Residuals Treatment Facility

2021 Report

Operational Certificate 109471

Capital Regional District | Parks & Environmental Services, Environmental Protection

Prepared by:
Capital Regional District – Parks & Environmental Services
625 Fisgard Street, Victoria, BC V8W 2S6
T: 250.360.3000 F: 250.360.3079
www.crd.bc.ca

June 2022

RESIDUALS TREATMENT FACILITY
2021 REPORT

CONTENTS

1. INTRODUCTION 1

2. SITE AND OPERATIONS OVERVIEW 1

3. BIOSOLIDS PRODUCTION AND USE 2

4. TREATMENT WORKS PERFORMANCE 2

4.1 Introduction 2
4.2 Odour Control System 2
4.3 Biogas Flare 3
4.4 Boilers 3
4.5 Thermal Oil Heater 3
4.6 Diesel Pump and Generators 4

5. ODOUR CONTROL & RESPONSE 4

6. SPILL UPDATE REPORT 4

7. CONCLUSIONS 5

8. REPORT SIGNOFF 6

TABLE

Table 1. Biosolids Production and Use 2

FIGURE

Figure 1. Daily Average Odour Treatment H_2S Discharge Data 3

APPENDICES

Appendix A – Summary of Complaints Received
Appendix B – Odour Monitoring Non-Compliance Notification
Appendix C – Spill Update Report

RESIDUALS TREATMENT FACILITY
2021 ANNUAL REPORT

1. INTRODUCTION

The Residuals Treatment Facility (RTF) is owned by the Capital Regional District (CRD) and designed, built, financed, operated and maintained by Hartland Resource Management Group (HRMG). The RTF is located 15 km northwest of Victoria, British Columbia (BC) on the northwest corner of the Hartland Landfill property. The CRD received Operational Certificate 109471 from the BC Ministry of Environment and Climate Change Strategy (ENV) on May 29, 2020. The approved operating budget for the RTF is allocated under the Core Area Liquid Waste Management Plan.

The data reported herein is required to meet provincial regulatory requirements per Operational Certificate Section 5.1 and includes:

- Quantity of Class A biosolids produced each year (in dry tonnes),
- Quantity of biosolids sent to the cement kiln each year,
- Quantity of biosolids directed to the Hartland Landfill,
- Evaluation of treatment works performance and any changes,
- Implementation schedule for any alterations to the treatment and disposal works which may impact the discharge under the Operational Certificate,
- Summary and analysis of odour data collected as required by the approved Odour Control and Response Plan,
- Summary and analysis of all complaints received, and
- Summary and analysis of all non-compliance events.

2. SITE AND OPERATIONS OVERVIEW

The RTF is located in the District of Saanich, within the Tod Creek watershed, in the bedrock highlands of the Gowland Range, northwest of Victoria, and Mount Work Regional Park lies to the west and south of the RTF. Willis Point Road borders the site to the north, and beyond that is a Department of National Defence rifle range. Private residential properties are located to the east and southeast of the RTF.

The RTF is a component of the recently constructed Core Area Wastewater Treatment Project and serves the population of the Core Area municipalities (Victoria, Esquimalt, Saanich, Oak Bay, View Royal, Langford and Colwood, as well as the Esquimalt and Songhees First Nations) totaling approximately 334,000 people. The RTF receives Core Area residual solids, produced at the McLoughlin Point Wastewater Treatment Plant via the residual solids conveyance line. Residual solids are treated at the RTF through mesophilic anaerobic digestion, thickening, dewatering and thermal drying to produce pelletized Class A biosolids, as defined by the *BC Organic Matter Recycling Regulation*, with a moisture content of around 5-7%.

Construction of the RTF was completed in September 2020, and the plant achieved operational Project Service Commencement in March of 2021. Under normal RTF operations, and in accordance with the CRD's approved Short-Term Biosolids Management Plan (Definitive Plan), the CRD transports biosolids to Lafarge Canada Inc.'s Richmond Cement Plant to be used as an alternative fuel in their cement kiln. During planned cement-kiln maintenance periods, and in accordance with the CRD's approved Short-Term Contingency Plan, the dried Class A biosolids will be beneficially reused at Hartland as either biosolids growing medium, or biocover. The long-term use of the CRD's biosolids is to be determined by July 2024.

