Cyclone

Date		BC ENV OC Criteria	06-Jun-17	05-Jul-17	15-Aug-17	07-Nov-17	25-Apr-18
Field	**Units**						
Conductivity	uS/cm	-	83.5	96.4	352	566	532
pH	pH	-	8.4	7.4	6.8	7.08	6.46
Temperature	°C	-	16.2	13.3	14.2	3.5	5.0
Dissolved Oxygen	%l	-	-	6.4	12.7	7.7	5.7
Dissolved Oxygen	mg/L						
Turbidity	NTU	-	-	-	-	-	-
ORP	mV	-	-	-	-	-	105.6
Water level							
Flow rate							
Iron	ppm						
Analyte							
Alkalinity, Total (as CaCO3)	mg/L	-	36	41	59	348	110
Conductivity	uS/cm	-	-	-	-	-	-
Hardness (as CaCO3)	mg/L	-	43.2	39.8	59.3	244	213
pH	pH	6.5 - 8.5	7.4	7.4	7.6	7.57	-
Kjeldahl Nitrogen, Total [TKN]	mg/L	-					
Ammonia, Total (as N)	mg/L	214	<0.03	<0.03	<0.03	15.5	18.5
Bromide (Br)	mg/L	-	-	-	-	-	0.071
Chloride (Cl)	mg/L	5000	<1.0	2.4	2.7	58.4	15.3
Fluoride (F)	mg/L	-	<0.10	<0.10	<0.10	<0.20	0.071
Nitrate (as N)	mg/L	-	<0.01	0.023	0.031	<0.050	0.071
Nitrite (as N)	mg/L	-	<0.01	<0.01	<0.01	<0.010	<0.0050
Nitrogen, total	mg/L	-					
Orthophosphorus (P)	mg/L	-	-	-	-	<0.0010	<0.0010
Sulfate (SO4)	mg/L	-	3.4	5.5	5.3	13.1	<0.0010
Total Organic Carbon	mg/L	-	2.14	1.39	1.57	146	42.4
Total Metals							
Aluminum (Al)-Total	mg/L	-	0.054	0.0497	0.0183	0.0388	0.0290
Antimony (Sb)-Total	mg/L	-	0.00021	0.00027	0.00022	0.00059	0.00041
Arsenic (As)-Total	mg/L	-	<0.00050	<0.00050	<0.00050	0.00250	0.00529
Barium (Ba)-Total	mg/L	-	0.0513	0.0341	0.0432	0.241	0.320
Beryllium (Be)-Total	mg/L	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00020
Bismuth	mg/L	-	<0.00010	<0.00010	<0.00010	<0.000050	<0.00010
Boron (B)-Total	mg/L	-	0.009	0.0165	0.0111	0.355	0.217
Cadmium (Cd)-Total	mg/L	0.1	<0.000010	0.000019	<0.000010	0.0000618	0.0005260
Calcium (Ca)-Total	mg/L	-	15.9	14.6	22	83.6	72.9
Cessium (Cs) - Total	mg/L	-	-	-	-	0.000630	0.000529
Chromium (Cr)-Total	mg/L	-	<0.00050	<0.00050	<0.00050	0.00453	0.00093
Cobalt (Co)-Total	mg/L	-	<0.00010	<0.00010	<0.00010	0.00823	0.00965
Copper (Cu)-Total	mg/L	-	0.00155	0.00203	0.00177	0.00650	0.02150
Iron (Fe)-Total	mg/L	6	0.086	0.093	0.052	5.64	14.90
Lead (Pb)-Total	mg/L	-	0.00077	0.00085	<0.00020	0.000572	0.004330
Lithium (Li)-Total	mg/L	-	<0.00010	<0.00010	<0.00010	<0.0010	<0.0020
Magnesium (Mg)-Total	mg/L	-	0.841	0.806	1.05	8.63	7.56
Manganese (Mn)-Total	mg/L	-	0.00355	0.00483	0.012	16.7	25.0
Mercury (Hg)-Total	mg/L	-	<0.00002	<0.000020	<0.000010	<0.000025	<0.0000050
Molybdenum (Mo)-Total	mg/L	-	0.00058	0.00068	0.00074	0.000640	0.000700
Nickel (Ni)-Total	mg/L	-	<0.00020	<0.00020	<0.00040	0.00667	0.00540
Phosphorus - Total	mg/L	-	<0.050	<0.050	<0.050	1.32	0.13
Potassium (K)-Total	mg/L	-	0.89	0.93	1.17	28.5	16.4
Rubidium (Rb) - Total	mg/L	-	-	-	-	0.0326	0.0257
Selenium (Se)-Total	mg/L	-	<0.00050	<0.00050	<0.00050	0.000108	<0.00010
Silicon - Total	mg/L	-	2.3	2.1	2.5	2.72	3.43
Silver (Ag)-Total	mg/L	-	<0.000050	0.000073	<0.000050	<0.000010	<0.000020
Sodium (Na)-Total	mg/L	-	1.28	1.4	2.13	54.1	36.1
Strontium - Total	mg/L	-	0.183	0.204	0.271	0.297	0.401
Sulfur - Total	mg/L	-	4	3.9	<3.0	6.94	<1.0
Tellurium - Total	mg/L	-	<0.00020	<0.00020	<0.00050	<0.00020	<0.00040
Thallium (Tl)-Total	mg/L	-	<0.000020	<0.000020	<0.000020	0.000018	<0.000020
Thorium - Total	mg/L	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00020
Tin (Sn)-Total	mg/L	-	<0.00020	<0.00020	<0.00020	0.00013	0.00037
Titanium (Ti)-Total	mg/L	-	<0.0050	<0.0050	<0.0050	0.00274	0.00203
Tungsten (W) - Total	mg/L	-	-	-	-	0.00010	<0.00020
Uranium (U)-Total	mg/L	-	<0.000020	<0.000020	0.00003	0.000045	0.000083
Vanadium (V)-Total	mg/L	-	<0.0010	<0.0010	<0.0010	0.00186	0.00170
Zinc (Zn)-Total	mg/L	100	0.0315	0.0249	<0.0040	0.0428	0.0616
Zirconium - Total	mg/L	-	<0.00010	<0.00010	<0.00010	0.000063	<0.00012
Aggregate Organics							
BOD	mg/L	-	<3.0	<4.0	<4.0	-	11.8
COD	mg/L	-	-	-	-	466	167

NOTES

(1) BC MoE Approved and Working Water Quality Guidelines, 2015 Edition
(2) BC Contaminated Sites Regulation (CSR) for protection of aquatic life or drinking water, Schedule 6
(3) All criteria limits for BCWQG - Drinking Quality Guidelines based on Total Metal Concentration except Aluminum (Dissolved)
(4) BC MoE Water Quality Guidelines for Protectionof Wildlife
(a) Range based on max pH 8.5 to min pH 6.5 at temperature of 6.0 'C
(b) at pH less than 6.5, limit is determined by regression equation, else limit is 0.1 mg/L.
(c) Limit for dissolved metals, not total metals
(d) Limit dependent upon hardness.

Table 21: Leachate Water Quality Results Sampling Location F5, Sand Cyclone

Date		BC ENV OC Criteria	18-May-18	27-Aug-18	16-Apr-19	22-May-19	28-May-19
Field	**Units**						
Conductivity	uS/cm	-	239	1019	978	1056	
pH	pH	-	7.07	6.96	6.95	7	
Temperature	°C	-	16.2	18.4	6.7	15.3	
Dissolved Oxygen	%l	-	-	1	1.4	2.1	
Dissolved Oxygen	mg/L						
Turbidity	NTU	-	-	-	-		
ORP	mV	-	-	-	-	195	
Water level							
Flow rate							
Iron	ppm						
Analyte							
Alkalinity, Total (as CaCO3)	mg/L	-	-	466	553	539	-
Conductivity	uS/cm	-	-	-	-		-
Hardness (as CaCO3)	mg/L	-	-	227	377	304	252
pH	pH	6.5 - 8.5	-	8.02	7.29	7.48	-
Kjeldahl Nitrogen, Total [TKN]	mg/L	-					
Ammonia, Total (as N)	mg/L	214	-	30.8	36.8	28.1	-
Bromide (Br)	mg/L	-	-	-	<0.50	0.26	-
Chloride (Cl)	mg/L	5000	-	<0.25	88.9	91.8	-
Fluoride (F)	mg/L	-	-	<0.10	<0.20	<0.10	-
Nitrate (as N)	mg/L	-	-	0.044	<0.050	<0.025	-
Nitrite (as N)	mg/L	-	-	<0.0050	<0.010	0.0052	-
Nitrogen, total	mg/L	-					
Orthophosphorus (P)	mg/L	-	-	<0.0010	0.0554	0.0017	-
Sulfate (SO4)	mg/L	-	-	<1.5	<3.0	2.6	-
Total Organic Carbon	mg/L	-	-	3.2	219	221	-
Total Metals							
Aluminum (Al)-Total	mg/L	-	-	0.0268	0.04	0.09	0.027
Antimony (Sb)-Total	mg/L	-	-	0.00045	0.00	0.00	0.00068
Arsenic (As)-Total	mg/L	-	-	0.00367	0.01	0.01	0.00515
Barium (Ba)-Total	mg/L	-	-	0.254	0.38	0.41	0.407
Beryllium (Be)-Total	mg/L	-	-	<0.00010	<0.00050	<0.00050	<0.00050
Bismuth	mg/L	-	-	<0.000050	<0.00025	<0.00025	<0.00025
Boron (B)-Total	mg/L	-	-	0.508	0.55	0.56	0.469
Cadmium (Cd)-Total	mg/L	0.1	-	0.000051	0.00	0.00	0.00005
Calcium (Ca)-Total	mg/L	-	-	68.6	125.00	98.40	81.3
Cessium (Cs) - Total	mg/L	-	-	0.000876	0.00	0.00	0.000924
Chromium (Cr)-Total	mg/L	-	-	0.00146	0.00	0.00	0.00098
Cobalt (Co)-Total	mg/L	-	-	0.00226	0.01	0.00	0.00454
Copper (Cu)-Total	mg/L	-	-	0.0032	0.01	0.24	<0.0025
Iron (Fe)-Total	mg/L	6	2.21	2.5	25.30	7.62	6.23
Lead (Pb)-Total	mg/L	-	-	0.00030	0.00	0.03	0.00186
Lithium (Li)-Total	mg/L	-	-	<0.0010	<0.0050	<0.0050	<0.0050
Magnesium (Mg)-Total	mg/L	-	-	13.60	16.00	14.30	12
Manganese (Mn)-Total	mg/L	-	-	7.6	19.20	12.50	14.3
Mercury (Hg)-Total	mg/L	-	-	0.0000087	<0.000025	0.00	-
Molybdenum (Mo)-Total	mg/L	-	-	0.00040	0.00	0.00	0.00127
Nickel (Ni)-Total	mg/L	-	-	0.0054	0.01	0.01	0.0052
Phosphorus - Total	mg/L	-	-	0.74	0.78	1.11	0.43
Potassium (K)-Total	mg/L	-	-	44.6	48.50	43.90	36.9
Rubidium (Rb) - Total	mg/L	-	-	0.0506	0.05	0.05	0.0503
Selenium (Se)-Total	mg/L	-	-	0.00009	<0.00025	<0.00025	<0.00025
Silicon - Total	mg/L	-	-	2.42	3.50	2.86	2.58
Silver (Ag)-Total	mg/L	-	-	<0.000010	<0.000050	<0.000050	<0.000050
Sodium (Na)-Total	mg/L	-	-	84.4	90.40	91.90	80.1
Strontium - Total	mg/L	-	-	0.347	0.55	0.44	0.405
Sulfur - Total	mg/L	-	-	1.27	<2.5	<2.5	<2.5
Tellurium - Total	mg/L	-	-	<0.00020	<0.0010	<0.0010	<0.0010
Thallium (Tl)-Total	mg/L	-	-	0.000011	<0.000050	<0.000050	<0.000050
Thorium - Total	mg/L	-	-	<0.00010	<0.00050	<0.00050	<0.00050
Tin (Sn)-Total	mg/L	-	-	<0.00010	<0.00050	0.00	<0.00050
Titanium (Ti)-Total	mg/L	-	-	0.00134	0.00	0.01	<0.0015
Tungsten (W) - Total	mg/L	-	-	<0.00010	<0.00050	<0.00050	<0.00050
Uranium (U)-Total	mg/L	-	-	0.000056	0.00	0.00	0.000059
Vanadium (V)-Total	mg/L	-	-	0.0014	0.00	0.00	<0.0025
Zinc (Zn)-Total	mg/L	100	-	<0.0030	0.02	0.38	<0.015
Zirconium - Total	mg/L	-	-	0.000103	<0.00030	<0.00030	<0.00030
Aggregate Organics							
BOD	mg/L	-	-	24.4	-	51	-
COD	mg/L	-	-	178	669	234	-

NOTES

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(4) BC MoE Water Quality Guidelines for Protectionof Wildlife
(a) Range based on max pH 8.5 to min pH 6.5 at temperature of 6.0 'C
(b) at pH less than 6.5, limit is determined by regression equation, else limit is 0.1 mg/L.
(c) Limit for dissolved metals, not total metals
(d) Limit dependent upon hardness.

Table 21: Leachate Water Quality Results Sampling Location F5, Sand Cyclone

Date		BC ENV OC Criteria	29-May-19	31-May-19	17-Jul-19	01-Aug-19	27-May-2020
Field	**Units**						
Conductivity	uS/cm	-			858	838	315.9
pH	pH	-			6.91	6.88	7.15
Temperature	°C	-			15.7	18.7	8.6
Dissolved Oxygen	%l	-			0.9	2.2	26
Dissolved Oxygen	mg/L						3
Turbidity	NTU	-			-	-	0.6
ORP	mV	-			451.6	348	152.7
Water level							-
Flow rate							-
Iron	ppm						~1.5
Analyte							
Alkalinity, Total (as CaCO3)	mg/L	-			366	365	169
Conductivity	uS/cm	-	-			-	459
Hardness (as CaCO3)	mg/L	-	254	278	210	194	95.6
pH	pH	6.5 - 8.5			8.27	8.47	8.19
Kjeldahl Nitrogen, Total [TKN]	mg/L	-					3.42
Ammonia, Total (as N)	mg/L	214			21.7	18.3	2.11
Bromide (Br)	mg/L	-			<0.25	0.28	0.099
Chloride (Cl)	mg/L	5000			79.4	94.2	42.3
Fluoride (F)	mg/L	-			<0.10	<0.10	0.045
Nitrate (as N)	mg/L	-			6.87	1.48	0.466
Nitrite (as N)	mg/L	-			0.0323	0.0157	0.054
Nitrogen, total	mg/L	-					
Orthophosphorus (P)	mg/L	-			0.0057	0.004	0.0339
Sulfate (SO4)	mg/L	-			4.7	1.8	3.88
Total Organic Carbon	mg/L	-			25.4	20.5	7.72
Total Metals							
Aluminum (Al)-Total	mg/L	-	0.021	0.03	0.0419	0.03	0.0102
Antimony (Sb)-Total	mg/L	-	<0.00050	0.00	0.00058	0.00	0.00018
Arsenic (As)-Total	mg/L	-	0.00512	0.00	0.00418	0.00	0.00149
Barium (Ba)-Total	mg/L	-	0.497	0.32	0.355	0.21	0.091
Beryllium (Be)-Total	mg/L	-	<0.00050	<0.00020	<0.00010	<0.00010	<0.000100
Bismuth	mg/L	-	<0.00025	<0.00010	<0.000050	<0.000050	<0.000050
Boron (B)-Total	mg/L	-	0.542	0.57	0.528	0.56	0.224
Cadmium (Cd)-Total	mg/L	0.1	0.000048	0.00	0.000724	0.0002	0.000365
Calcium (Ca)-Total	mg/L	-	80.4	87.70	62.5	55.20	30.1
Cessium (Cs) - Total	mg/L	-	0.000935	0.00	0.00102	0.00	0.000163
Chromium (Cr)-Total	mg/L	-	0.00093	0.00	0.00139	0.00	0.00054
Cobalt (Co)-Total	mg/L	-	0.00485	0.00	0.00393	0.00	0.00113
Copper (Cu)-Total	mg/L	-	0.0054	0.02	0.855	0.01	0.0125
Iron (Fe)-Total	mg/L	6	6.52	3.68	7.67	1.15	0.868
Lead (Pb)-Total	mg/L	-	0.00113	0.00	0.00705	0.00	0.000755
Lithium (Li)-Total	mg/L	-	<0.0050	<0.0020	<0.0010	<0.0010	<0.0010
Magnesium (Mg)-Total	mg/L	-	13	14.30	13.1	13.50	4.94
Manganese (Mn)-Total	mg/L	-	17.4	8.58	10.9	3.88	2.88
Mercury (Hg)-Total	mg/L	-	<0.000025	0.00	<0.00010	<0.000025	<0.0000050
Molybdenum (Mo)-Total	mg/L	-	0.0013	0.00	0.00196	0.00	0.000825
Nickel (Ni)-Total	mg/L	-	0.0053	0.01	0.00862	0.01	0.00263
Phosphorus - Total	mg/L	-	0.58	0.48	0.521	0.22	0.198
Potassium (K)-Total	mg/L	-	35.7	43.60	40.0	42.30	18.6
Rubidium (Rb) - Total	mg/L	-	0.0514	0.05	0.0540	0.05	0.0187
Selenium (Se)-Total	mg/L	-	<0.00025	0.00	0.000138	0.00	<0.000050
Silicon - Total	mg/L	-	2.81	2.92	3.28	3.09	1.8
Silver (Ag)-Total	mg/L	-	<0.000050	<0.000020	0.000013	<0.000010	<0.000010
Sodium (Na)-Total	mg/L	-	79.4	93.90	82.6	89.10	36.6
Strontium - Total	mg/L	-	0.388	0.42	0.344	0.31	0.149
Sulfur - Total	mg/L	-	<2.5	3.20	2.19	1.47	1.77
Tellurium - Total	mg/L	-	<0.0010	<0.00040	<0.00020	<0.00020	<0.00020
Thallium (Tl)-Total	mg/L	-	<0.000050	<0.000020	0.000054	<0.000010	0.000016
Thorium - Total	mg/L	-	<0.00050	<0.00020	<0.00010	<0.00010	<0.00010
Tin (Sn)-Total	mg/L	-	<0.00050	<0.00020	0.0005	0.00	<0.00010
Titanium (Ti)-Total	mg/L	-	<0.0015	0.00	0.00103	<0.00090	0.00047
Tungsten (W) - Total	mg/L	-	<0.00050	<0.00020	0.00011	<0.00010	<0.00010
Uranium (U)-Total	mg/L	-	0.000066	0.00	0.000111	0.00	0.000061
Vanadium (V)-Total	mg/L	-	<0.0025	0.00	0.00303	0.00	0.00065
Zinc (Zn)-Total	mg/L	100	<0.015	0.01	0.0637	0.01	0.0100
Zirconium - Total	mg/L	-	<0.00030	<0.00012	<0.00020	<0.00020	<0.00020
Aggregate Organics							
BOD	mg/L	-			13.2	28.1	2.6
COD	mg/L	-			76	72	34

NOTES

(1) BC MoE Approved and Working Water Quality Guidelines, 2015 Edition
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(a) Range based on max pH 8.5 to min pH 6.5 at temperature of 6.0 'C
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(c) Limit for dissolved metals, not total metals
(d) Limit dependent upon hardness.