3. BIOSOLIDS PRODUCTION AND USE

Table 1. Biosolids Production and Use

Biosolids Type	Produced		End Use		
			Definitive Plan [b]	Contingency Plan: BGM [c]	Hartland Landfill [d]
Dried [a] Class A	Dry Tonnes	2,109	599	133	1,377
	Wet Tonnes (~5% moisture)	2,220	631	140	1,449
Non-Class A	Dry Tonnes	1,260			1,260
	Wet Tonnes (~75% moisture)	5,041			5,041

Notes:
[a] Greater than 90% solids
[b] Used as an alternative fuel at the Lafarge cement manufacturing facility in Richmond, BC
[c] Land applied within the leachate containment area of Hartland Landfill
[d] Class A Biosolids are placed within leachate containment areas as a layer of interim cover maximizing potential for fugitive gas mitigation, and Non-Class A Biosolids are landfilled as a controlled waste

As tabled above, 5,041 wet tonnes, at ~75% moisture, of Non-Class A dewatered sludge, was sent to Hartland Landfill during 2021. This was required as a result of a digester upset occurring in the second quarter, and also as a result of intermittent technical issues with the dryer system.

4. TREATMENT WORKS PERFORMANCE

4.1 Introduction

The facility commenced commissioning on September 18, 2020 and commissioning continued to the end of the 2020 reporting period. Commissioning was conducted in accordance with the ENV approved *"Hartland Resource Management Group: Start-up and Commissioning Plan"* to which there were no unapproved changes. In 2021, ENV was notified of service commencement and there were no alterations made to the RTF that impacted authorized discharge controls during this reporting period.

All equipment outlined in the Operational Certificate was installed according to design and manufacturers' specifications and also registered with Technical Safety BC. Equipment commissioning activities were focused on optimizing the performance of the odour control system and demonstrating functional completion for all other equipment outlined in the Operational Certificate. Based on the completed commissioning and successful operation and maintenance of all equipment (excluding the odour control system), the facility operated within the authorized discharge limits designated in the Operational Certificate.

4.2 Odour Control System

The odour treatment stack (19 m height and 900 mm diameter exhaust cone), exhausts treated air from the odour control works. These works consist of an impingement pre-filter (AMACS mesh mist eliminator), tri bio-trickling filters (Evoqua model BTF-1236), and a three-stage chemical scrubber (Evoqua model LP-7000-HN). The average daily odour treatment stack discharge rate was in compliance with the authorized discharge limit of 660 m^3/min.

Figure 1 displays the daily average stack hydrogen sulfide (H_2S) values for the reporting period. During the reporting period, there were no days when the RTF was operating outside the Operational Certificate H_2S limit of 2 mg/s.

A non-compliance was reported to ENV on October 19, 2021. A copy of this non-compliance notification can be found in Appendix B. On October 15, 2021, during routine calibration, staff identified a failure of the odour control discharge stack H_2S analyzer (Analyzer 18-AIT-405) that required factory repair/calibration. During the repair period, RTF staff implemented twice daily perimeter site patrols to monitor for offsite

migration of odours. No odours were detected offsite and no odour complaints were received during this period. A replacement analyzer was installed on October 28th.

Additionally, two impingement pre-filters (AMACS mesh mist eliminator) installed in parallel (duty/standby) ensure particulate matter from the treatment stack is below the designated limits outlined in the Operational Certificate. The filter is replaced and cleaned as required and pressure differential is monitored to ensure successful performance.

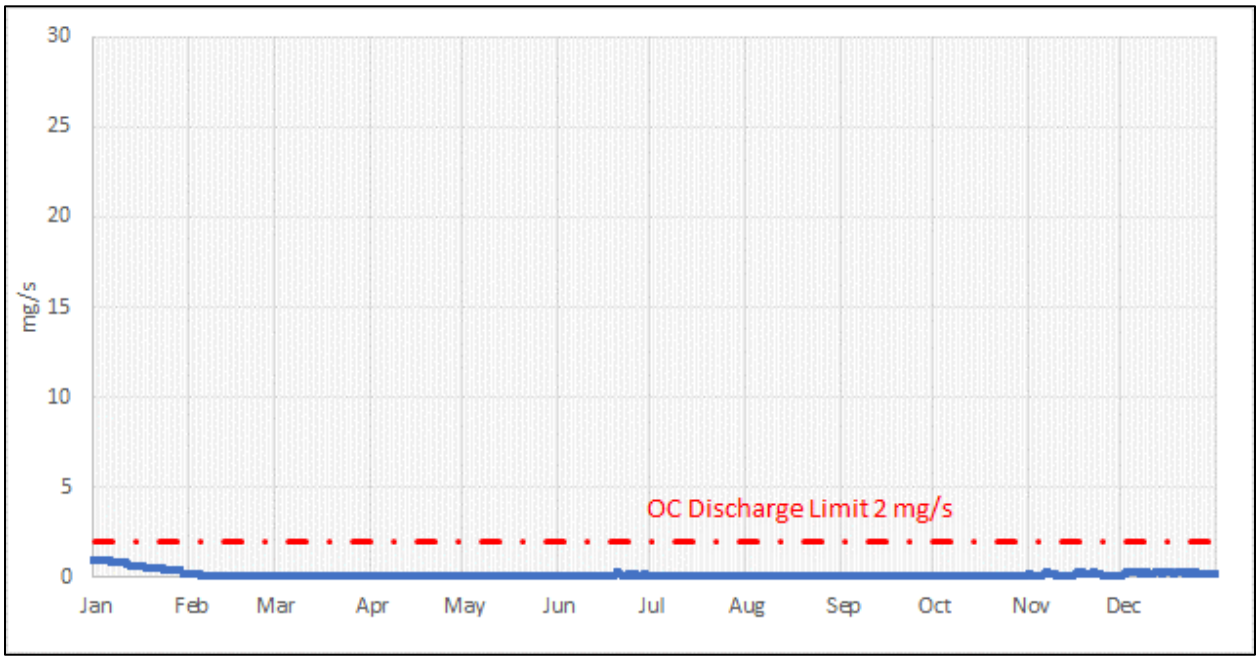


Figure 1. Daily Average Odour Treatment H_2S Discharge Data

4.3 Biogas Flare

Biogas is harvested from the digesters and digested solids storage tank. From there, it is either pressurized by the blower or flared off. The Varec 244E series enclosed waste gas burner system was installed according to design and manufacturer specifications. The flare was commissioned in September 2020, began flaring biogas on December 16, 2020, and operated successfully throughout 2021. In 2021, an estimated 2,255,143 m^3 of biogas was flared. However, due to condensate interference, the flow meter sometimes reports erroneous data. To correct this issue, a new meter will be installed in 2022.

4.4 Boilers

Boiler stacks are in place to provide heat to the digesters and RTF operations, as required. The boilers are dual fuel, running off either digester gas or supplemental fuel (propane). The installed boiler stacks are Superior Boilers (model 6-X-500-FMCF-W30-LP/DG), and one 250 BHP boiler (Superior Boilers model 6-X-1250-FMCF-W30-LP/DG). The boilers were installed according to design and manufacturer specifications. The boilers were commissioned in September 2020 and maintained successful and consistent operation through to the end of the reporting period. In 2021, 1,037,821 m^3 of biogas was used for fuel in the boilers or the thermal oil heater for beneficial use within the plant. Approximately 15-20% of the biogas is directed to the boilers, and the remaining 80-85% is used by the thermal oil heater.

4.5 Thermal Oil Heater

Biogas, supplemented as required, is used as the primary fuel in a dedicated thermal oil heater. Thermal oil is pumped to the in-bed heat exchanger to maintain the fluidized bed dryer at 85°C. The Ascentec S/TH-50-BE Thermal Oil Heater was installed according to design and manufacturer specifications. The Thermal

Oil Heater was commissioned in September of 2020 and operated successfully in 2021. The thermal oil heater operated primarily on biogas during 2021, with the exception of late December when cold temperatures affected gas temperatures, and the propane back-up was used. To prevent this occurrence in the future, biogas piping was heat traced and insulated.

4.6 Diesel Pump and Generators

The Operational Certificate has authorized discharge of miscellaneous sources, which include as follows:

- Two (2) 1,000 kW diesel power generators (Mitsubishi model MDI000)
- One (1) 160 Hp diesel pump (Clarke/John Deere model JU6H-UF34)

During the reporting period, the usage of the miscellaneous sources was limited to 60.5 hours for the generators and 23 hours for the diesel fire pump. All operation was done in accordance with Part 2, Section 6 of the *Environmental Management Act*.

5. ODOUR CONTROL & RESPONSE

As part of RTF commissioning and operation, the main focus around odour was to establish successful performance of the odour control system and limit the release of H_2S from the odour treatment stack (see Section 4.2 for discussion). As outlined in the Odour Control and Response Plan, RTF staff completed routine perimeter odour checks to monitor for odour generated by the RTF.

In late April 2021, the RTF's digester went into operational upset. The facility was forced to direct undigested sludge straight to the landfill, and the effluent captured from the centrifuge represented aged undigested material (greater than two weeks), which is high in acute odour producing compounds such as mercaptans. These compounds are detectable at low concentrations and are more difficult to eliminate. It was determined that the odour control system installed at the RTF was operating as designed, but that odour was being released from a manhole (manhole 24) on the centrate return line, located adjacent to Willis Point Road. The facility received four formal odour complaints during this time. During this period the following mitigations were implemented:

- Nitrate salt (Bioxide™) chemical injection was set up on May 1st to reduce odour producing microbial populations in the effluent return line until manhole 24 was removed.
- Reduced discharge flows below 25 L/s and ensured continuous, steady flows to prevent odour.
- Used antifoaming agents to reduce foaming and odours in the centrate return line as needed.
- Integrated an upstream manhole into foul air collection and treatment system to create a negative pressure headspace.
- Removed manhole 24, adjacent to Willis Point Road.