Table 22: Phytoremediation Soil Sample Results

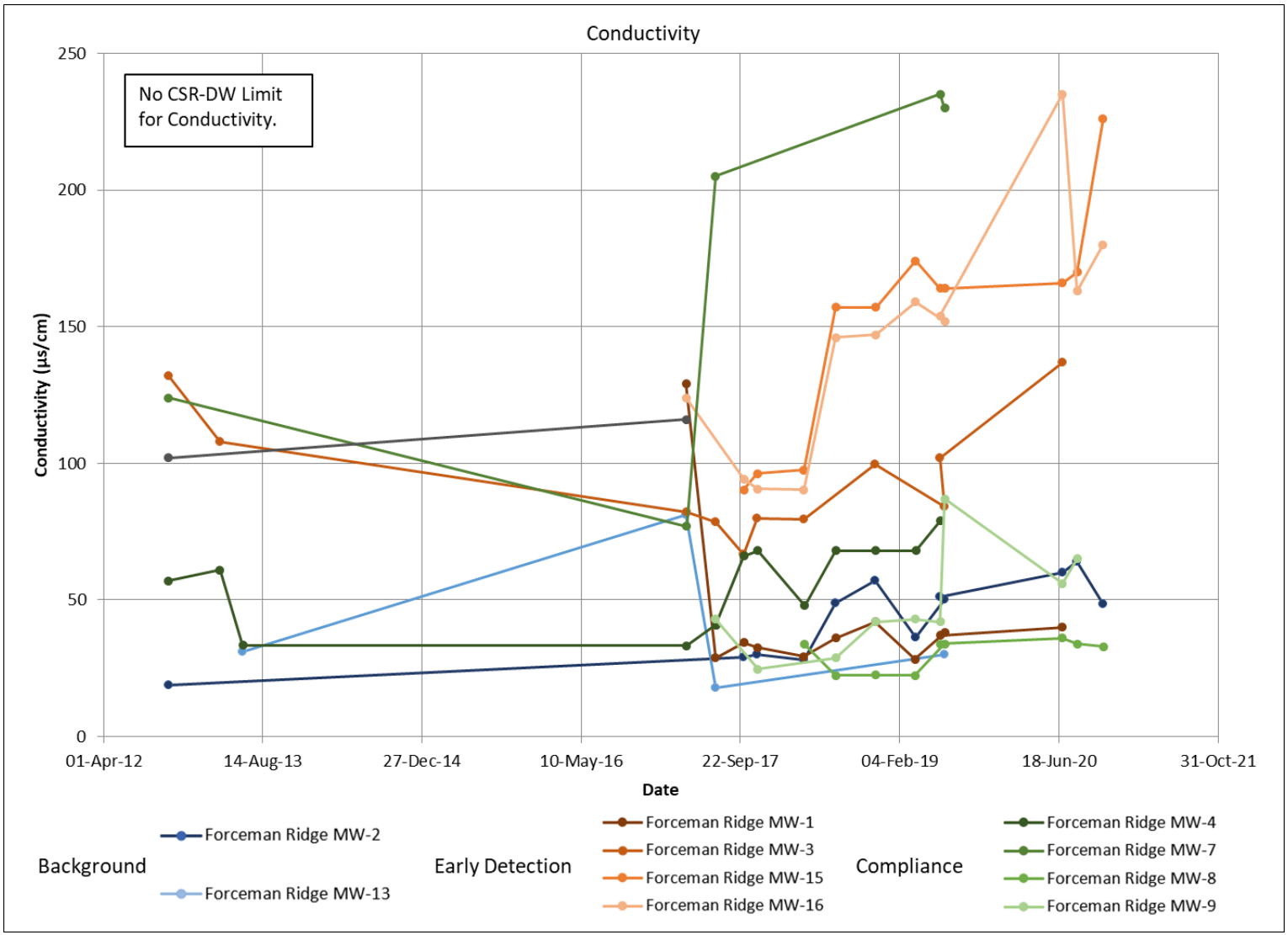
		CSR Standards	CSR Standards	22-Aug-17				25-Apr-18	22-May-19	07-May-20
Plot				Site A	Site B	Site C	Site D	-	-	2, 3, 7, 9
Physical Tests (Soil)	**Units**	**CSR-DW (1)**	**CSR-AW (2)**							
pH (1:2 soil:water)	pH	-	-	5.74	5.35	5.16	5.13	5.24	5.47	5.61
Saturated Paste Extractables (Soil)	Units									
Chloride (Cl)	mg/L			-	-	-	-	-	-	5.5
Chloride (Cl)	mg/kg	100	600	1.57	1.44	3.0	2.8	1.4	10.3	4.3
% Saturation	%	-	-	35.5	39	54.2	53.8	50.6	61.6	79.0
Sodium (Na)	mg/kg	15,000	-	<1.0	<1.0	<1.0	1.00	<1.0	5.9	<5.00
Metals (Soil)										
Aluminum (Al)	mg/kg	250,000	-	-	-	-	-	25,500	35,800	29900
Antimony (Sb)	mg/kg	40,000	40	0.50	0.40	0.41	0.41	0.37	0.36	0.38
Arsenic (As)	mg/kg	10	10	7.98	6.71	6.51	5.86	5.67	5.79	5.01
Barium (Ba)	mg/kg	350	3,500	71.9	54.6	43.8	43.7	51.1	51.4	41.3
Beryllium (Be)	mg/kg	1 - 2,500 (3)	1 - 500 (4)	0.40	0.37	0.36	0.36	0.29	0.41	0.29
Bismuth (Bi)	mg/kg	-	-	-	-	-	-	<0.20	<0.20	<0.20
Boron (B)	mg/kg	1,000,000	-	-	-	-	-	<5.0	<5.0	<5.0
Cadmium (Cd)	mg/kg	1 - 70 (5)	1 - 50 (5)	0.108	0.067	0.058	<0.050	0.067	0.055	0.057
Calcium (Ca)	mg/kg	-	-	-	-	-	-	1,620	1280	1280
Chromium (Cr)	mg/kg	60	60	33.1	29.1	29.6	27.6	27.1	30.7	27.4
Cobalt (Co)	mg/kg	25	25	14.2	11.0	9.2	7.7	8.7	8.38	6.92
Copper (Cu)	mg/kg	500	75	41.7	29.5	26.4	18.2	23.1	20.3	17.1
Iron (Fe)	mg/kg	150,000	-	-	-	-	-	34,400	39300	37600
Lead (Pb)	mg/kg	120 - 8,500 (6)	200 - 90,000 (7)	7.09	6.61	7.14	8.16	6.15	6.91	6.58
Lithium (Li)	mg/kg	450	-	-	-	-	-	13	13.5	12.1
Magnesium (Mg)	mg/kg	-	-	-	-	-	-	6,200	6220	5960
Manganese (Mn)	mg/kg	2,000	-	-	-	-	-	564	479	444
Mercury (Hg)	mg/kg	-	75	<0.050	<0.050	<0.050	<0.050	<0.050	0.056	0.0561
Molybdenum (Mo)	mg/kg	15	650	0.61	0.62	0.79	0.77	0.67	0.90	0.79
Nickel (Ni)	mg/kg	70 - 500 (8)	90 - 9,500 (7)	31.5	24.6	18.8	16.5	18.2	18.2	14.5
Phosphorus (P)	mg/kg	-	-	-	-	-	-	1,020	1140	1160
Potassium (K)	mg/kg	-	-	-	-	-	-	610	610	520
Selenium (Se)	mg/kg	1	1	<0.20	0.23	0.32	0.29	0.27	0.27	0.23
Silver (Ag)	mg/kg	35,000	40	<0.10	<0.10	0.14	0.13	0.11	0.13	0.14
Sodium (Na)	mg/kg	-	-	-	-	-	-	93	95	131
Strontium (Sr)	mg/kg	-	-	-	-	-	-	15	14.0	14.1
Sulfur (S)	mg/kg	-	-	-	-	-	-	<1000	<1000	<1000
Thallium (Tl)	mg/kg	-	25	0.065	0.066	0.066	0.076	0.063	0.072	0.062
Tin (Sn)	mg/kg	1,000,000	300	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Titanium (Ti)	mg/kg	-	-	-	-	-	-	1,090	1260	1050
Tungsten (W)	mg/kg	-	-	-	-	-	-	<0.50	<0.50	<0.50
Uranium (U)	mg/kg	30	150	0.622	0.574	0.492	0.529	0.423	0.518	0.382
Vanadium (V)	mg/kg	100	-	83.5	76.1	83.2	81.3	77.3	83.3	79.7
Zinc (Zn)	mg/kg	200 - 5,500 (7)	150 - 3,000 (7)	92.0	78.2	70.4	66.4	71.8	74.3	62.0
Zirconium (Zr)	mg/kg	-	-	-	-	-	-	10	17.5	11.9

NOTES

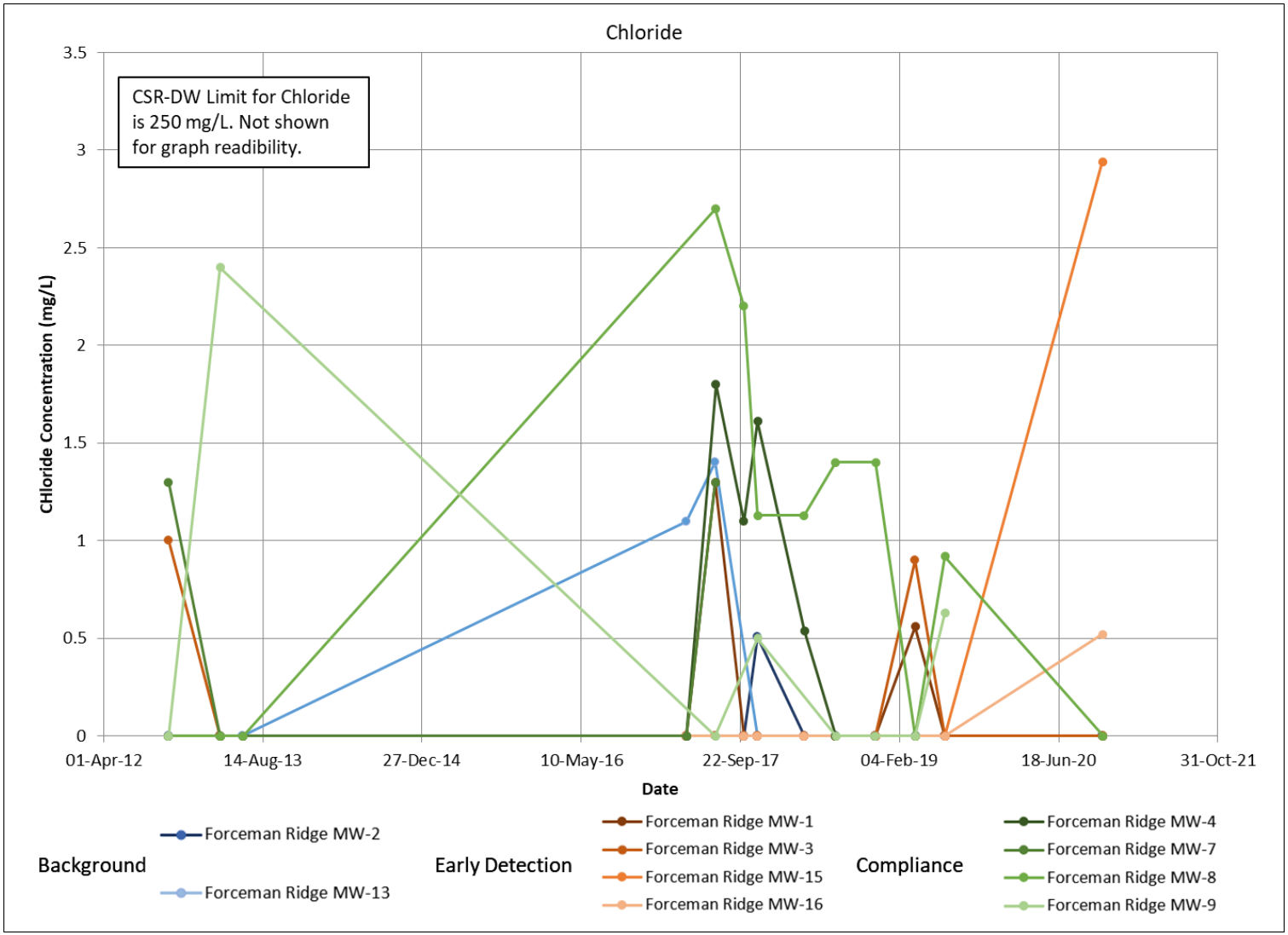
(1) BC Contaminated Sites Regulation (CSR) Soil Standards for Drinking Water, Schedule 3.1, 1997 (Amended June 2018)
(2) BC Contaminated Sites Regulation (CSR)Soil Standards for Aquatic Life, Schedule 3.1, 1997 (Amended June 2018)
(3)Limit dependent on pH. At pH less than 5.5, limit is 1 mg/kg.
(4)Limit dependent on pH. At pH less than 6.5, limit is 1 mg/kg.
(5)Limit dependent on pH. At pH less than 7, limit is 1 mg/kg.
(6)Limit dependent on pH. At pH less than 5.5, limit is 120 mg/kg.
(7Limit dependent on pH.
(8)Limit dependent on pH. At pH less than 7.5, limit is 70 mg/kg.

CSR-DW	*BC Contaminated Sites Regulation Soil Standards for Drinking Water, Schedule 3.1*
CSR-AW	*BC Contaminated Sites Regulation Soil Standards for Aquatic Life, Schedule 3.1*

Appendix C: Graphs



Sperling Hansen Associates	Regional District of Kitimat-Stikine	PROJECT: **Forceman Ridge WMF 2020 Annual Water Quality Monitoring Report**	TITLE: **Groundwater Conductivity**	SCALE: N/A; DATE: 2021/04.16 yyyy/mm/dd; PROJECT NO: PRJ20014; DESIGNED AM; DRAWN AM; CHECKED IB; DRAWING NO: **Graph 1**



Sperling Hansen Associates

Regional District of Kitimat-Stikine

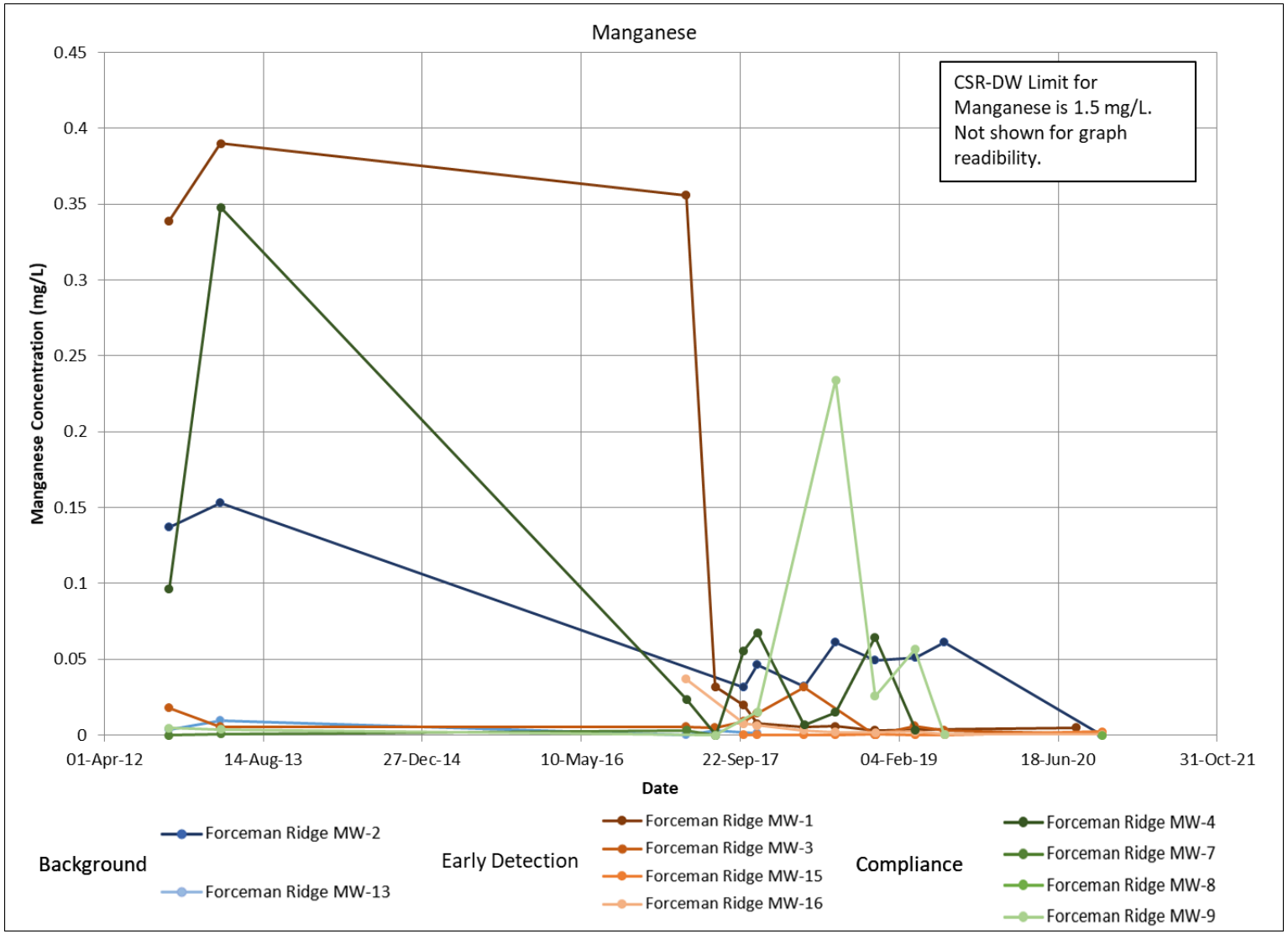
PROJECT:

Forceman Ridge WMF 2020 Annual Water Quality Monitoring Report

TITLE:

Groundwater Chloride

SCALE:	DATE:	PROJECT NO:
N/A	2021/04.16 yyyy/mm/dd	PRJ20014
DESIGNED	AM	DRAWING NO:
DRAWN	AM	**Graph 2**
CHECKED	IB	



Sperling Hansen Associates

Regional District of Kitimat-Stikine

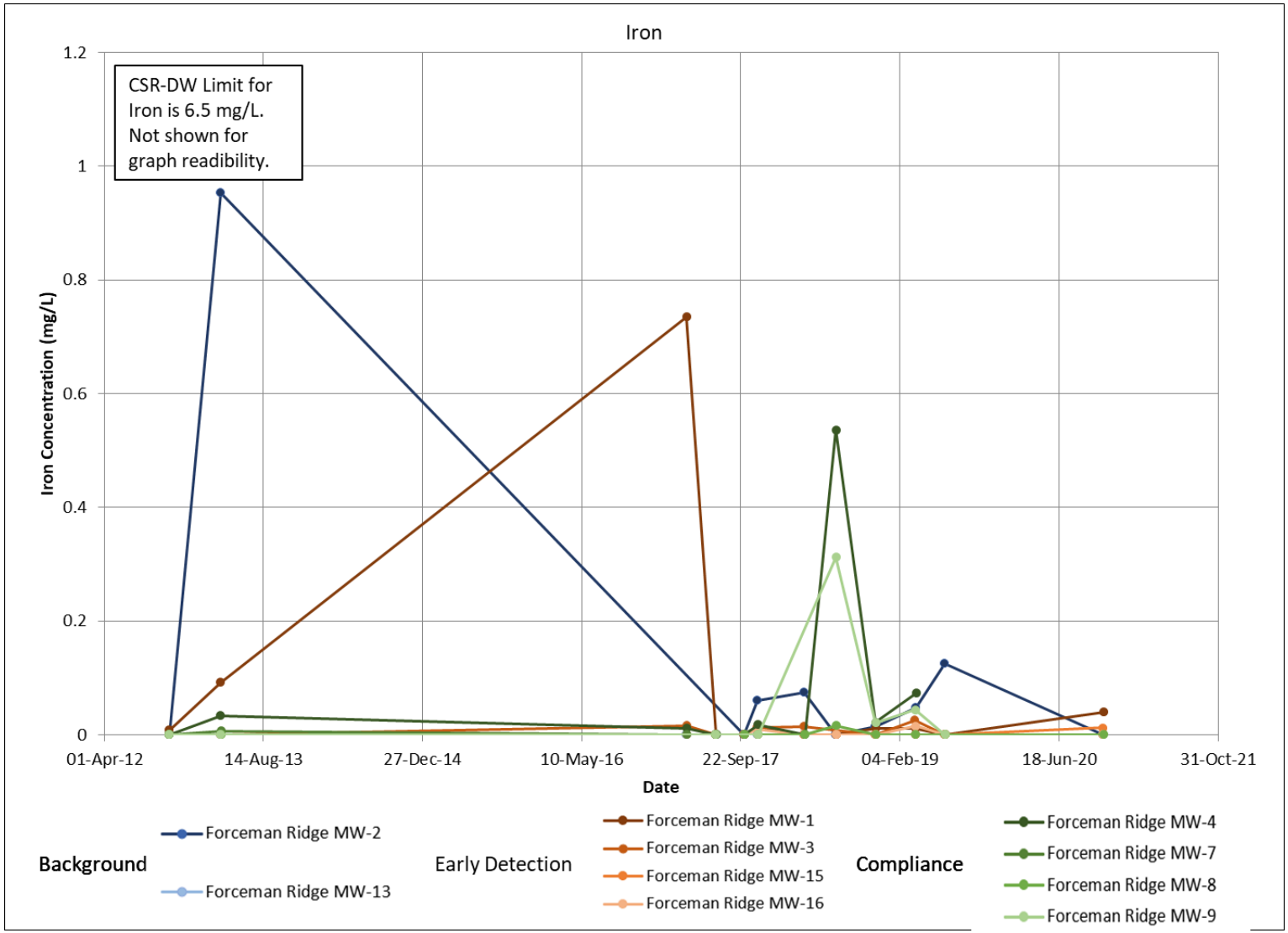
PROJECT:

Forceman Ridge WMF 2020 Annual Water Quality Monitoring Report

TITLE:

Groundwater Dissolved Manganese

SCALE:	DATE:	PROJECT NO:
N/A	2021/04.16 yyyy/mm/dd	PRJ21014
DESIGNED	AM	DRAWING NO:
DRAWN	AM	**Graph 3**
CHECKED	IB	



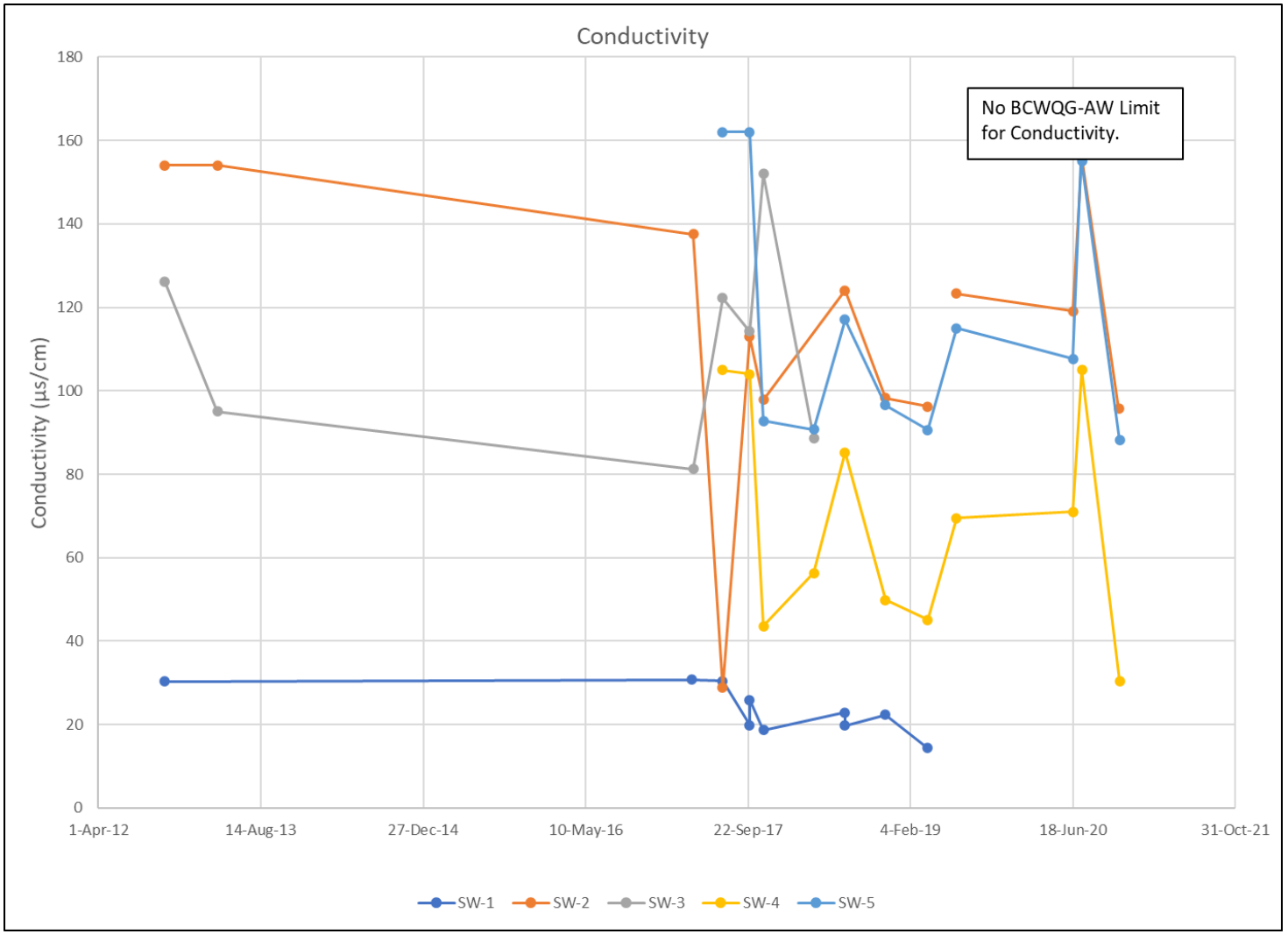
Sperling Hansen Associates

Regional District of Kitimat-Stikine

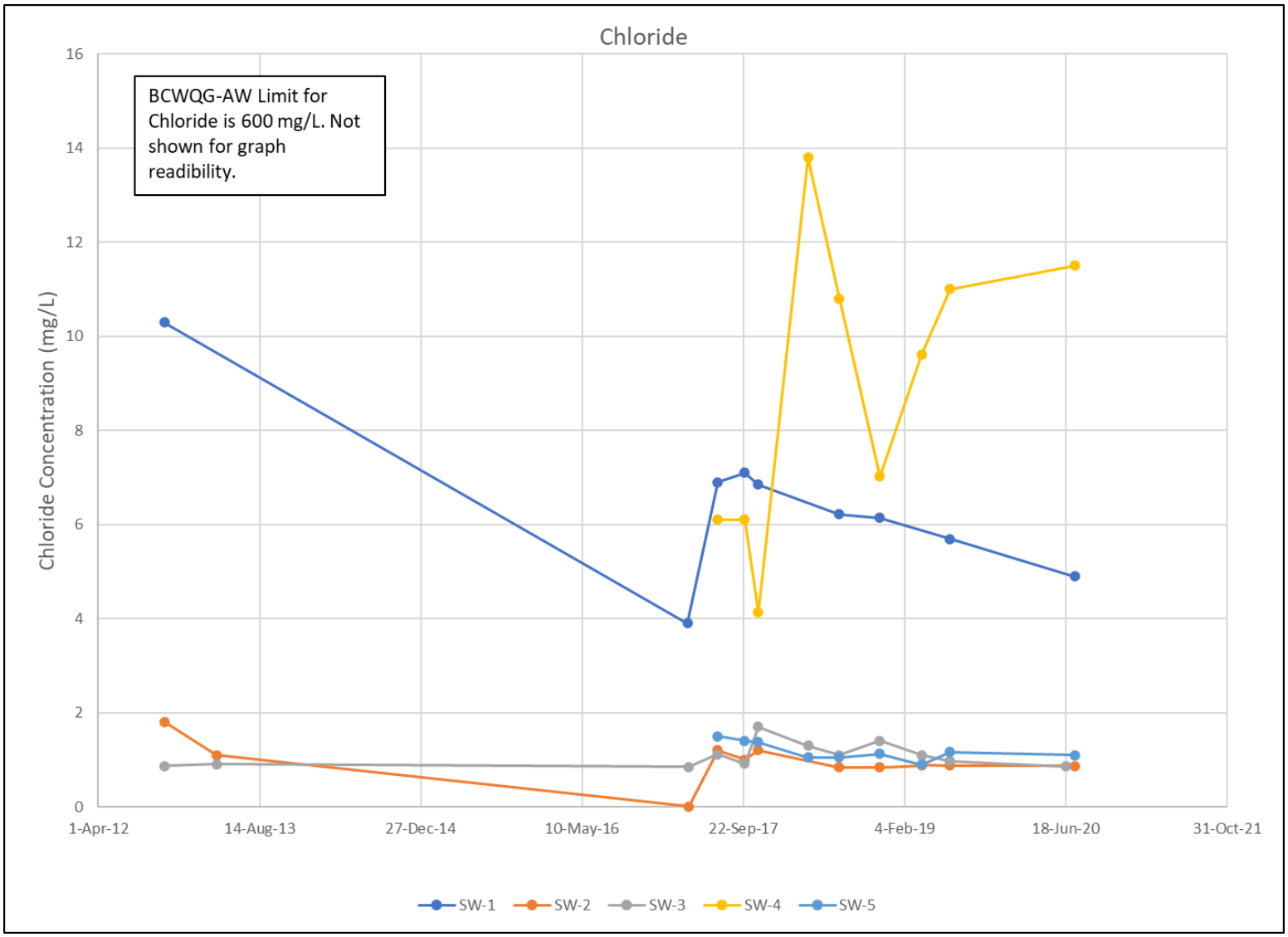
PROJECT:
Forceman Ridge WMF 2020 Annual Water Quality Monitoring Report

TITLE:
Groundwater Dissolved Iron

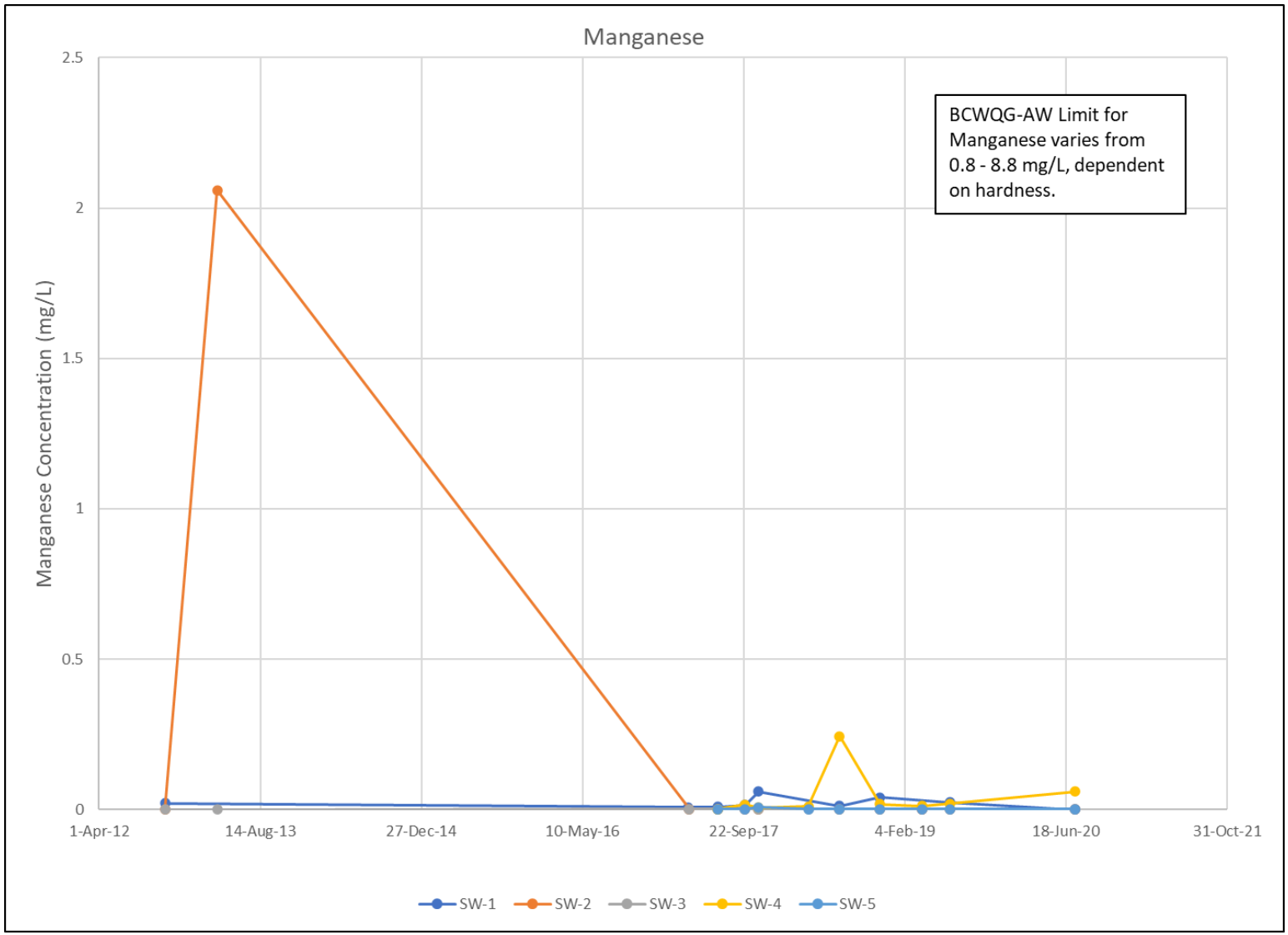
SCALE:	DATE:	PROJECT NO:
N/A	2021/04/16 yyyy/mm/dd	PRJ21014
DESIGNED	AM	DRAWING NO:
DRAWN	AM	**Graph 4**
CHECKED	IB	



Sperling Hansen Associates	Regional District of Kitimat-Stikine	PROJECT: **Forceman Ridge WMF 2020 Annual Water Quality Monitoring Report**	TITLE: **Surface Water Conductivity**	SCALE: N/A; DATE: 2021/04/16 yyyy/mm/dd; PROJECT NO: PRJ21014; DESIGNED AM; DRAWN AM; CHECKED IB; DRAWING NO: **Graph 5**



Sperling Hansen Associates	Regional District of Kitimat-Stikine	PROJECT: Forceman Ridge WMF 2020 Annual Water Quality Monitoring Report	TITLE: Surface Water Chloride	SCALE: N/A; DATE: 2021/04/16; PROJECT NO: PRJ21014; DESIGNED: AM; DRAWN: AM; CHECKED: IB; DRAWING NO: Graph 6



Sperling Hansen Associates

Regional District of Kitimat-Stikine

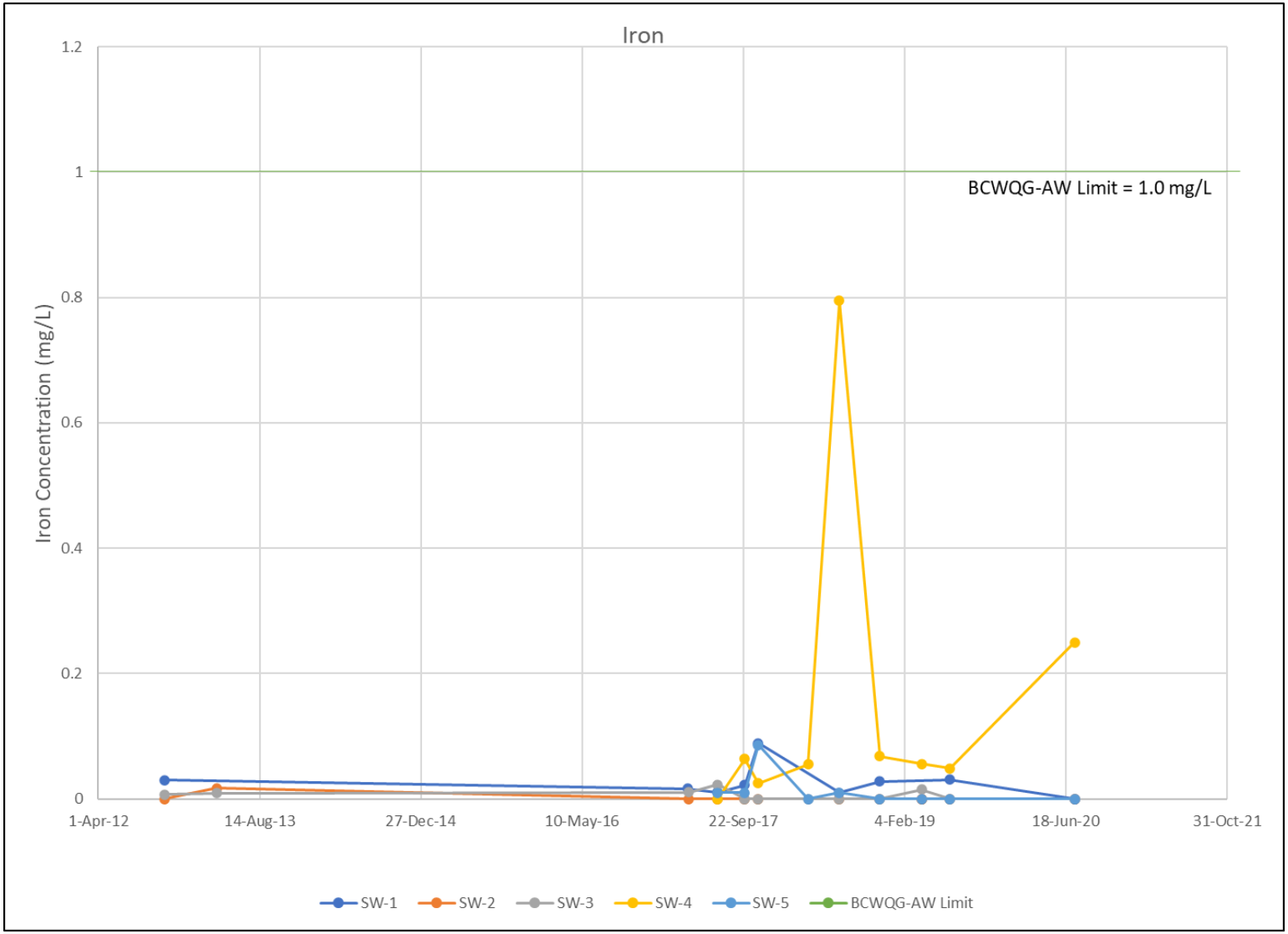
PROJECT:

Forceman Ridge WMF 2020 Annual Water Quality Monitoring Report

TITLE:

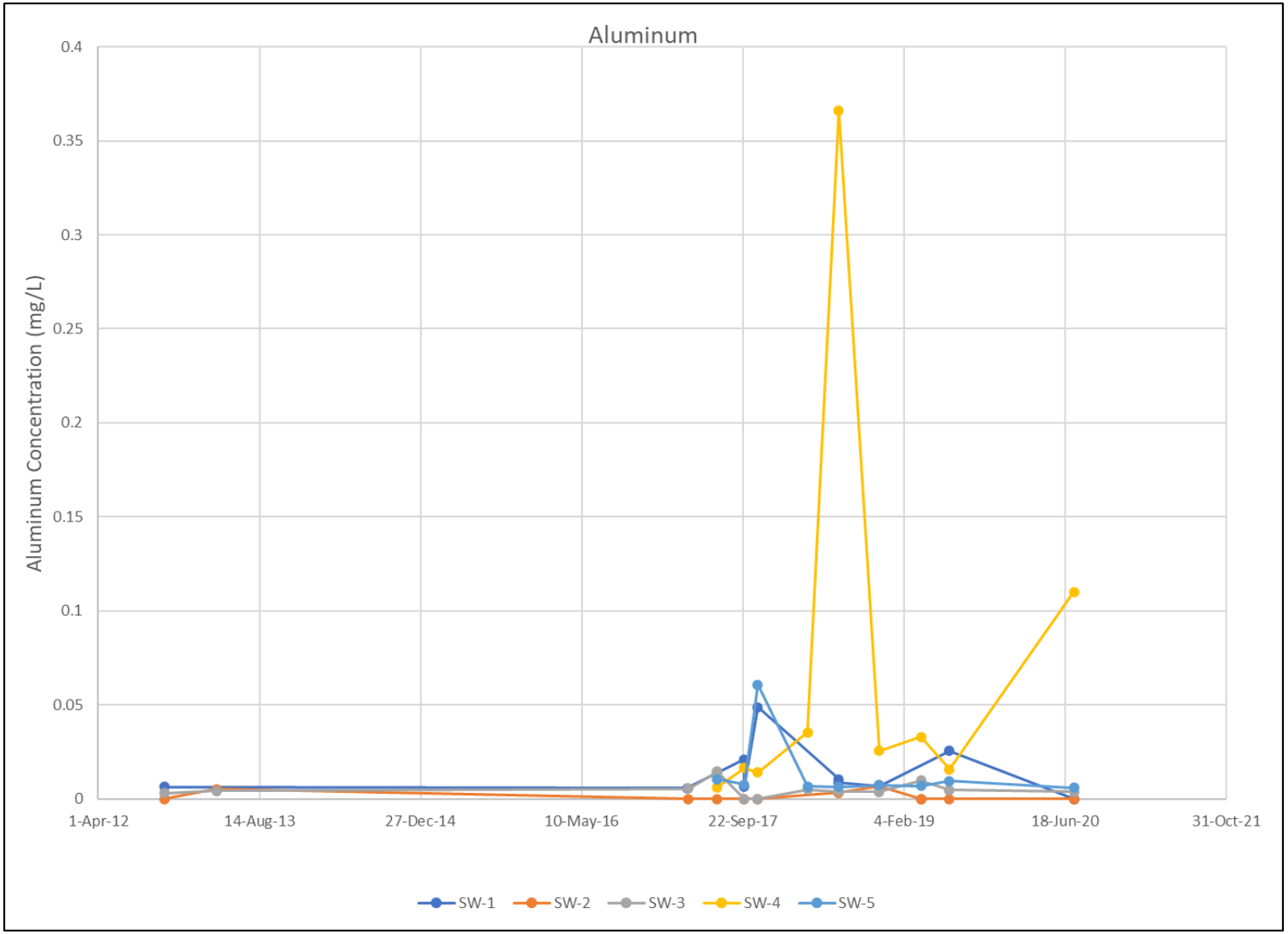
Surface Water Total Manganese

SCALE:	DATE:	PROJECT NO:
N/A	2021/04/16 yyyy/mm/dd	PRJ21014
DESIGNED	AM	DRAWING NO:
DRAWN	AM	**Graph 7**
CHECKED	IB	

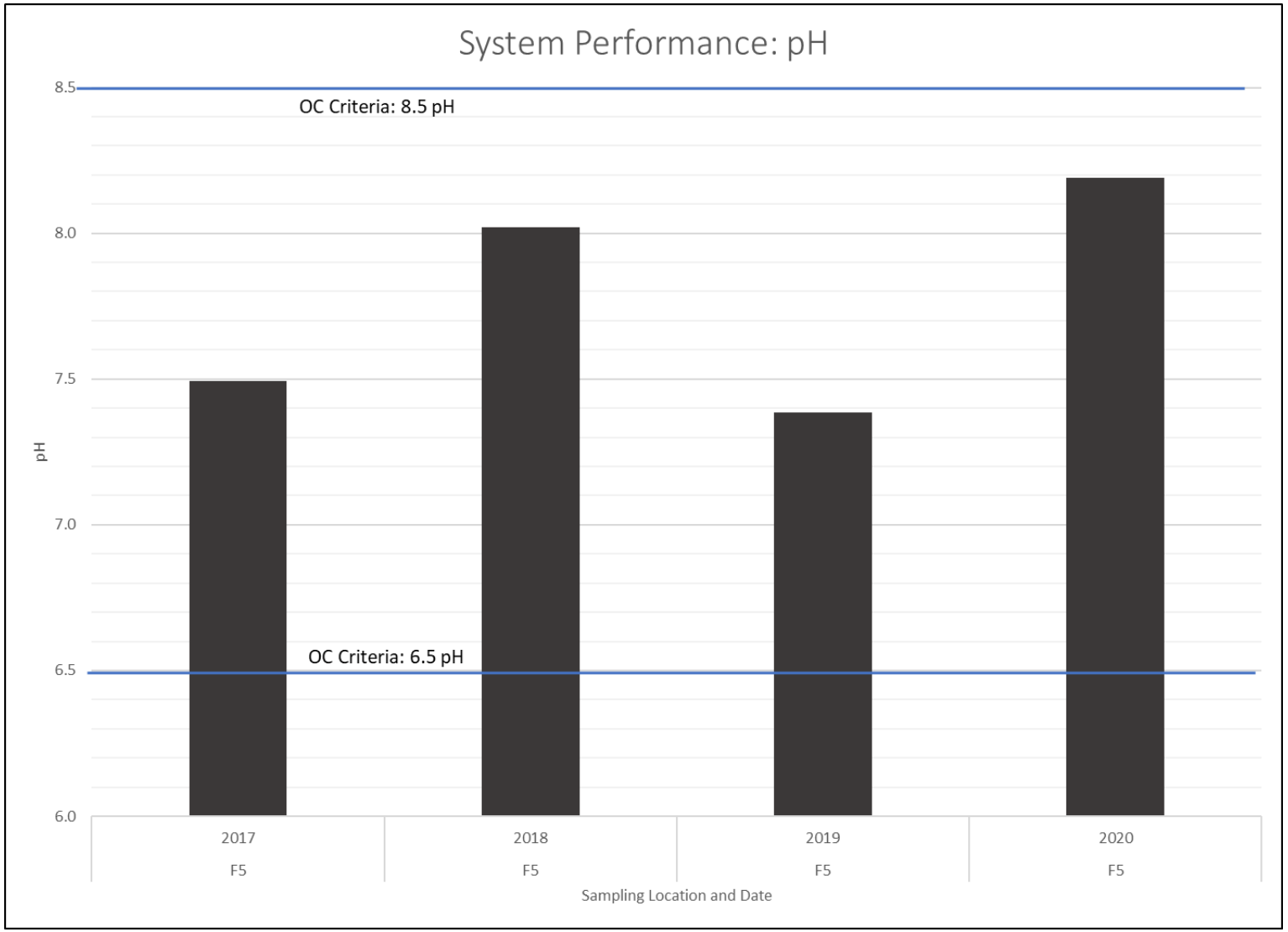


Sperling Hansen Associates	Regional District of Kitimat-Stikine	PROJECT: **Forceman Ridge WMF 2020 Annual Water Quality Monitoring Report**	TITLE: **Surface Water Total Iron**

SCALE: N/A	DATE: **2021/04/16** yyyy/mm/dd		PROJECT NO: **PRJ21014**
DESIGNED	AM	DRAWING NO: **Graph 8**	
DRAWN	AM		
CHECKED	IB		



Sperling Hansen Associates	Regional District of Kitimat-Stikine	PROJECT: Forceman Ridge WMF 2020 Annual Water Quality Monitoring Report	TITLE: Surface Water Total Aluminum	SCALE: N/A; DATE: 2021/04/16 yyyy/mm/dd; PROJECT NO: PRJ21014; DESIGNED: AM; DRAWN: AM; CHECKED: IB; DRAWING NO: Graph 9



SPERLING HANSEN ASSOCIATES

Regional District of Kitimat-Stikine

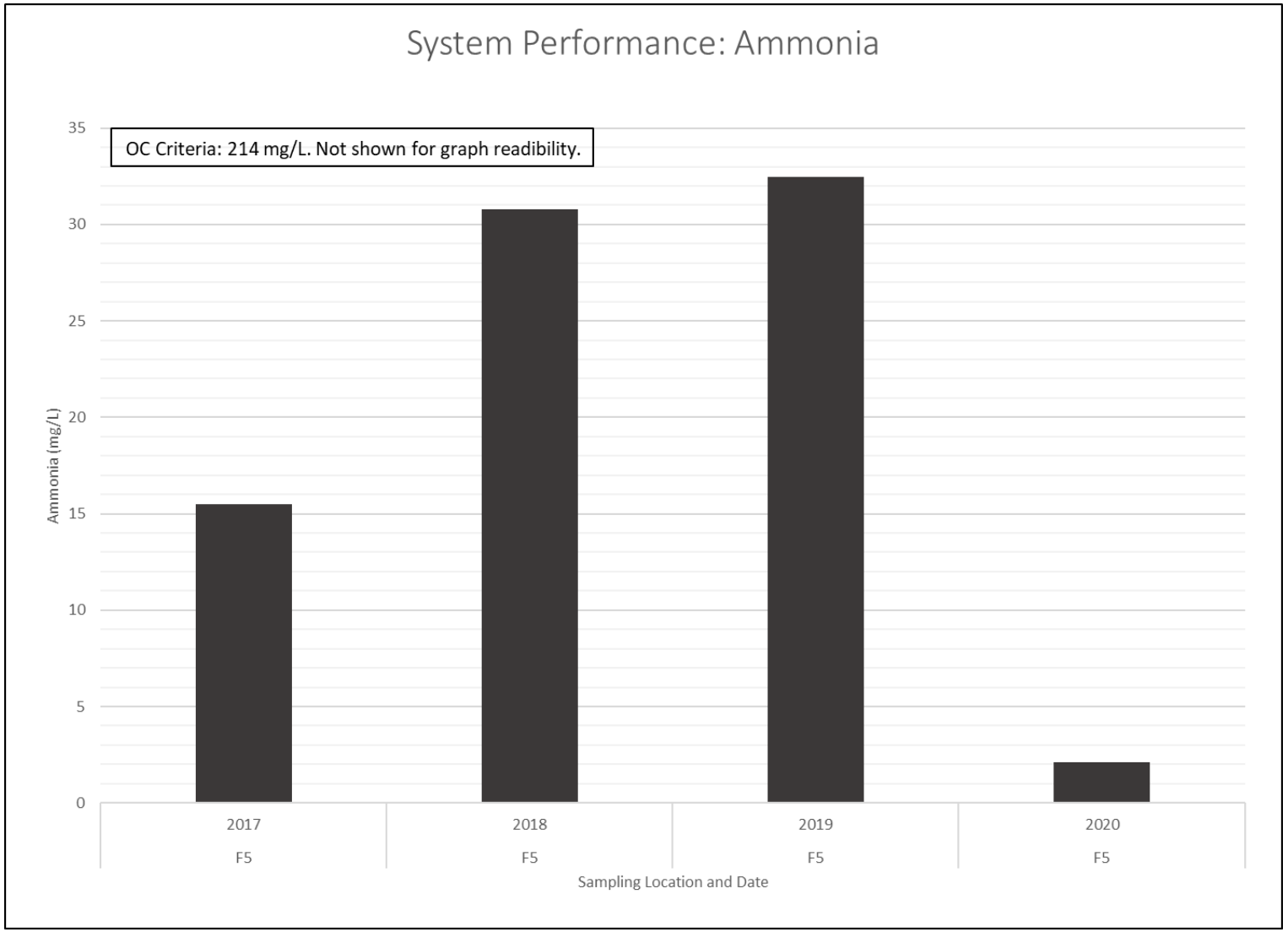
PROJECT:

Forceman Ridge WMF 2020 Annual Water Quality Monitoring Report

TITLE:

System Performance: pH

SCALE:	DATE:	PROJECT NO:
N/A	2021/04/16 yyyy/mm/dd	PRJ21014
DESIGNED	AM	DRAWING NO:
DRAWN	AM	**Graph 10**
CHECKED	IB	



SPERLING HANSEN ASSOCIATES	Regional District of Kitimat-Stikine	PROJECT: **Forceman Ridge WMF 2020 Annual Water Quality Monitoring Report**	TITLE: **System Performance: Ammonia**

SCALE: N/A	DATE: **2021/04/16** yyyy/mm/dd		PROJECT NO: **PRj21014**
DESIGNED	AM	DRAWING NO: **Graph 11**	
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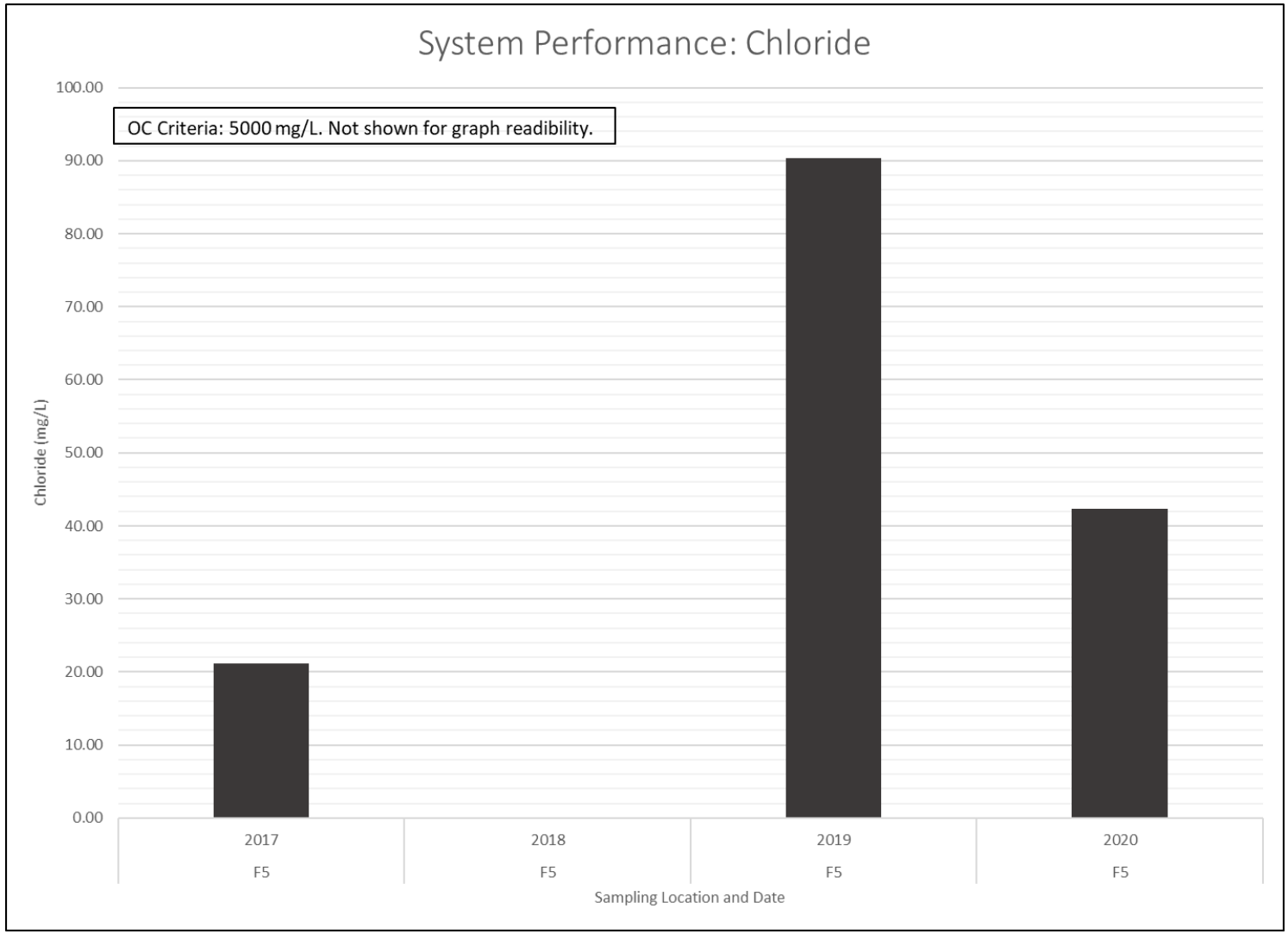
CHECKED	IB		