Once manhole 24 was removed, temporary measures were ceased and no further odour complaints were received in 2021.

As digestion was recovered through June, July and into August, odour was significantly reduced. A summary of all formal odour complaints received in 2021 is attached as Appendix A.

6. SPILL UPDATE REPORT

On October 13, 2020, an unplanned release (spill) of partially dewatered residual material (i.e., sewage sludge combined with wastewater; residual solids) occurred from the RTF. The spill area, was entirely on CRD property, including Hartland Landfill and the receiving environment is in Mount Work Regional Park. The spill extent is within the traditional territory of W̱SÁNEĆ First Nations. Details about the area extent, volume, material characteristics, how the spill occurred, and efforts to contain and clean it up can be found in the *End-of-Spill Report* (#DGIR202520) completed by Associated Engineering and submitted to the BC ENV in January 2021. Upon submission of the *End of Spill Report*, the ENV concluded the reporting was complete. An additional update report entitled *CRD Residual Treatment Facility Update Report* was completed in August 2021, summarizing the results of monitoring undertaken after the submission of the

End of Spill Report in January 2021. As requested by BC ENV the additional update report has been included in this report (Appendix C) and its results and findings are summarized below:

- The 2021 sampling events consisted of surface water, groundwater, soil and sediments sampling within the spill pathway, and downstream receiving environments to assess the risk of the spill to ecological and human health.

- Since the *End of Spill Report* parameters of concern, specifically E. coli and fecal coliforms, have declined overtime, with no evidence of more being added to the system. Also, there is no evidence of the microbial parameters migrating out of the wetland system to Durrance Lake, or shallow or deep groundwater. Based on these sampling results, the spill poses a low risk.

- Amphibians (Pacific tree frogs and Northern red-legged frogs) were observed and heard at low density in the largest wetland in the spill area, including adults and one egg mass. There were no obvious impediments to the completion of their lifecycle from the spill. Based on lab analysis, and the successful use of the wetland by amphibians' to-date, no additional amphibian monitoring was recommended.

Overall, the report concluded, that investigation can be considered complete, and that no additional sampling or monitoring is required.

7. CONCLUSIONS

Commissioning of the RTF was completed in March 2021 and the facility transitioned to an operating phase through the end of the reporting period. In total 2,109 dry tonnes of Class A biosolids were produced. Of those tonnes, 599 were sent to the Lafarge cement manufacturing facility, 133 tonnes were used to create biosolids growing medium, and 1,377 were used as daily cover material at Hartland Landfill during 2021. A total of 1,260 dry tonnes of non-Class A dewatered biosolids at ~75% moisture were produced and sent to the Hartland Landfill during the reporting period for 2021.

During the reporting period the odour control system performed as expected (except during October 2021, as referenced above in section 4.2) and readings at the discharge stack did not exceed the H_2S limit of 2 mg/s. As the facility transitioned from commissioning to operations, the facility underwent a major operational upset with the digester in April 2021, resulting in four formal odour complaints received. With odour control measures installed on the effluent return line, and the recovery of digester health, odour was significantly reduced, and no further odour complaints were received in 2021.

The biogas flare, boilers, thermal oil heater, and diesel pump and generators were all operated and maintained, as per design and manufacturer specifications.

8. REPORT SIGNOFF

Prepared by:

Kelly Tradewell
Supervisor, Geo-Environmental Programs

Reviewed by:

Glenn Harris, Ph.D., R.P.Bio., Senior Manager, Environmental Protection

Peter Kickham, M.E.T. R.P.Bio, Manager, Regulatory Services, Environmental Protection

APPENDIX A

SUMMARY OF COMPLAINTS RECEIVED

Appendix A – Summary of Complaints Received

Date of Complaint	Nature of Complaint	Details	Response
8-April-2021	Odour	Via email – General complaint of odour in the vicinity of the RTF while driving by.	Advised that steps to mitigate odours were being taken.
23-April-2021	Odour	Via phone - General complaint of odour in the vicinity of the RTF while biking by.	Advised that steps to mitigate odours were being taken.
26-April-2021	Odour	Via email – General complaint of odour in the vicinity of the RTF while driving by.	Advised that steps to mitigate odours were being taken.
27-April-2021	Odour	Via email – General complaint of odour in the vicinity of the RTF while driving by.	Advised that steps to mitigate odours were being taken.
29-April-2021	Odour	Via email – General complaint of odour in the vicinity of the RTF while driving by.	Advised that steps to mitigate odours were being taken.

APPENDIX B

ODOUR MONITORING NON-COMPLIANCE NOTIFICATION

Luke Novy

From: Luke Novy
Sent: Tuesday, October 19, 2021 10:23 AM
To: EnvironmentalCompliance@gov.bc.ca
Cc: Peter Kickham; Kingsley, Magda ENV:EX; Ben Christianson P.Eng, EP
Subject: OC109471 NCR 20211015 Odour Monitoring

Categories: Sent to HRMG

Attention: Non-compliance report for Operational Certificate - 109471
Odour Monitoring Interruption

Date of Non-compliance: 2021-10-15.

Location of Non-compliance: Residuals Treatment Facility, Victoria BC

Nature of Non-compliance: This report is to identify a monitoring non-compliance for the discharge from the odour treatment stack. As part of the calibration of the H_2S monitor on the odour treatment stack (Ref # E319474) the service technician was unable to get a proper verification on the discharge stack monitor, specifically analyzer 18-AIT-405. This has resulted in not being able to collect continuous H_2S readings for the odour treatment stack (OC requires continuous monitoring with a discharge limit of 2mg/s H_2S).

The CRD and site operator (Synagro) are confident that the odour control system continues to function effectively. A general lack of odour observed in perimeter surveys completed over recent months, (combined with compliant H_2S monitoring) is indicative that the odour treatment system is functioning as designed.

Initial Response/Actions taken: The technician initially worked with the analyzer manufacturer to field troubleshoot the problem however they were not successful. The unit was removed and shipped to back to the manufacturer for service. A replacement unit is being priority shipped and it is anticipated that the unit will be back in service by the end of this week (October 23, 2021).

Monitoring conducted: Until the replacement unit is back in service, Synago will complete two perimeter surveys daily, during the day and night shifts, to ensure odours are not present at the perimeter of the site.

Contact information: Peter Kickham, Manager, Environmental Regulations, Environmental Protection (250) 217-8356
Lukas Novy, Supervisor, Geo-Environmental Programs (250)360-3148

Lukas Novy, P.Eng | Supervisor, Geo-Environmental Programs
Environmental Protection | Capital Regional District
625 Fisgard Street, PO Box 1000, Victoria, BC V8W 2S6
T: 250.360.3148
www.crd.bc.ca | Facebook | Twitter | YouTube

APPENDIX C

SPILL UPDATE REPORT

Associated Environmental

REPORT

Hartland Resource Management Group

CRD Residual Treatement Facility
Spill Update Report

AUGUST 2021

A Carbon Neutral Company

CANADA BEST MANAGED COMPANIES Platinum member

TABLE OF CONTENTS

SECTION			PAGE NO.
Table of Contents			i
List of Tables			ii
List of Figures			iii
1	Background		4
2	Methods		6
	2.1	Regulatory Context	6
	2.2	Sampling Procedures	7
	2.3	Amphibian Survey	13
3	Results		15
	3.1	Surface Water	15
	3.2	Groundwater	16
	3.3	Soil	18
	3.4	Wetland Sediments	19
	3.5	Amphibian Monitoring	20
4	Conclusion		20
Closure			
References			
Appendix A - Detailed Lab Results			
Appendix B - Detailed Amphibian Survey Results			

LIST OF TABLES

PAGE NO.

Table 2-1 Surface water sampling location details 9
Table 2-2 Groundwater sampling location details 11
Table 2-3 Soil sampling location details 12
Table 2-4 Sediment sampling location details 13
Table 3-1 Concentrations of parameters of concern in surface water 15
Table 3-2 *E.coli* and fecal results in groundwater wells 16
Table 3-3 Concentrations of parameters that exceeded guidelines or standards and *E.coli* and fecal results in shallow groundwater 17
Table 3-4 Concentrations of parameters that exceeded standards and *E.coli* and fecal coliform results in soil 18
Table 3-5 Typical background value of metals in soils in the Saanich area compared to samples 19
Table 3-6 Concentrations of parameters that exceeded standards in sediment and *E.coli* and fecal coliform results 19