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SCALE: N/A	DATE: 2021/04/16 yyyy/mm/dd		PROJECT NO: PRJ21014
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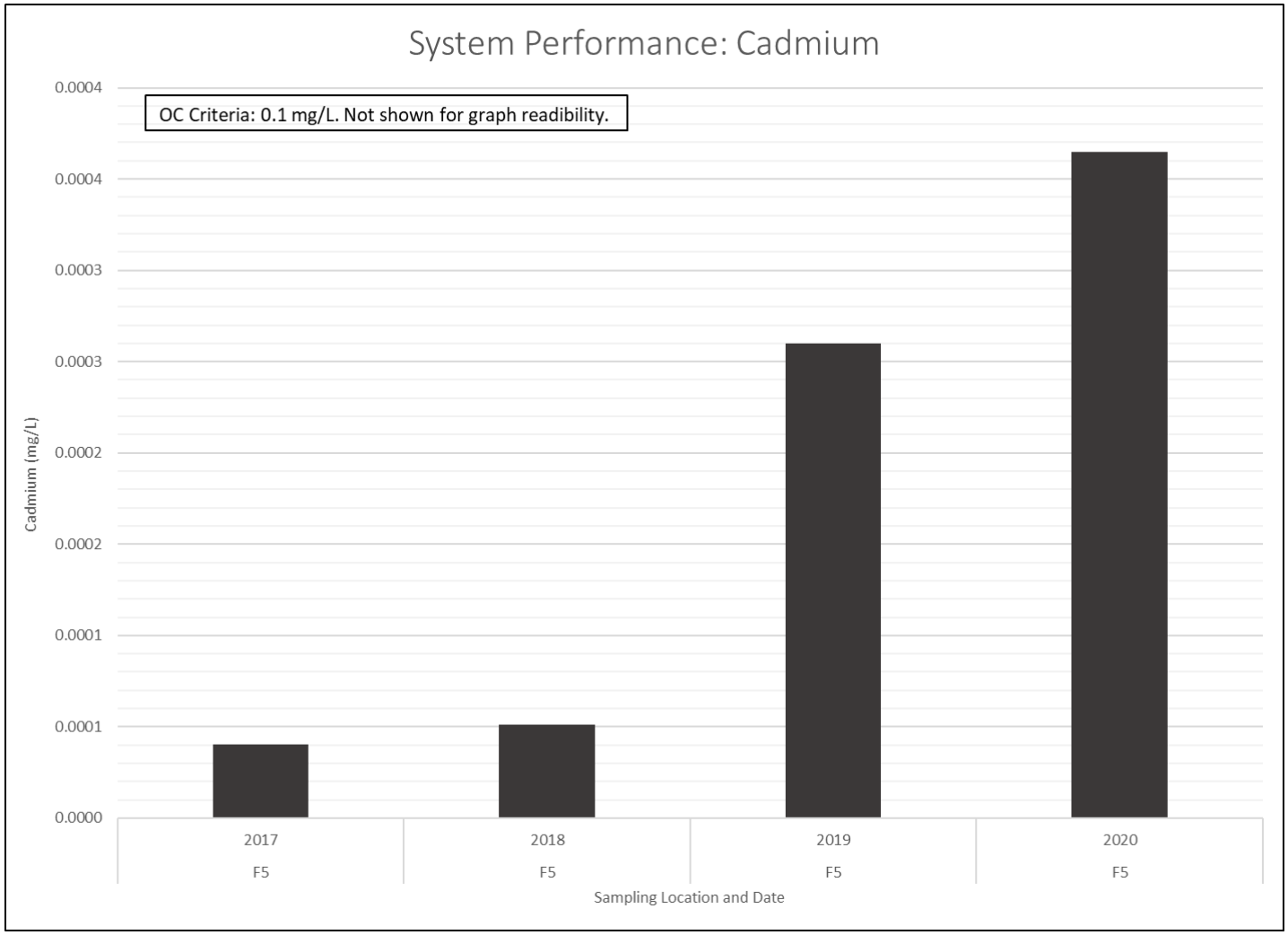

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SCALE: N/A	DATE: **2021/04/16** yyyy/mm/dd		PROJECT NO: **PRJ21014**
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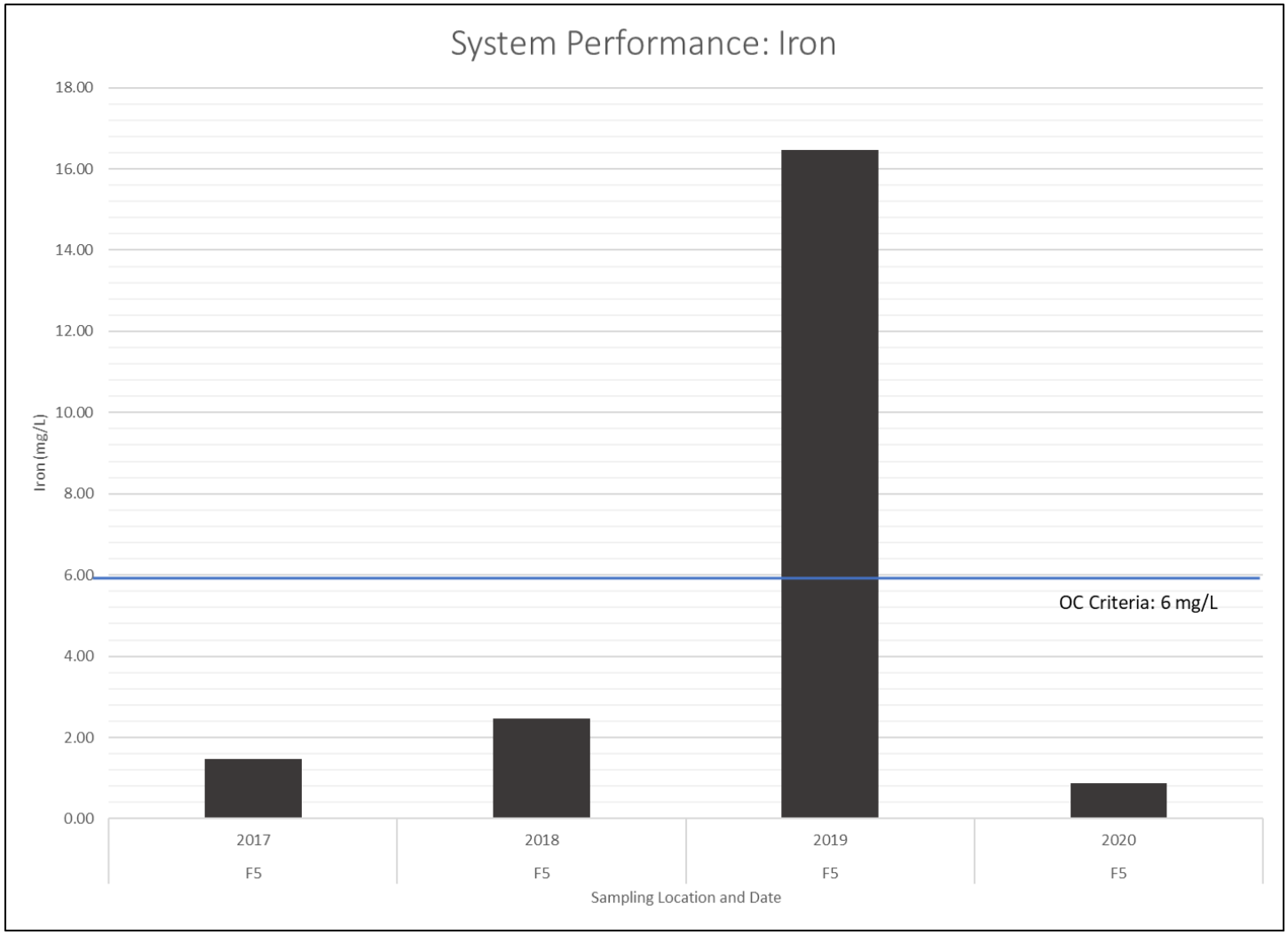

Sperling Hansen Associates

Regional District of Kitimat-Stikine

PROJECT:

Forceman Ridge WMF 2020 Annual Water Quality Monitoring Report

TITLE:

System Performance: Iron

SCALE:	DATE:	PROJECT NO:
N/A	2021/04/16 yyyy/mm/dd	PRJ21014
DESIGNED	AM	DRAWING NO:
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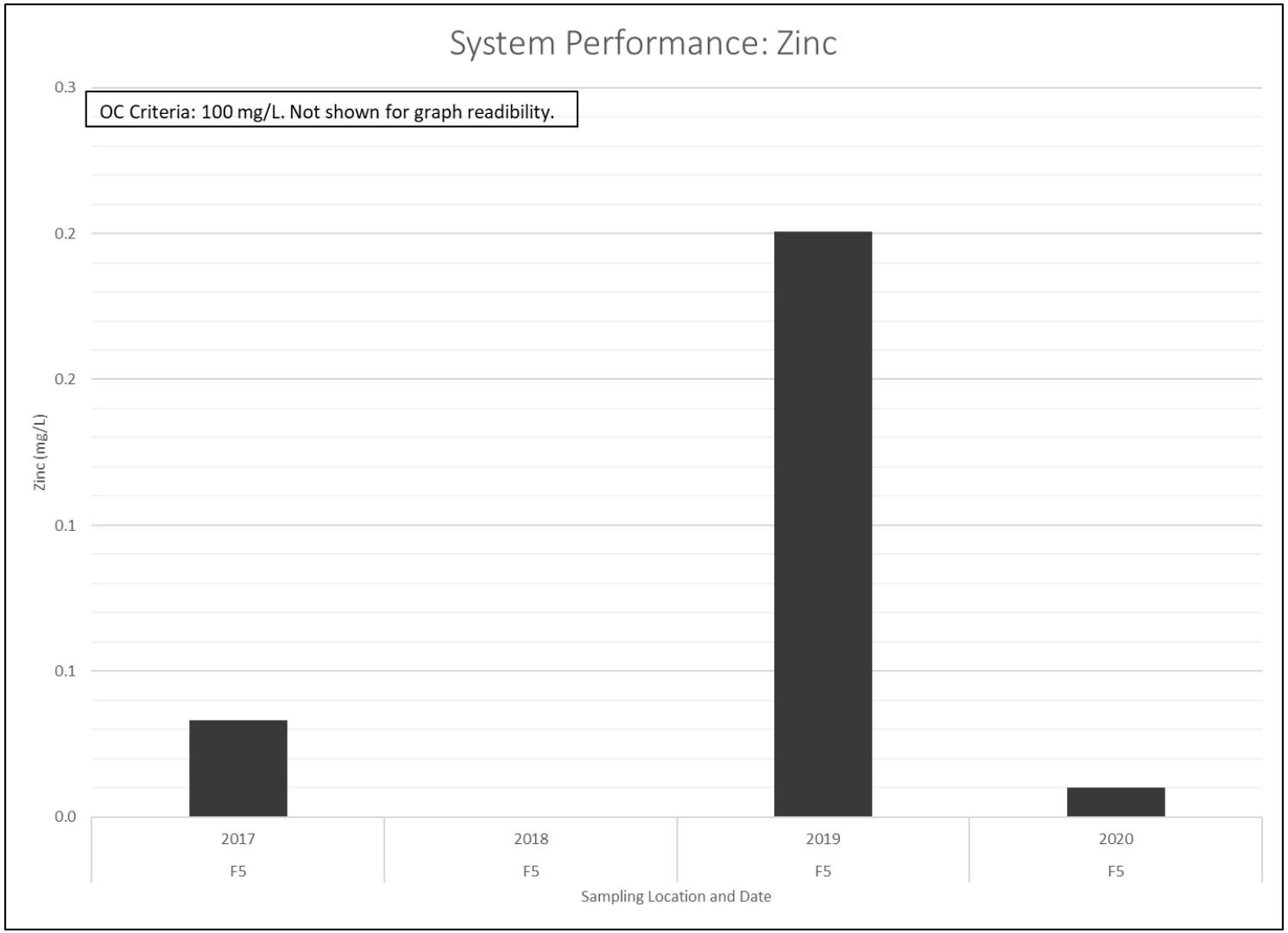
CHECKED	IB	



Sperling Hansen Associates	Regional District of Kitimat-Stikine	PROJECT: Forceman Ridge WMF 2020 Annual Water Quality Monitoring Report	TITLE: System Performance: Zinc

SCALE: N/A	DATE: 2021/04/16 yyyy/mm/dd		PROJECT NO: PRJ21014
DESIGNED	AM	DRAWING NO: Graph 15	
DRAWN	AM		
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Appendix D: Amended Operational Certificate 17227 (September 19, 2019) Temporary Amendment 17227 (November 3, 2020)

Foreman Ridge

September 19, 2019

Tracking Number: 385635
Authorization Number: 17227

REGISTERED MAIL

REGIONAL DISTRICT OF KITIMAT-STIKINE
300 4545 LAZELLE AVENUE
TERRACE, BC
V8G 4E1

Dear Operational Certificate Holder:

Enclosed is Amended Operational Certificate 17227 issued under the provisions of the *Environmental Management Act*. Your attention is respectfully directed to the terms and conditions outlined in the operational certificate. An annual fee will be determined according to the Permit Fees Regulation.

This operational certificate does not authorize entry upon, crossing over, or use for any purpose of private or Crown lands or works, unless and except as authorized by the owner of such lands or works. The responsibility for obtaining such authority rests with the operational certificate holder. It is also the responsibility of the operational certificate holder to ensure that all activities conducted under this authorization are carried out with regard to the rights of third parties, and comply with other applicable legislation that may be in force.

The Director may require the Permittee to repair, remove, or add to existing works, or to construct new works, and to submit plans and specifications for works specified in this authorization.

The Director may require the Permittee to conduct additional monitoring, and may specify procedures for monitoring, analysis, and procedures or requirements respecting the handling, treatment, transportation, discharge or storage of waste.

This decision may be appealed to the Environmental Appeal Board in accordance with Part 8 of the *Environmental Management Act*. An appeal must be delivered within 30 days from the date that notice of this decision is given. For further information, please contact the Environmental Appeal Board at (250) 387-3464.

Ministry of Environment and Climate Change Strategy
Environmental Protection Division
Suite 325 - 1011 4th Avenue
Prince George BC V2L 3H9
Authorizations - North Region
Telephone: (250) 565-6135
Facsimile: (250) 565-6629

Administration of this operational certificate will be carried out by staff from the Authorizations - North Region. Plans, data and reports pertinent to the operational certificate are to be submitted to the Regional Manager, Environmental Protection, at Ministry of Environment and Climate Change Strategy, Regional Operations, Authorizations - North Region, Suite 325 - 1011 4th Avenue, Prince George BC V2L 3H9.

Yours truly,

Karen Moores, P.Ag.
for Director, *Environmental Management Act*
Authorizations - North Region

BRITISH COLUMBIA

MINISTRY OF ENVIRONMENT AND CLIMATE CHANGE STRATEGY

OPERATIONAL CERTIFICATE

17227

for the

FORECEMAN RIDGE LANDFILL

Under the Provisions of the Environmental Management Act and in Accordance with the Regional District of Kitimat-Stikine's Solid Waste Management Plan

REGIONAL DISTRICT OF KITIMAT-STIKINE

300 4545 LAZELLE AVENUE
TERRACE, BC
V8G 4E1

is authorized to store, handle, treat and discharge municipal waste at a sanitary landfill facility located near Forceman Ridge approximately 30 km south of Terrace, British Columbia, subject to the terms and conditions listed below. Contravention of any of these conditions is a violation of the *Environmental Management Act* and may result in prosecution.

Capitalized terms referred to in this authorization are defined in the attached Glossary. Other terms used in this authorization have the same meaning as those defined in the *Environmental Management Act* and applicable regulations.

Where this authorization provides that the Director may require an action to be carried out, the Permittee must carry out the action in accordance with the requirements of the Director.

This Authorization supersedes and replaces all previous versions of Permit 17227 issued under Section 14 of the *Environmental Management Act*.

Date Issued: November 7, 2008
Date Amended: September 19, 2019
(most recent)

for Director, *Environmental Management Act*
Authorizations - North Region

Operational Certificate Number: 17227

1. LOCATION OF LANDFILL PROPERTY

The location of the property where discharges are authorized to occur is described as District Lot 8128, Range 5, Coast District.

2. AUTHORIZED DISCHARGES

2.1. Municipal Solid Waste

This section applies to the discharge of municipal solid waste to ground. The site reference number for this discharge is E249849.

2.1.1. Quantity of Discharge

The quantity of solid wastes discharged to ground shall not exceed the design capacity of the landfill facility specified as follows: (1) by an engineered final design footprint (see section 3.3); and (2) by engineered excavation and final grade contours (see section 3.4).

2.1.2. Characteristics of the Discharge

Subject to sections 6.2, 6.3 and 6.4, the characteristics of the discharge shall be typical of municipal solid waste.

2.1.3. Authorized Works

The authorized works are a separate municipal solid waste disposal area and related appurtenances located approximately as shown on the attached site plan.

2.2. Open Burning Air Contaminants

This section applies to the discharge of air contaminants to the atmosphere from the regulated open burning of selected combustibles. The site reference number for this discharge is E249850.

2.2.1. Quantity of Discharge

The maximum authorized quantity of discharge of air contaminants is indeterminate.

2.2.2. Characteristics of the Discharge

The characteristics of the discharge shall be typical of those resulting from the regulated open burning of selected combustibles as per section 11.3.

2.2.3. Authorized Works

The authorized works are a separate burn area associated with a landfill operation and related appurtenances located approximately as shown on the attached Site Plan.

2.3. Liquid Wastes

This section applies to the discharge of selected liquid wastes to the ground. The site reference number for this discharge is E249851.

2.3.1. Quantity of Discharge

The maximum authorized quantity of discharge is indeterminate.

2.3.2. Characteristics of the Discharge

The characteristics of the discharge shall be those typical of septic tank pumpage, holding tank effluent, sewage treatment plant sludges, and wash water and grit from drain sumps at car and light truck wash facilities and parking lots.

2.3.3. Authorized Works

The authorized works are liquid waste storage and treatment lagoons and related appurtenances located approximately as shown on the attached Site Plan.

2.4. Leachate

This section applies to the discharge of leachate to a phytoremediation area. The site reference number for this discharge is E249852.

2.4.1. Quantity of Discharge

The maximum authorized rate of discharge is 609 m^3/day and the average rate of discharge is 400 m^3/day. The discharge may occur 24 hours/day, 7 days/week during the months of April to October inclusive.

2.4.2. Characteristics of the Discharge

The characteristics of treated leachate shall not exceed the following limits:

Total Nitrogen	300 mg/L
Ammonia	214 mg/L
pH	6.5 to 8.5
Chloride	5000 mg/L
Total iron	6 mg/L
Total zinc	100 mg/L
Total cadmium	0.1 mg/L

2.4.3. Authorized Works

The authorized works are leachate collection and treatment facilities including an equalization basin, aeration lagoon, sedimentation pond, sand filter and hybrid poplar plantation and related appurtenances located approximately as shown on the attached Site Plan.

3. LANDFILL DESIGN

3.1. Design by Qualified Professional(s)

The landfill and associated works [including but not limited to the size(s) and location(s) of disposal area(s), maximum allowable slopes of disposal area(s), leachate management system, progressive and final closure details, etc.] shall be designed by qualified professionals [such as

engineer(s) and/or geoscientist(s)] registered in the Province of British Columbia who have expertise in the field of landfill design. Where a design feature prepared by a qualified professional is in conflict with any requirement of this operational certificate, it shall be brought to the attention of the Director who shall determine a resolution to the conflict.

3.2. Construction

The landfill and associated works shall be constructed in accordance with the design prepared by qualified professionals.

3.3. Engineered Footprint

The landfill design shall include preparation of an engineered final design footprint delineating the maximum extent of solid waste disposal allowable at the facility horizontally (in plan view). The engineered final design footprint shall be clearly shown on a scaled plan of the site and the plan shall be made available in an electronic format as a computer aided design (CAD) drawing.

3.4. Engineered Excavation and Final Grade Contours

The landfill design shall include preparation of engineered excavation grade (if below grade landfilling is to occur) and final grade contours delineating the maximum extent of solid waste disposal allowable at the facility vertically (in cross-sectional view). The engineered excavation and final grade contours shall be clearly shown on scaled drawings (accompanied with typical cross sections to aid in depicting the landfill profile) and the drawings shall be made available in an electronic format as computer aided design (CAD) drawings.

4. LANDFILL GAS MANAGEMENT

4.1. Lower Explosive Limit

The landfill shall be operated such that combustible gas concentrations do not exceed the lower explosive limit in soils at the property boundary or 25% of the lower explosive limit in any on-site or off-site structure or facility, including any services (water, sewer, electrical, etc.).