LIST OF FIGURES

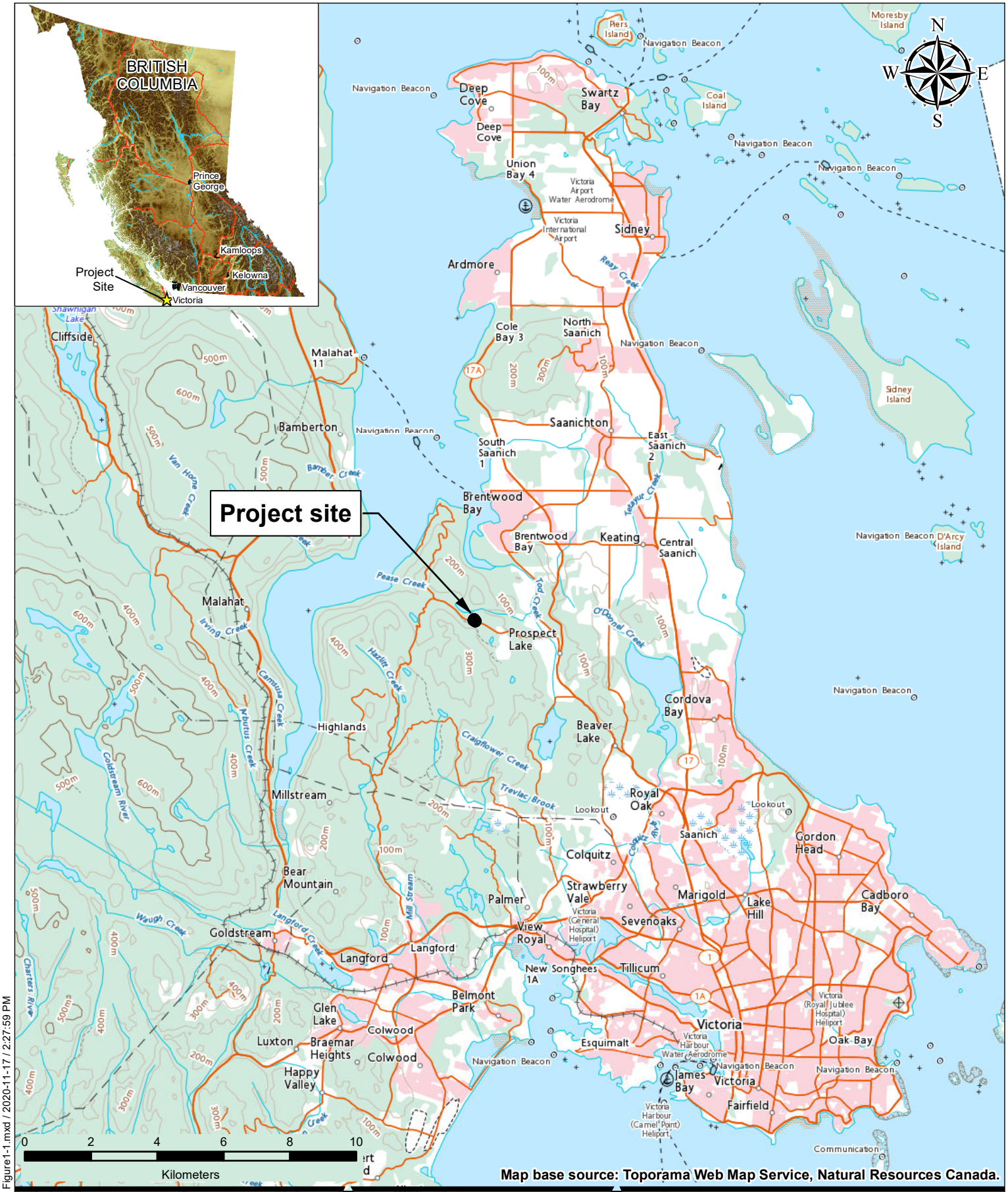
PAGE NO.

Figure 1-1 Project Location 5
Figure 2-1 Amphibian Survey Locations 14

1 BACKGROUND

On October 13, 2020, an unplanned release (spill) of partially dewatered residual material (i.e., sewage sludge combined with wastewater; residual solids) occurred at the Capital Regional District (CRD) Residual Treatment Facility (RTF), located at the Hartland Landfill (Figure 1-1) (#DGIR202520). The spill area, referred to as the Site, is located entirely on CRD property, including Hartland Landfill and the receiving environment is in Mount Work Regional Park. The spill extent is within the traditional territory of W̱SÁNEĆ First Nations. Details about the area extent, volume, material characteristics, how the spill occurred, and efforts to contain and clean it up can be found in the End-of-Spill report submitted to the Ministry of Environment and Climate Change Strategy (ENV) in January 2021 (Associated 2021).

Upon submission of the End of Spill Report, the Ministry of Environment and Climate Change Strategy (ENV) concluded the reporting was complete. This report, referred to as the Spill Update Report is meant to provide a summary of the monitoring results collected since the December sampling summarized in the End of Spill Report. This is the results of sampling from January to May 2021. Results will be included in the annual reporting completed for the RTF under their Operational Certificate.



Map base source: Toporama Web Map Service, Natural Resources Canada.

Figure1-1.mxd / 2020-11-17 / 2:27:59 PM

Associated Environmental

PROJECT NO.: 2020-8732
DATE: November 2020
DRAWN BY: BdJ

FIGURE 1-1: SITE LOCATION

Maple Rienders Bird Joint Venture
CRD Residual Treatment Facility Spill

2 METHODS

The initial site investigation was initiated by Corvidae Environmental Consulting (Corvidae) on October 14, 2020 with guidance from Associated Environmental Consultants Inc. (Associated) and Gary Hamilton, P.Geo., CSAP. The End of Spill Report (Associated 2021) reported on results from October 14 through December 17, 2020 (referred to as "2020 sampling events"). Follow-up sampling investigation was concluded on May 13, 2021 and this Spill Update Report summarizes the results of the continued monitoring from December 17, 2020 to May 13, 2021 (referred to as "2021 sampling events"). The investigation for both the 2020 and 2021 sampling events consisted of surface water and groundwater quality sampling, sediment[1] sampling in the wetted areas of the wetland, and soil sampling in the non-wetted areas, as well as visual and olfactory documentation of the spill-affected areas. Sampling locations are informed by the understanding of the potential flow characteristics of the spill based on:

- Observations by Corvidae at the Site;
- Available borehole logs of the geologic formations under the spill;
- South Vancouver Island Beach Sampling Results (Island Health 2020); and
- Previous groundwater modelling reports (AECOM 2019).

The Site investigation is focussed on the following media:

- Surface water;
- Groundwater;
- Soil;
- Wetland sediments;

In addition to the Site media investigation, amphibian habitat use was monitored in the spring of 2021, focussing on the affected wetland.

2.1 Regulatory Context

The BC *Contaminated Sites Regulation* (CSR) provides standards for water, soil, and sediment that are legally enforceable. As a second benchmark, the BC Approved and Working Water Quality Guidelines (WQG) are guidelines used to evaluate ambient water quality, protect water values (such as aquatic life, wildlife, and drinking water), and inform decision making. It is important to note that as per ENV (2019a), "exceeding a water quality guideline does not imply that unacceptable risks exist, but rather that the potential for adverse effects may be increased and additional investigation may be required." Further, there are no BC CSR standards for microbiological parameters (i.e., *E. coli* and fecal coliforms), but there are applicable BC WQG. Therefore, both BC CSR and BC WQG have been used to complete a comprehensive review of spill effects and to develop recommendations for the Site going forward.

Surface water includes the water in the wetland and Durrance Lake as *potential* receptors. Durrance Lake is primarily used for recreation, and there are two surface water licences located on the east end of the lake, one for irrigation and one for land improvement. The wetland has potential to support aquatic life. The following guidelines were therefore applied to surface water data:

[1] "Soil" includes unconsolidated mineral or organic material, rock, and/or fill in a terrestrial setting. "Sediment" means particulate material that usually lies below water.

- BC Approved and Working Water Quality Guidelines (BCAWQG and BCWWQG) for Aquatic Life (AL) and Wildlife[2] (WL) (ENV 2019a, 2020a); and
- BC Recreational Water Quality Guidelines (ENV 2019b).

For groundwater, the BC CSR standards for aquatic life and drinking water apply, for the reasons detailed in Appendix C in the End of Spill Report, and BC WQG for aquatic life were applied to the groundwater wells located within 10 m of an aquatic receiving environment (piezometers installed around the wetland to the north; RTF-W-DP# shown in Figure 4-2 in End of Spill Report). The BC WQG were also applied for microbiological parameters only, as there are no CSR standards for microbiological parameters. The following standards and guidelines were therefore applied to bedrock groundwater data:

- BC CSR groundwater standards for Aquatic Life (AW) (freshwater) and Drinking Water (ENV 2017);
- BC Source Drinking Water Guidelines (BC SDWQG) (ENV 2020b) (*applied only for microbiological*).

The following standards and guidelines were therefore applied to shallow groundwater data:

- BC CSR groundwater standards for Aquatic Life (AW) (freshwater) and Drinking Water (DW) (ENV 2017);
- BC Approved and Working Water Quality Guidelines (BCAWQG and BCWWQG) for Aquatic Life (AL) and Wildlife[3] (WL) (ENV 2019a, 2020a);
- BC Source Drinking Water Guidelines (BC SDWQG) (ENV 2020b) (*applied only for microbiological*); and
- BC Recreational Water Quality Guidelines (ENV 2019b) (*applied only for microbiological*).

For soil, the following standards were applied:

- BC CSR Industrial standards for soil/substrate; and
- BC CSR Urban Park soil standards.

For sediment, the following standards were applied, and microbiological concentrations were qualitatively reviewed:

- BC CSR Sensitive Sediment standards.