5. LEACHATE MANAGEMENT REQUIREMENTS

5.1. Leachate Containment

The operational certificate holder shall ensure that leachate is contained through the use of a barrier system. The barrier system shall consist of a minimum of 2 metres of natural, *in-situ* clay with a hydraulic conductivity of 1×10^{-6} cm/s or less. Alternatively, an engineered barrier may be used provided it is equivalent to or better than the natural clay barrier specified above. The actual specifications of the leachate containment system shall be set out in the detailed engineering design.

5.2. Leachate Collection

A continuous drainage blanket shall be established beneath all landfill phases. The drainage blanket shall consist of, or be equivalent to, a minimum 300 mm thick layer of clean gravel with an effective hydraulic conductivity exceeding 1×10^{-1} cm/s. The leachate collection system shall be designed such that the hydraulic head on top of the barrier layer does not exceed 300 mm at any time.

5.3. Protection Against Clogging

The drainage layer shall be protected against sedimentation and bio-chemical clogging. Under no circumstances shall leachate piping or leachate collectors be wrapped in geotextile.

6. GENERAL REQUIREMENTS

6.1. Site Identification

A sign shall be erected at the main entrance to the site which identifies the following: site name, owner and operator, contact phone number and address, tipping fees (if applicable) and prohibited wastes. The lettering on the sign shall be such that it is clearly readable upon approach.

6.2. Prohibited Wastes

No wastes as defined by the *Hazardous Waste Regulation* shall be received, stored or disposed of at this site except as authorized by the Director. Lead-acid batteries shall not be landfilled but may be salvaged/recycled provided they are stored, handled and shipped in compliance with the *Hazardous Waste Regulation* and with section 10 of

this operational certificate. Tires equal to or less than 43.2 centimetres (17") in rim size and auto hulks shall not be landfilled.

6.3. Waste Asbestos

Notwithstanding section 6.2 of this operational certificate, the disposal of waste asbestos under section 2.1 of this operational certificate and in compliance with the requirements of the *Hazardous Waste Regulation* is hereby authorized.

6.4. Contaminated Soil

Soil that contains contaminants in concentrations less than "hazardous waste" as defined by the *Hazardous Waste Regulation* may be disposed at the landfill site. Disposal includes monofilling, co-disposal with other wastes, use as a refuse cell berm material and use as a refuse cell cover material. Disposal must occur within a disposal area as authorized by sections 7 and 8 of this operational certificate. Disposal does not include use as final cover material.

6.5. Waste Measurement

The quantity of waste material landfilled at the site shall be measured using a weigh scale or by volume or estimated by means suitable to the Director. The results shall be submitted once per year on or before June 30 for the previous year expressed in tonnes/yr and/or m^3/yr.

6.6. Ozone Depleting Substances

Release of ozone depleting substances from the storage, handling and disposal of used refrigerator equipment, freezers, motor vehicle air conditioners and other air conditioning equipment, fire extinguishers or other equipment containing ozone depleting substances is strictly forbidden as per the requirements of the *Ozone Depleting Substances and other Halocarbons Regulation.*

6.7. Fire Prevention

The operational certificate holder shall make all reasonable efforts to prevent unauthorized fires from occurring at the landfill site. As a minimum, a fire break clear of all combustible materials at least 15 metres wide shall surround all disposal, treatment and individual storage areas

which have received or are receiving combustible materials. Disposal areas that have had 30 cm of compacted mineral soil cell cover or final cover applied are exempt. Water supply and pumping capabilities and/or soil and earth moving equipment shall be maintained at a sufficient level to extinguish fires. In addition, reasonable efforts shall include, but are not necessarily limited to, the preparation of a fire prevention and response plan.

6.8. Extinguishment of Fires

In the event of an unauthorized fire (including any smouldering fire), the operational certificate holder shall immediately make all reasonable efforts to extinguish the fire. Any fire which poses a threat to public health or to neighbouring property shall be reported to Emergency Management BC at 1-800-663-3456, the local fire authority, and/or the BC Wildfire Service at 1-800-663-5555.

6.9. Buffer Zone

No material shall be landfilled within 50 metres of the property boundary.

6.10. Litter Control

The operational certificate holder shall make all reasonable efforts to prevent litter from scattering. Any litter scattered on neighbouring property shall be cleaned up as soon as practicable.

6.11. Water Table Restriction

Wastes shall not be deposited or stored less than 1.2 metres above the highest groundwater level.

6.12. Inert Materials

Specific inert materials may be exempted from the requirements of section 6.11 by the Director. The permission of the Director must be obtained in writing prior to any disposal or handling of inert materials on an exemption basis.

6.13. Bear-Proof Containment of Putrescibles

All putrescible wastes that arrive at the landfill facility must be

immediately contained within a bear-proof bin (i.e. on-site transfer station of bear-proof design and construction) or within an area enclosed by an electric fence. Grass, leaves, weeds, branches and ground wood waste are not considered putrescible for the purposes of this operational certificate.

6.14. Electric Fencing

6.14.1. Design, Construction and Maintenance

Wherever required, electric fencing and gate systems at the landfill shall be designed, constructed, and maintained such that bears are prevented from entering into the landfill through any portion of the fence or gates at any time of the day.

6.14.2. Fence Type

Fencing may be either high tensile smooth wire or fence fabric (e.g., mesh-wire, page-wire or chain link). The configuration of a high tensile smooth wire fence shall consist of a minimum of eight strands, with four energized strands alternating with four grounded strands as follows: the bottom strand shall be a grounded or (-) strand and shall not be more than 10 cm from the ground (soil) at any location; and thence starting from the bottom strand, the other seven strands shall be spaced 15 ± 2 cm, 15 ± 2 cm, 15 ± 2 cm, 20 ± 2 cm, 20 ± 2 cm, 20 ± 2 cm, and 25 ± 2 cm. Additional strands to this minimum configuration may be used.

A fence fabric may be used instead of high tensile smooth wire. The fence fabric shall: be a minimum of 1.22 metre high; be constructed of a minimum wire thickness of 11 gauge, and have a maximum mesh size of 15 cm. The bottom of the fabric shall not be more than 10 cm from the ground (soil) at any location. Any uncharged fence fabric must have a minimum of four strands of charged wires on an outrigger system, spaced as follows: the first strand shall not be higher than 25 cm from the ground; and each of the remaining three strands shall be spaced approximately 25 cm apart from adjacent charged strands.

6.14.3. Wire Tension

For a high tensile smooth wire fence construction, all strands shall be tightened to a minimum of 125 lbs tension at 20°C. The required tension is to be corrected for temperature by use of the following

formula for 12-½ gauge high tensile steel wire:

$$Tension = 125 - 2.5(Temperature - 20)$$

where: *Tension* is in lbs force

Temperature is in °C

6.14.4. Post Spacing

Fence posts shall be spaced a maximum of 7.5 metres apart.

6.14.5. Grounding System

A grounding system shall be installed consisting of solid grounding rods (i.e., not pipe) with a minimum diameter of 16 mm (5/8 inch) that have a buried length of at least 2 metres. A minimum of three grounding rods (spaced at least 3 metres apart) shall be installed and connected to the energizer. Alternative energizer grounding systems (e.g., grounding plates, or a deep-driven grounding system) may be used provided the grounding is equivalent to or better than three grounding rods. A grounding rod (or equivalent) shall be installed at least once every 450 metres along the fence and connected to the grounded wire strands or uncharged fence fabric. Additional grounding may be required for dry sites or if other conditions affect proper grounding.

6.14.6. Period of Operation

Electric fencing shall be fully operational during the period of April 1 to October 31 inclusive each year and at any other time of year when there is bear activity in the immediate surrounding area. If snow is present during this period, any electrified strands above snow line shall be isolated from the remainder of the system and energized.

6.14.7. Minimum Voltage

Electric fencing shall be operated with a minimum voltage of 6,000 volts.

6.14.8. Gate(s)

Any access through electric fencing for vehicles, equipment and

personnel shall consist of an electrified gate system that is closed during non-operating hours. The gate system shall be electrified to a minimum voltage of 6,000 volts at all times except when being opened or closed. Any gate that is open during operating hours shall be periodically checked by the attendant for bear activity during hours of operation. Gaps between the gate and the fence and ground, and between gate panels (for a double-hung gate), shall not exceed 10 cm.

6.14.9. Fence Inspections

The entire perimeter of the electric fencing shall be inspected at least once every seven days and the voltage of the fencing measured at several points along the fencing and at each gate using a proper electric fence voltmeter matched to the brand of the fence charging unit. The results of voltage testing shall be recorded in a log book or electronic record. Any results less than the minimum 6,000 volts shall be immediately investigated for the cause of the low voltage (e.g., low battery, litter, vegetation, loose or crossed wires, broken insulators, breaks in the grounding system, etc.). Corrective actions to restore proper voltage shall be immediately undertaken.

Signs of digging or other attempts by bears to penetrate electric fencing shall be recorded in a log book or electronic record. Any penetrations through electric fencing by bears shall be immediately reported to the Conservation Officer Service at 1-877-952-7277.

In cases of low voltage or signs of penetration attempts, inspections shall be increased from once per week to once per day until proper voltage is fully restored and until there are no new signs of penetration attempts, respectively.

6.15. Municipal Solid Waste Separation

Municipal solid waste may be separated into the following streams: (1) a mixed waste stream including putrescibles for disposal; (2) a mixed waste stream not including any putrescibles for disposal; (3) an organic waste stream, including untreated wood wastes, for composting; (4) a selected waste stream for salvage and recycling; and (5) a selected combustibles waste stream for open burning or air-curtain burning. Each of these waste streams is subject to all of the general requirements contained in sections 6.1 through 6.14 above, as well as being subject to specific requirements as outlined in a separate section for each below.

6.16 Groundwater Quality

The characteristics of the groundwater at the property boundary shall not exceed drinking water standards in Schedule 6 of the Contaminated Sites Regulation. Where natural background water quality concentrations exceed the aforementioned standard, the characteristics of the groundwater at the property boundary must not exceed background concentrations.

Where monitoring shows contaminant concentrations exceed the applicable water use, or other standards, the operational certificate holder shall notify the Director and take one of the following corrective actions:

- Mitigation to meet standards or
- Based on the results of a risk assessment carried out in accordance with Contaminated Sites Regulation guidance (i.e. Technical Guidance 7), undertake the warranted mitigation measures to achieve acceptable risk.

7. OPERATIONAL REQUIREMENTS FOR DISPOSAL OF SOLID WASTES CONTAINING PUTRESCIBLES

7.1. Location

The operational certificate holder shall identify an area for disposal of putrescible refuse (herein referred to as the putrescible disposal area) that is within the authorized municipal solid waste disposal footprint (see section 2.1.1). Disposal of any solid wastes consisting of or mixed with putrescibles shall be restricted to the designated putrescible disposal area.

7.2. Nature of Wastes

Wastes disposed at the active face of the putrescible disposal area may include any municipal solid waste except liquid wastes and hot ashes or as otherwise restricted by section 6.2.

7.3. Bear-Proofing

The putrescible waste disposal area shall be maintained inside an electric fence. The electric fence shall comply with all requirements of section 6.14.

7.4. Waste Compaction

Wastes at the active face of the putrescible disposal area shall be spread in layers of 60 centimetres or less on the active face and then compacted with a minimum of three (3) passes with heavy equipment.

7.5. Maximum Lift Height

The maximum height of any lift of compacted refuse in the putrescible disposal area shall be 5 metres.

7.6. Waste Cover

Cover shall be applied to refuse in the putrescible disposal area as specified below. The operational certificate holder shall maintain a log book or electronic record with all dates of cover application.

7.6.1. Active Face Cover

Except as otherwise stated in sub-section 7.6.2, the active face of the putrescible disposal area does not normally require cover. Based on information concerning environmental or public health concerns related to exposed refuse at the active face, however, the Director may require that the active face be covered completely at a specified frequency with 0.15 m of soil (or functional equivalent) for a specified period.

7.6.2. Cell Cover

A uniform cover of 30 cm compacted soil shall be applied to all sides of the active refuse cell in the putrescible disposal area such that no more than 500 m^2 of refuse are exposed at the active face at any time and such that the volume of refuse in the cell does not exceed 5,000 m^3. Once the maximum volume of refuse has been reached in a cell, the active face shall be covered with 30 cm of compacted soil and a new refuse cell begun.

7.6.3. Final Cover

Completed portions of the putrescible disposal area shall progressively receive final cover during the active life of the landfill (see section 15.5).

7.7. Dead Animal Disposal

Dead animals and animal parts shall be disposed of in the putrescible disposal area and covered as soon as practicable with a minimum of 60 centimetres of soil and/or refuse material such that flies and scavenging animals are prevented from accessing the carrion.

8. OPERATIONAL REQUIREMENTS FOR DISPOSAL OF NON-PUTRESCIBLE SOLID WASTES

8.1. Location

The operational certificate holder may identify an area for the disposal of non-putrescible wastes (herein referred to as the non-putrescible disposal area) that is within the authorized municipal solid waste disposal footprint (see sub-section 2.1.1).

8.2. Nature of Wastes

Wastes disposed at the active face of the non-putrescible disposal area may include any municipal solid waste except putrescibles, liquid wastes and hot ashes or materials otherwise restricted by section 6.2.

8.3. Waste Compaction

Wastes at the active face of the non-putrescible disposal area shall be spread in layers of 60 centimetres or less on the active face and then compacted with a minimum of three (3) passes with heavy equipment.

8.4. Maximum Lift Height

The maximum height of any lift of compacted refuse in the non-putrescible disposal area shall be 5 metres.

8.5. Waste Cover

Cover shall be applied to refuse in the non-putrescible disposal area as specified below. The operational certificate holder shall maintain a log book or electronic record with all dates of cover application.

8.5.1. Active Face Cover

Except as otherwise stated in sub-section 8.5.2, the active face of

the non-putrescible disposal area does not normally require cover. Based on information concerning environmental or public health concerns related to exposed refuse at the active face, however, the Director may require that the active face be covered completely at a specified frequency with 0.15 m of soil (or functional equivalent) for a specified period.

8.5.2. Cell Cover

A uniform cover of 30 cm compacted soil shall be applied to all sides of the active refuse cell in the non-pustrescible disposal area such that no more than 500 m^2 of refuse are exposed at the active face at any time and such that the volume of refuse in the cell does not exceed 5,000 m^3. Once the maximum volume of refuse has been reached in a cell, the active face shall be covered with 30 cm of compacted soil and a new refuse cell begun.

8.5.3. Final Cover

Completed portions of the non-putrescible disposal area shall progressively receive final cover during the active life of the landfill (see section 15.5).

9. OPERATIONAL REQUIREMENTS FOR COMPOSTING

9.1. Location

The operational certificate holder may identify an area for composting (herein referred to as the composting area). Any composting shall be restricted to the designated composting area. This area shall be clearly identified at the landfill site.

9.2. On-Site Usage of Compost Product

Composting may be conducted passively by static pile (i.e., no aeration, etc.) provided the compost product is used on-site at the landfill for cover, reclamation or landscaping purposes. The compost piles must be rested at least one year after the last addition of organic waste prior to use.

9.3. Use of Sewage Sludge

Dewatered sludge from the liquid waste disposal lagoons authorized by

section 2.3 may be included in static compost piles provided: the sludge is first blended with carbonaceous material (e.g., sawdust and/or wood shavings); and the public is prohibited from accessing any composting area that includes sludge.

9.4. Off-site Usage of Compost Product

If compost product is to be made available to the public or otherwise used offsite, composting operations shall comply with the requirements of the *Organic Matter Recycling Regulation* and any other relevant composting legislation.

9.5. Bear-Proofing

If the composting operation is to receive any organic wastes that are potential attractants to bears, then composting shall be completely enclosed by an electric fence or contained in a bear-proof structure (building or composting vessel). The electric fence shall comply with all requirements of section 6.14.

10. OPERATIONAL REQUIREMENTS FOR STORAGE OF SELECTED WASTES FOR SALVAGE AND RECYCLING

10.1. Location

The operational certificate holder may identify an area for the storage of selected wastes for salvage and recycling (herein referred to as the salvage/recycling area). Any salvage/recycling shall be restricted to the designated salvage/recycling area.

10.2. Nature of Wastes

Wastes to be salvaged/recycled may be any items with potential salvage or recycling value but shall not include any refuse consisting of or containing putrescibles, any liquid wastes, hot ashes or materials otherwise restricted by section 6.2.

10.3. Contamination

Contamination of any of the designated salvage/recycling storage piles

with putrescible wastes shall be cleaned up immediately. Contamination of any of the storage piles with materials other than the intended salvageable/recyclable material (e.g., scrap metal with wood waste, or white goods with demolition debris, etc.) may result in a requirement to clean up the contamination or to landfill the contaminated material.

11. OPERATIONAL REQUIREMENTS FOR REGULATED OPEN BURNING

11.1. Location

The operational certificate holder may identify an area for the use of open burning to treat selected combustibles (herein referred to as the open burning area). Any open burning of selected wastes shall be restricted to the designated open burning area.

11.2. Quantity, Timing and Duration of Discharge

The maximum authorized quantity of wood residue to be open burned during each event is that which has accumulated at the time of burn initiation.

The maximum authorized duration of each burn shall be limited to the period between two hours after sunrise on the day of ignition, and sunset on the following day. Each open burn shall be completely extinguished at the end of the authorized burn duration.

Should a condition arise which prevents the burn pile(s) from being burned within this period, the Director shall be notified in accordance with this authorization.

11.3. Nature of Wastes

Acceptable materials for burning may only include dry, unpainted, untreated demolition, construction and packing-related wood residue, clean stumps and brush, but shall exclude nuisance-causing combustibles such as glue-containing wood, painted and treated wood, sawdust, yard wastes, mulch, wood chips, rubber, plastics, tars, insulation, roofing material, asphalt shingles, etc.

11.4. Favourable Weather for Smoke Dispersion

Open burning shall not proceed unless the recorded Environment Canada Ventilation Index Forecast for Terrace is good for the first day and good or fair for the second day.

The contact number for the forecast is 1-888-281-2992. Ventilation index forecasts can also be obtained after 7:00 a.m. from the following Environment Canada website:
http://www.env.gov.bc.ca/epd/epdpa/venting/venting.html

A burn registration number shall be obtained from the Ministry of Forests (1-888-797-1717) prior to ignition.

Open burning of wood residue shall not be initiated or continued if the local air flow will cause the smoke to negatively impact a nearby population or cause pollution. No burning shall occur during periods of fire hazard or when burning is prohibited by other agencies.

11.5. Fire Accelerant

An approved fire accelerant such as diesel fuel or commercial fire starter gel or a flame-thrower shall be used to ensure efficient and rapid ignition of the waste material.

11.6. Minimization of Smoke

Each burn shall be tended in a manner that ensures minimization of smoke emissions. Measures to minimize smoke shall include, but not necessarily be limited to: stacking of waste in a manner that eliminates inclusion of dirt; waiting to burn until wastes are reasonably dry after any significant precipitation event; and using adequate equipment and staff.

11.7. Extinguishment Contingency Plan

Prior to burning, a contingency plan shall be in place detailing how the open burn will be extinguished in the event of any of the following occurring:

i) Inadequate smoke dispersion in the surrounding environment;

ii) wood continues to smoulder after the authorized burn period;

iii) the Director requires that the open burn be extinguished for

environmental protection reasons

11.8. Extinguishment

All combustion shall be completely extinguished at the end of the authorized period as set out in Section 6.2.

12. OPERATIONAL REQUIREMENTS FOR DISPOSAL OF LIQUID WASTES

12.1. Location

The operational certificate holder may identify an area for the controlled disposal of selected liquid wastes (herein referred to as the liquid waste disposal area). Disposal of any liquid wastes from pumper trucks or the like shall be restricted to the designated liquid waste disposal area.

12.2. Liquid Waste Disposal Lagoons

Disposal of any liquid wastes shall be to properly designed and constructed lagoon(s) located in the liquid waste disposal area. The lagoon(s) shall function as decant lagoons (with decant discharged to an authorized liquid waste handling system such as a leachate treatment system) and/or as part of an organic matter composting system. The lagoons shall be of an impervious design that prevents the escapement of liquid to the ground. In all cases, design and construction of the liquid waste disposal lagoon(s) shall be such that seepage through the berms shall not occur.

12.3. Signage and Fencing

The liquid waste disposal area shall be fenced with chain link or steel woven-wire (e.g., page wire) a minimum of 1.2 metres high. Signs identifying the nature of the lagoon disposal area shall be erected on all sides of the fence such that the lagoons are easily identifiable from any approach.

12.4. Freeboard

A minimum freeboard of 50 centimetres shall be maintained at all times.

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The lagoon berms shall be maintained in good working order and the Director shall be notified immediately of any failure or overflow.

12.5. Nature of Wastes

The nature of wastes which may be discharged to a designated lagoon is that of typical septic tank pumpage, sewage holding tank waste, sewage treatment plant sludge, and wash water and grit from drain sumps at automobile wash facilities (intended primarily for cars and light trucks) and parking lots. Industrial liquid wastes and sludges shall be excluded.

12.6. Off-Loading Chute

An off-loading chute shall be provided to ensure that all effluent enters the lagoon and does not spill on the ground in the unloading area.

12.7. Sludge Removal

If the sludge is to be removed from a lagoon for final disposal at an active face of a designated solid waste disposal area (under section 7) or for composting (under section 9), then the lagoon must be rested for a sufficient amount of time to allow the wastes to dewater. Semi-solid sludge may be removed and stockpiled above ground for further dewatering provided: the sludge stockpile is located on impervious ground; drainage from the stockpile area is directed into the lagoon or other approved liquid waste disposal system (e.g., a leachate collection and treatment system) and provided the sludge stockpile is contained within a signed and fenced area as per section 12.3. Once the solidified sludge is deposited at an active face of a designated solid waste disposal area, it must be covered immediately with a minimum of 30 centimetres of cover material and then the area of sludge disposal compacted immediately after cover is applied.

12.8. Lagoon Closure

If a lagoon is to be closed without removal of sludge as per section 12.7, the sludge must be allowed to dewater to a moisture content that will support final cover. The lagoon must then be covered with a minimum of 1 metre of compacted soil and sloped to promote runoff.

12.9. Volume Measurement

The operational certificate holder shall maintain a log book or electronic record with quantities of sewage wastes discharged to the lagoons.

13. MONITORING REQUIREMENTS

The operational certificate holder shall carry out an environmental monitoring program as follows:

13.1 Treated Leachate/Phytoremediation Area

Location	Parameters	Frequency
E249852 Treated Leachate Prior to Discharge to Phytoremediation Area	Lab: total metals, alkalinity, chloride, fluoride, sulphate, hardness, ammonia, nitrate, nitrite, total organic carbon, orthophosphorus, COD, BOD, VOCs[1], pH and Total Kjeldahl Nitrogen	Quarterly→Annually*
	Field: conductivity, temperature, turbidity, water level, flow rate, pH and dissolved oxygen Volume	Monthly→Quarterly* Continuous during seasonal discharge
E306624 Composite Soil Sample[2] from Phytoremediation Area	Lab: metals, salinity	Annually, prior to discharge each season.

[1]One-time sample of VOCs for background levels
[2]Composite sample assembled from 4 locations from a pre-established list of 12 locations
* quarterly reduced to annually and monthly reduced to quarterly following two complete years of sampling.

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13.2 Groundwater

Location	Parameters	Frequency
Background E251531 MW-02 E287385 MW-13 Early Detection E251530 MW-01 E251532 MW-03 E251533 MW-04 E287379 MW-07 E287380 MW-08 E287381 MW-09 E302210 MW-15 E302211 MW-16	Lab: dissolved metals, alkalinity, chloride, fluoride, sulphate, hardness, ammonia, nitrate, nitrite, TOC, COD, pH, VOCs[1] and Total Kjedahl Nitrogen	Quarterly→Annually*
	Field: conductivity, temperature, water level and pH	Monthly→Quarterly*
All of the above wells and: E251534 MW-05 E251535 MW-06 E287382 MW-10 E287383 MW-11 E287384 MW-12 E287386 MW-14	Water elevation	quarterly

[1]One-time sample of VOCs for background levels
* quarterly reduced to annually and monthly reduced to quarterly following two complete years of sampling.

13.3 Surface Water

Location	Parameters	Frequency
E273828 SW-01 (Onion Lake) E273829 SW-02 (Upper Clearwater Lake at outlet) E273831 SW-03 (Lower Clearwater Lake at outlet) E306587 SW-04 (Creek	Lab: total metals, dissolved metals, chloride, fluoride, sulphate, hardness, ammonia, nitrate, nitrite, Total Kjedahl Nitrogen, pH, COD and BOD	Quarterly→Annually*

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from Onion Lake at FSR) E296117 SW-05 (Clearwater Creek at FSR)		
	Field: conductivity, temperature, turbidity, flow rate, pH and dissolved oxygen	Monthly→Quarterly*

* quarterly reduced to annually and monthly reduced to quarterly following two complete years of sampling. Once sampling on an annual basis commences, it shall occur during the season with lowest stream flows

13.4 Leachate and Water Monitoring Procedures

13.4.1 Sampling Procedures

Sampling is to be carried out in accordance with the procedures described in the most recent edition of the "British Columbia Field Sampling Manual for Continuous Monitoring and the Collection of Air, Air-Emission, Water, Wastewater, Soil, Sediment, and Biological Samples", or by suitable alternative procedures as authorized by the Director.

13.4.2 Analytical Procedures

Analyses are to be carried out in accordance with procedures described in the most recent edition of the "British Columbia Environmental Laboratory Methods Manual for the Analysis of Water, Wastewater, Sediment, Biological Materials and Discrete Ambient Air Samples" or by suitable alternative procedures as authorized by the Director.

13.4.3 Quality Assurance and Quality Control

The operational certificate holder is required to conduct the following Quality Assurance and Control Program to determine the acceptability of data required by this operational certificate and

Section 2(d) of the Environmental Data Quality Assurance Regulation:

a) Obtain and keep current, the laboratory precision, accuracy and blank quality control criteria for each laboratory analyzed parameter from the analytical laboratory(ies)

b) Collect one duplicate sample during each sampling session from one of the discharge points.

c) Each duplicate sample shall be submitted to the laboratory; one of the pair identified as the regular sample, and the other, as a blind sample identified by a fictitious site-name established solely to identify the duplicate sample.

d) For each parameter, report the results of the field duplicates in terms of the degree of variation as the relative percent difference

e) A sample collection blank shall be prepared, containing distilled water, and preservative if required, and submitted as a blank sample with one sample set per session. If any result for any parameter indicates detectable concentrations, then efforts shall be made to determine and control the source of contamination.

14. DATA ANALYSES AND REPORTING

14.1. Log Book

As required by sections 6.14.9, 7.6, 8.5, and 12.9 the operational certificate holder shall maintain a log book or electronic record. The log book or electronic record shall be made available for inspection upon request by Ministry staff or Kitselas First Nation.

14.2. Reporting

Whenever required, the operational certificate holder shall submit data, studies and reports to the Director by email or electronic transfer or as otherwise instructed.

An annual report shall be submitted to the Director and posted on the Regional District of Kitimat-Stikine website on or before June 30 each year for the previous calendar year.

The annual report shall contain at minimum:

i) The type and tonnage or volume of waste received, recycled, composted and landfilled for the year;

ii) Occurrences or observations of wildlife attempting to access the facility;

iii) The results of all required monitoring programs undertaken by the operational certificate holder for the site. Trend analysis, as well as an evaluation of any identified impacts of the discharges on the receiving environment in the previous year shall be carried out by a qualified professional.

14.3. Groundwater Model

The operational certificate holder shall have a qualified professional maintain the existing groundwater model of the landfill site and immediate downstream receiving environment using all available, relevant groundwater and surface water monitoring, stream flow, and precipitation data. Development of the groundwater model shall include a water balance assessment for the drainage area in which the landfill site is situated. The groundwater model shall define, where possible, the groundwater regime (flow directions, flow rates, groundwater divide, any evidence of a leachate plume, extent of plume, etc.) at and in the immediate surrounding area of the landfill site. Based on monitoring data and inferred groundwater flow direction from each previous year, the annual report as required in Section 14.2 shall contain a preliminary assessment of any recommended changes to the model. Based on this assessment and any other information available, the Director may require that a formal update to the model be undertaken.

15. CLOSURE REQUIREMENTS

15.1. Notification of Closure

The operational certificate holder shall notify the Director and Kitselas First Nation in writing of intentions to close the landfill site.

15.2. Closure Plan

A closure plan shall be submitted to the Director upon request. Upon

issuance of the draft closure plan, the Kitselas First Nation shall also be provided with a copy. The closure plan shall, as a minimum, include the following:

- proposed end-use of the landfill property after closure;
- anticipated total waste volume and tonnage, and life of the landfill (i.e., closure date);
- a topographic plan showing the final elevation contours of the landfill and surface water diversion and drainage controls;
- design of the final cover suited to the intended end-use of the site, including the thickness and permeability of barrier layers and drainage layers, and information on topsoil, vegetative cover and erosion prevention controls;
- procedures for notifying the public about the closure and about alternative waste disposal facilities;
- rodent and nuisance wildlife control procedures;
- a comprehensive monitoring plan, including groundwater monitoring, surface water monitoring, landfill gas monitoring, leachate monitoring, final cover monitoring, and erosion and settlement monitoring, for a minimum post-closure period of 25 years;
- a plan and accompanying design for the collection, storage and treatment/use of landfill gas for a minimum 25 year post-closure period (if required);
- a plan for operation of any required pollution abatement engineering works such as leachate collection and treatment systems, for a minimum post-closure period of 25 years; and
- an estimated cost, updated annually, to carry out closure and post-closure activities for a minimum period of 25 years.

15.3. Closure Funding

The operational certificate holder shall ensure that sufficient funds will be available to provide for all closure and post-closure requirements as outlined in the closure plan required by section 15.2, plus a reasonable contingency for any remediation which may be required.

15.4. Final Cover

The final cover system shall be designed by a qualified professional to match the intended end-use of the landfill site and to match the needs of any required environmental management systems (leachate minimization or recirculation, as the case may be, landfill gas collection and treatment,

etc.). Generally, the final cover shall consist of a layer of 1 metre of low permeability (<1 x 10^{-5} cm/s) compacted soil followed by a layer of topsoil suitable for establishment of vegetation. Use of higher permeability soil must first be approved by the Director. The final cover shall be constructed with minimum and maximum slopes as specified by a qualified professional (see section 3.4) to promote runoff and minimize erosion, with appropriate runon/runoff drainage controls, erosion controls, and gas venting controls. The site shall be seeded with a grass/legume mixture suited to the local climate.

15.5. Progressive Application of Final Cover

Completed portions of the landfill shall progressively receive final cover during the active life of the landfill. The maximum area of disposed refuse that has not yet received final cover shall not exceed 25% of the total final footprint area. Final cover is to be applied according to the specifications identified in section 15.4.

16. ENVIRONMENTAL IMPACT

Inspections of the discharge will be carried out by Environmental Protection personnel as a part of the routine operational certificate inspection procedure. Based on these inspections and any other information available to the Director on the effect of the discharge on the receiving environment, the operational certificate holder may be required to undertake additional monitoring, install additional pollution control works, or change the method of operation.

17. MAINTENANCE OF WORKS, EMERGENCY PROCEDURES AND NON-COMPLIANCE REPORTING

The operational certificate holder shall inspect the operation regularly and maintain it in good order. The operational certificate holder shall immediately notify the Director or designate as well as the Kitselas First Nation of any circumstance which prevents continuing operation in the approved manner or results in noncompliance with the requirements of this operational certificate.

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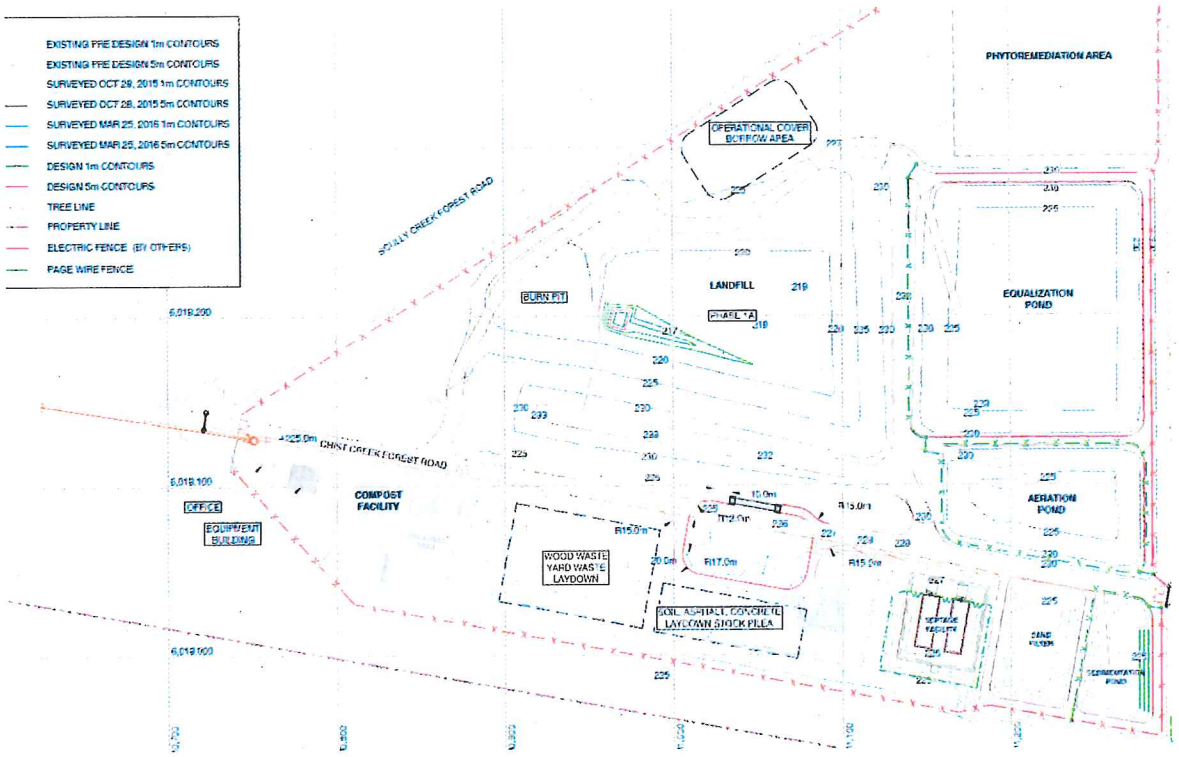
SITE PLAN



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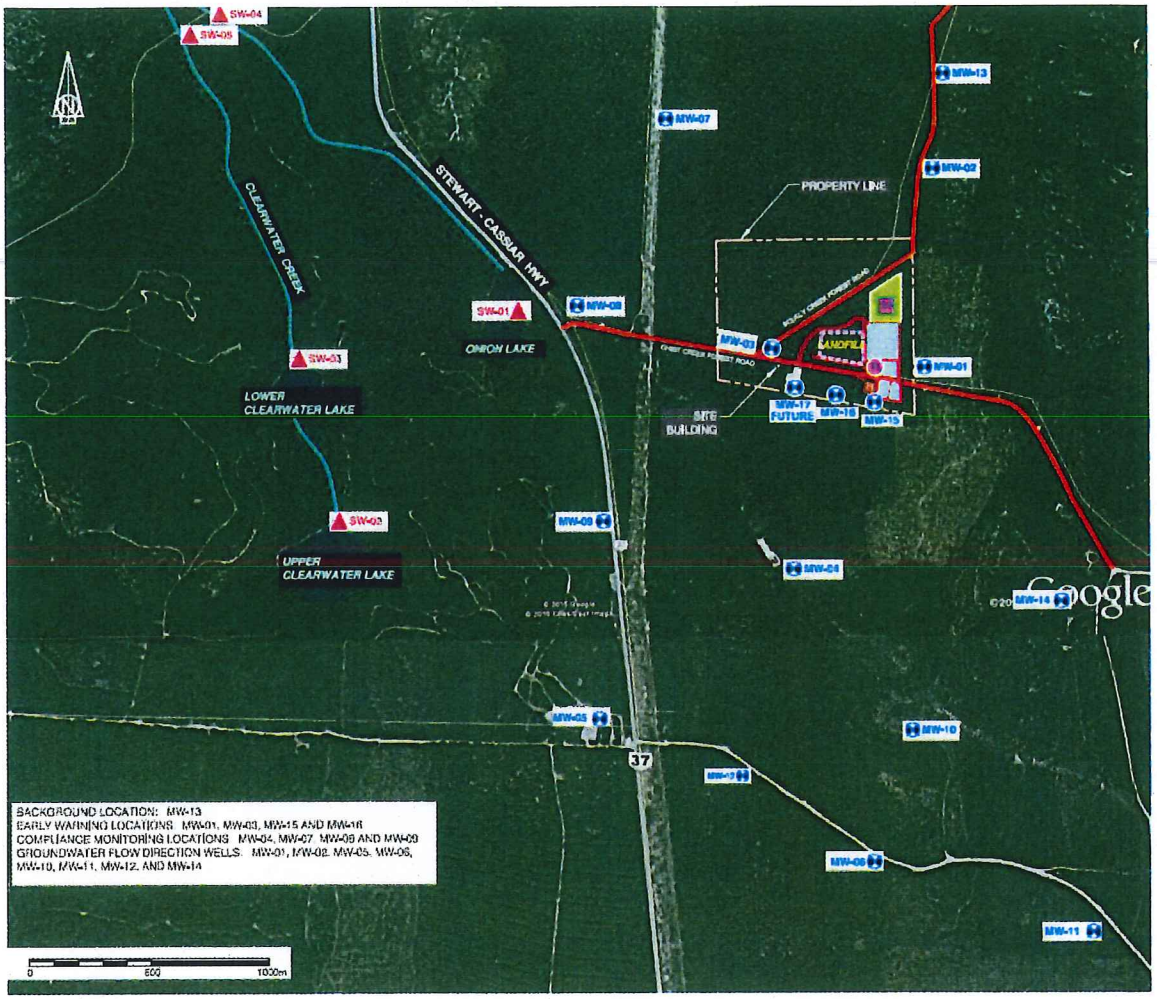
MONITORING LOCATIONS



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Appendix E: Borehole Logs

APPENDIX C

Record of Previous Monitoring Well Installations AGRA (1997) and Golder (2006)

Golder Associates

Regional District of Kitimat-Stikine	Double D Drilling	BOREHOLE NO: BH-1
Proposed Landfill Siting Investigation	Air Rotary	PROJECT NO: VE50789
Terrace, British Columbia		ELEVATION: 227.63 (m)

SAMPLE TYPE: DISTURBED | CORE BARREL RUN | SPLIT SPOON | AUGER FLYTES | AIR RETURN

DEPTH (m)	SAMPLE TYPE	SAMPLE NO	SOIL SYMBOL	Soil Description	WELL INSTALLATION	Installation Details	ELEVATION(m)
0.0				SAND, medium, some fine, with GRAVEL, some wood bits (roots?), dry-moist, greyish-brown.		Stick-up casing at surface, locked.	227.0
				SAND, medium to fine, some GRAVEL, dry to moist, greyish-brown.			
				SAND, fine with medium, some GRAVEL, dry to moist, light brown.			
5.0		1-1		SAND, medium to fine, some GRAVEL, dry to moist, greyish-brown. -moist to damp -rock at 21-22.5'			222.0
		1-2		-becomes GRAVELLY			
				SAND and GRAVEL, medium to fine sand, rounded to subangular gravel, moist, greyish-brown. -rock at 33-34'			
10.0							217.0
		1-3		SAND, medium to fine, trace GRAVEL, moist to damp, greyish-brown.		Steel casing, 6".	
15.0				-damp to wet			212.0
				SAND and GRAVEL, medium to fine, subrounded to subangular, damp, greyish-brown.			
		1-4		-dry to moist -dense, slower drilling			
20.0							207.0
		1-5		SAND, medium to fine, damp to wet, grey-green. -trace GRAVEL			
25.0				-some GRAVEL			202.0
				SAND, fine to medium, some GRAVEL, light grey, dry			
		1-6		SAND, medium to fine, trace to some GRAVEL grey-green, moist			
30.0				-damp			197.0
				-wet			
		1-7		-GRAVELLY, damp to wet			
35.0							

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LOGGED BY: GRE	COMPLETION DEPTH: 61.0 m
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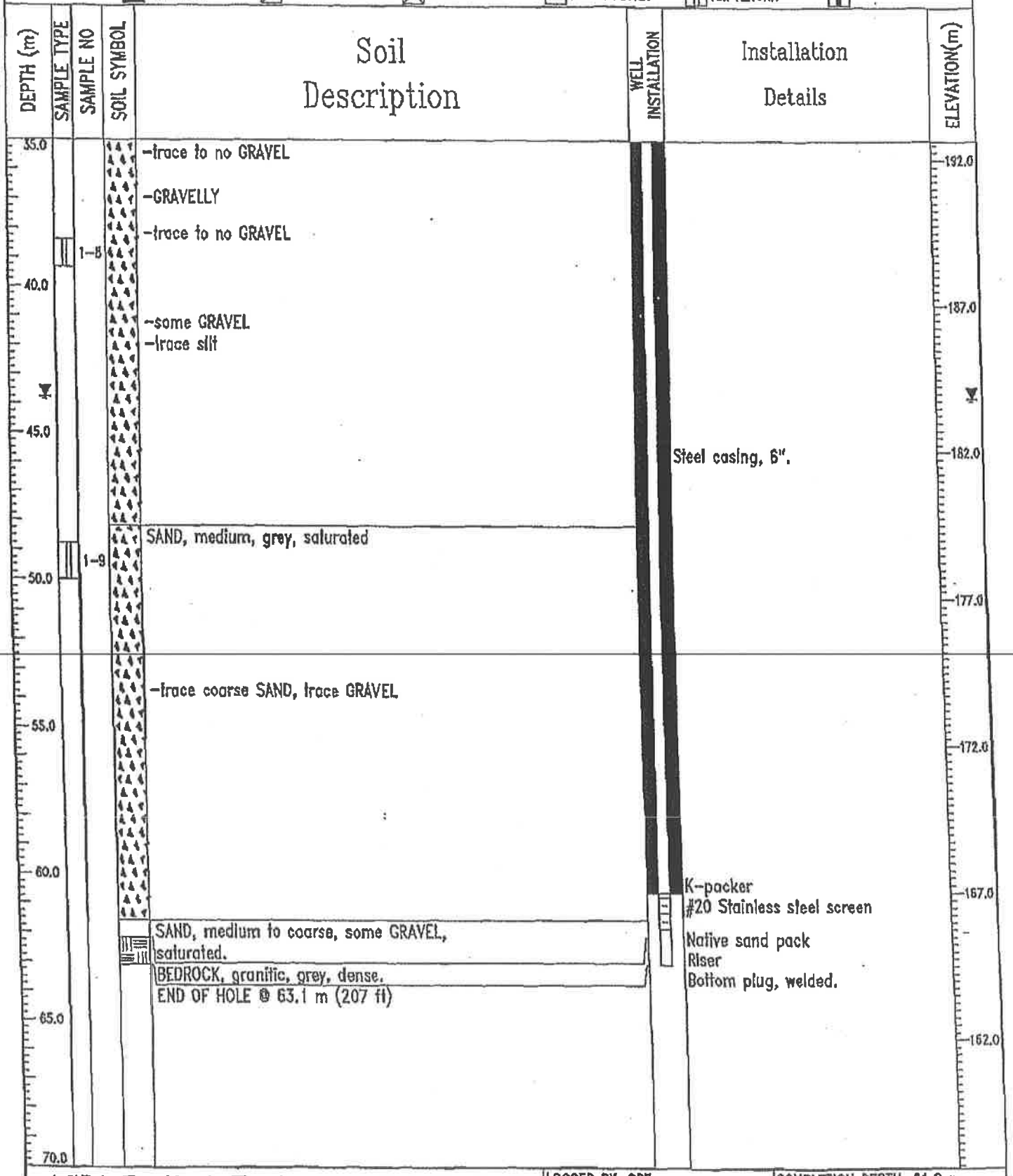
Regional District of Kitimat-Stikine	Double D Drilling	BOREHOLE NO: BH-1
Proposed Landfill Siting Investigation	Air Rotary	PROJECT NO: VE50789
Terrace, British Columbia		ELEVATION: 227.63 (m)

SAMPLE TYPE: DISTURBED | CORE BARREL RUN | SPLIT SPOON | AUGER FLYTES | AIR RETURN



AGRA Earth & Environmental Limited Burnaby, B.C.	LOGGED BY: GRE REVIEWED BY: GEB Fig. No: BH-1	COMPLETION DEPTH: 61.0 m COMPLETE: 02/12/97 Page 2 of 2

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Regional District of Kitimat-Stikine	Double D Drilling	BOREHOLE NO: BH-2
Proposed Landfill Siting Investigation	Air Rotary	PROJECT NO: VE50789
Terrace, British Columbia		ELEVATION: 231.43 (m)

SAMPLE TYPE ■ DISTURBED ☒ CORE BARREL RUN ☒ SPLIT SPOON ☰ AUGER FLYTES ▥ AIR RETURN

DEPTH (m)	SAMPLE TYPE	SAMPLE NO	SOIL SYMBOL	Soil Description	WELL INSTALLATION	Installation Details	ELEVATION (m)
0.0				GRAVEL, with SAND, angular, medium gravel, coarse to medium sand, greyish-brown, moist.		Stick-up casing at surface, locked.	231.0
		2-1		SAND, medium, some coarse, trace medium gravel, greyish-brown, moist.			
				-GRAVELLY			
5.0				-and GRAVEL, medium, angular			226.0
				-GRAVELLY, medium			
		2-2					
				-and GRAVEL, medium			
10.0							221.0
				SAND, medium, trace medium GRAVEL, grey-brown, moist to damp.			
		2-3		-some GRAVEL, medium, damp			
				-trace fine SAND			
15.0				-GRAVELLY, medium, damp		Steel casing, 6".	216.0
		2-4		SAND, medium to fine, trace to no gravel, damp			
				SAND, medium, GRAVELLY, medium, grey-brown damp.			
20.0				-grey-green			211.0
				-medium to fine gravel, rounded to subrounded			
				-SAND, medium, and GRAVEL, medium to fine			
		2-5		-GRAVEL, medium and SAND, medium			
25.0				-cobbles to coarse gravel, 76'- 82'			206.0
		2-6		SAND, medium to fine, trace GRAVEL, medium rounded to subrounded, grey-green, damp.			
				-some GRAVEL, medium to fine			
				-trace GRAVEL, fine to medium			
				-some GRAVEL			
30.0		2-7		-GRAVELLY, rounded to subrounded, medium			201.0
				-SAND, trace to no GRAVEL			
35.0							

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Fig. No: BH-2 | Page 1 of 2

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Regional District of Kitimat-Stikine	Double D Drilling	BOREHOLE NO: BH-2
Proposed Landfill Siting Investigation	Air Rotary	PROJECT NO: VE50789
Terrace, British Columbia		ELEVATION: 231.43 (m)

SAMPLE TYPE: DISTURBED | CORE BARREL RUN | SPLIT SPOON | AUGER FLYTES | AIR RETURN

DEPTH (m)	SAMPLE TYPE	SAMPLE NO	SOIL SYMBOL	Soil Description	WELL INSTALLATION	Installation Details	ELEVATION(m)
35.0							196.0
		2-8		-GRAVELLY, medium to fine, rounded to subrounded, trace SILT -no SILT -some GRAVEL			
40.0				-some to trace GRAVEL, medium, subrounded to rounded -trace GRAVEL, trace SILT			
		2-9		-fine to medium SAND -no SILT -some GRAVEL			191.0
				-GRAVELLY, damp			
		2-10		-trace SILT, some GRAVEL			
45.0				-some SILT -SILTY -some SILT, some GRAVEL -no SILT, GRAVELLY -some GRAVEL		Steel casing, 6".	186.0
		2-11		-wet to saturated, water in air return			
50.0				GRAVEL, angular and SAND, coarse, greyish brown, saturated. -medium to fine SAND, angular to subangular GRAVEL			181.0
				SAND, medium to fine, some GRAVEL, trace SILT, greyish brown, wet.			
55.0						K-packer #25 Stainless steel screen Native sand pack Bottom plug, welded.	
		2-12		-trace gravel, flowing SAND			176.0
				END OF HOLE @ 58.2 m (191 ft)			
60.0							171.0
65.0							166.0
70.0							

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REVIEWED BY: GEB	COMPLETE: 03/12/97
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Regional District of Kitimat-Stikine	Double D Drilling	BOREHOLE NO: BH-3
Proposed Landfill Siting Investigation	Air Rotary	PROJECT NO: VE50789
Terrace, British Columbia		ELEVATION: 226.68 (m)

SAMPLE TYPE: DISTURBED | CORE BARREL RUN | SPLIT SPOON | AUGER FLYTES | AIR RETURN

DEPTH (m)	SAMPLE TYPE	SAMPLE NO	SOIL SYMBOL	Soil Description	WELL INSTALLATION	Installation Details	ELEVATION (m)
0.0				SAND, coarse to medium, and GRAVEL, angular to subrounded, medium brown, moist		Stick-up casing at surface, locked.	226.0
		3-1					
5.0				SAND, medium to fine, some GRAVEL, brown, moist to damp. -GRAVELLY -cobble at 19' -medium-coarse SAND -some fine SAND			221.0
		3-2		SAND, medium to fine, some GRAVEL, brownish grey, moist -medium to coarse SAND -GRAVELLY			
10.0				SAND, medium to coarse, and GRAVEL, rounded to subrounded, medium brown, damp -trace SILT, GRAVELLY -dark brown			216.0
15.0		3-3				Steel casing, 6".	211.0
20.0				-medium SAND, trace GRAVEL -medium to coarse SAND, and GRAVEL -medium SAND, trace GRAVEL -medium to coarse SAND, and GRAVEL			206.0
25.0				-GRAVEL and SAND -SAND, medium, GRAVELLY			201.0
		3-4					
30.0				SAND, medium, trace fine, and GRAVEL, rounded, greyish brown			196.0
35.0							

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LOGGED BY: GRE	COMPLETION DEPTH: 59.7 m
REVIEWED BY: GEB	COMPLETE: 04/12/97
Fig. No: BH-3	Page 1 of 2

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Regional District of Kitimat-Stikine	Double D Drilling	BOREHOLE NO: BH-3
Proposed Landfill Siting Investigation	Air Rotary	PROJECT NO: VE50789
Terrace, British Columbia		ELEVATION: 226.68 (m)

SAMPLE TYPE: DISTURBED | CORE BARREL RUN | SPLIT SPOON | AUGER FLYTES | AIR RETURN

DEPTH (m)	SAMPLE TYPE	SAMPLE NO	SOIL SYMBOL	Soil Description	WELL INSTALLATION	Installation Details	ELEVATION (m)
35.0							191.0
		3-5					
40.0							186.0
				SAND, medium to coarse, trace GRAVEL, brownish grey, wet			
45.0				-water in air return		Steel casing, 6".	181.0
		3-6					
50.0							176.0
		3-7		GRAVEL, rounded, some coarse SAND, saturated.		K-packer	
55.0						#25 Stainless steel screen Native sand pack Bottom plug, welded.	171.0
60.0				END OF HOLE @ 59.7 m (196 ft)			166.0
65.0							161.0
70.0							

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LOGGED BY: GRE	COMPLETION DEPTH: 59.7 m
REVIEWED BY: GEB	COMPLETE: 04/12/87
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PROJECT No.: 03-1412-140 (5000)

RECORD OF BOREHOLE: MW-07

SHEET 1 OF 3

LOCATION: Terrace, B.C.

BORING DATE: August 24, 2006

DATUM:

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	CORE No.	CORE RECOVERY %	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		Ground Surface		229.93 / 0.00							Top of Casing at Elev. 230.82m
0	Double D Drilling Ltd. Barber Air Rotary	Loose, dry, grey, fine SAND and subangular GRAVEL.			1	CS					Bentonite Seal
2				227.80 / 2.13							
4		Loose GRAVEL, trace to some sand from 3.05m - 6.1m depth.			2	CS					
					3	CS					
6				223.83 / 6.10	4	CS					
		Loose, dry, grey, fine to coarse SAND and subangular to subrounded GRAVEL.									
				222.31 / 7.62	5	CS					
8											
					6	CS					
10											Slough
					7	CS					
12					8	CS					
		Loose, dry, light brown, fine to coarse SAND, some gravel. - grey-brown from 10.7m - 12.2m depth - trace fine gravel at 15.2m depth. - trace gravel at 16.8m depth. - some gravel at 18.3m depth.			9	CS					
14											
					10	CS					
16											
					11	CS					
18											
					12	CS					
20					13	CS					

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DEPTH SCALE
1 : 100

Golder Associates

LOGGED: L.W.
CHECKED: G.P.

ENVIROLOG 03-1412-140.GPJ GLDR_CAN.GDT 10/26/06

PROJECT No.: 03-1412-140 (5000)

RECORD OF BOREHOLE: MW-07

SHEET 2 OF 3

LOCATION: Terrace, B.C.

BORING DATE: August 24, 2006

DATUM:

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	CORE No.	CORE RECOVERY %	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
20	Double D Drilling Ltd. Barber Air Rotary			209.51 / 20.42							
22					14	CS					
					15	CS					
24					16	CS					
26		Loose, dry, grey, gravelly fine SAND. - fine to coarse sand at 24.4m depth. - grey-brown, fine sand, some gravel at 27.4m depth. - moist at 29.0m depth.			17	CS					
28					18	CS					
					19	CS					Slough
30					20	CS					
32				198.53 / 31.39	21	CS					
					22	CS					
34					23	CS					
36		Loose, moist, brown, fine to coarse SAND and GRAVEL.			24	CS					
38					25	CS					
					26	CS					Bentonite Seal
40		*CONTINUED NEXT PAGE*									

ENVIROLOG 03-1412-140.GPJ GLDR_CAN.GDT 10/26/06

DEPTH SCALE

1 : 100

Golder Associates

LOGGED: L.W.

CHECKED: G.P.

PROJECT No.: 03-1412-140 (5000)

RECORD OF BOREHOLE: MW-07

SHEET 3 OF 3

LOCATION: Terrace, B.C.

BORING DATE: August 24, 2006

DATUM:

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	CORE No.	CORE RECOVERY %	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
40	Double D Drilling Ltd. Barber Air Rotary	Loose, moist, brown, fine to coarse SAND and GRAVEL. *(continued)*			27	CS					Filter Sand
42				187.26 / 42.67	28	CS					Slotted PVC Pipe Sept.13/06 ▽
44					29	CS					
46		Loose, moist, brown, medium SAND, trace gravel.			30	CS					
48					31	CS					Slough
50					32	CS					
				179.64 / 50.29	33	CS					
		End of BOREHOLE.									
52											
54											
56											
58											
60											

DEPTH SCALE

1 : 100

Golder Associates

LOGGED: L.W.

CHECKED: G.P.

ENVIROLOG 03-1412-140.GPJ GLDR_CAN.GDT 10/26/06

PROJECT No.: 03-1412-140 (5000)

RECORD OF BOREHOLE: MW-08

SHEET 1 OF 2

LOCATION: Terrace, B.C.

BORING DATE: August 25, 2006

DATUM:

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	CORE No.	CORE RECOVERY %	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0	Double D Drilling Ltd. Barber Air Rotary	Ground Surface		194.62 / 0.00							Top of Casing at Elev. 195.62m
		Loose, moist, brown, medium to coarse SAND, trace subangular to subrounded gravel.			1	CS					Bentonite Seal
2					2	CS					
4					3	CS					Slough
6				188.52 / 6.10							
		Loose, moist, brown, fine SAND. - fine to medium sand at 9.1m depth.			4	CS					
8					5	CS					▽
10				183.95 / 10.67	6	CS					Bentonite Seal
											Filter Sand
12					7	CS					
					8	CS					Slotted PVC Pipe
14		Loose, moist to wet, dark grey-brown, medium SAND. - wet at 12.2m depth. - fine to medium sand at 15.2m depth.									
16					9	CS					
											Slough
18				176.33 / 18.29	10	CS					
		Loose, wet, grey-brown, fine SAND, some silt.									
20					11	CS					

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ENVIROLOG 03-1412-140.GPJ GLDR_CAN.GDT 10/26/06

DEPTH SCALE

1 : 100

Golder Associates

LOGGED: L.W.

CHECKED: G.P.

PROJECT No.: 03-1412-140 (5000)

RECORD OF BOREHOLE: MW-08

SHEET 2 OF 2

LOCATION: Terrace, B.C.

BORING DATE: August 25, 2006

DATUM:

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	CORE No.	CORE RECOVERY %	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
20	Double D Drilling Ltd. Barber Air Rotary	Loose, wet, grey-brown, fine SAND, some silt. *(continued)*		173.28 / 21.34							
22		Loose, wet, brown-grey SILT, trace clay.			12	CS					
24				170.24 / 24.38	13	CS					
26					14	CS					
28					15	CS					Slough
30		Loose, wet, dark grey-brown, silty SAND.			16	CS					
32											
34											
36				158.04 / 36.58	17	CS					
		End of BOREHOLE.									
38											
40											

ENVIROLOG 03-1412-140.GPJ GLDR_CAN.GDT 10/26/06

DEPTH SCALE

1 : 100

Golder Associates

LOGGED: L.W.

CHECKED: G.P.