Further details on the regulations and how they apply to the spill can be found in the End of Spill Report (Associated 2021)

2.2 Sampling Procedures

Sample locations for surface water, groundwater, soil and sediments are shown in Figure 4-2 in the End of Spill Report. Sample codes correspond to locations as follows:

- Spill Area 1, RTF-P: RTF location
- Spill Area 2, RTF-NAR: north access road (along ditch adjacent to road leaving the RTF)
- Spill Area 3, RTF-W: wetland area (all sites on north side of Willis Point Road)
- GW: Hartland Landfill monitoring well
- DL: Durrance Lake.

[2] Although the guideline is for wildlife and agriculture, the agricultural component of this guideline was not applied because the Durrance Lake water license is not used for crop irrigation, it is used in for landscape watering.

The soil, water, and sediment samples were obtained following procedures published by the BC government (technical guidance for site characterisation and confirmation testing [MOE 2009] and the field sampling manual for water and wastewater [MOE 2013]). Additional information on procedures is provided in Sections 4.2.1 to 4.2.5 of the End of Spill Report (Associated 2021).

2.2.1 Laboratory and Field Quality Assurance/Quality Control (QA/QC)

Sample results were provided by ALS Laboratories up until January 18, 2021, when the analyses were switched to AGAT Laboratories. ALS and AGAT laboratories quality control included:

- Laboratory duplicate (DUP);
- Matrix spike;
- Reference material;
- Method blank; and
- Laboratory control.

The field QA/QC procedures followed BC protocols (MOE 2009 and MOE 2013) and included:

- Using nitrile gloves and replacing gloves at each sample location.
- Cleaning the shovel and auger using distilled water, acetone and shop towels between each sample location (for soil and sediment sampling).
- Using ice to cool the samples during transport.
- Ensuring no headspace was remaining in the sample jars.
- Collecting one field duplicate for every 10 samples.

2.2.2 Surface Water

For the 2021 sampling events, 16 surface water samples have been collected at 5 locations. Surface water was collected in:

- Durrance lake on the south shore, nearest the spill pathway;
- the affected wetland;
- the second wetland to the north;
- a seepage near the spill pathway;
- and between the affected wetland and second wetland to the north.

A natural groundwater seep proximal to Spill Area 2 (RTF-NAR-W1) was also sampled and considered to represent localized groundwater flow associated with the ephemeral drainage ditch. It is being contrasted to surface water standards and guidelines because the seepage is within 10 m of a surface waterbody (i.e. the wetland).

Surface water samples were collected as grab samples from the upper 10 cm of the water column. Field parameters have been recorded for all samples. Surface water sample types are in one of three categories:

1. Receptor – areas outside the spill boundaries that could potentially be affected by the spill (e.g., Durrance Lake, and a second wetland and spring to the north of Spill Area 3).
2. Wetland – within the spill pathway area defined as wetland, and second wetland to the north of Spill Area 3.
3. Seepage – within the spill pathway but on the south side of Willis Point Road.

The water samples were collected by Corvidae in laboratory-supplied bottles, filtered and preserved in the field (where necessary), placed in coolers with ice, and shipped via chain-of-custody protocol to AGAT Laboratories in Burnaby (an accredited laboratory). Based upon the constituents of typical wastewater, the surface-water samples taken from Durrance Lake were analyzed for ammonia-N, nitrate-N, nitrite-N, and microbiological analysis (*E. coli*, fecal coliforms and total coliforms), the primary parameters of concern related to the spill material and this receptor. The remaining surface water sample locations, listed in Table 2-1, were sampled and analyzed for:

- Microbiological (*E. coli*, fecal coliforms and total coliforms);
- Total and dissolved metals;
- Ammonia-N, nitrite-N, nitrate-N, TKN, organic nitrogen, and total nitrogen;
- Total phosphorus (P), total dissolved P, ortho-P;
- Anions (chloride, bromide, fluoride, sulphate);
- Alkalinity;
- Total dissolved solids; and
- Biochemical Oxygen Demand (5-day).

Petroleum hydrocarbons are not a major constituent of typical wastewater and not considered as a potential contaminant of concern.

Table 2-1
Surface water sampling location details

Sample ID	Sample Type	UTM Coordinates (U 10)		Elevation (m asl)[1]	Date(s) Sampled (2021)[2]
Durrance Lake SE (DL-SE)	Receptor	464969.0 m E	5377112.0 m N	136	Jan 18, Feb 18, and March 18
RTF-1-WPRO	Wetland[3]	465177.0 m E	5376891.0 m N	152	Feb 3, Feb 18, and March 18
RTF-2-WPRO	Wetland[3]	465123.0 m E	5376949.0 m N	149	Feb 3, Feb 18, and March 18
RTF-3-WPRO	Wetland[3]	465087.2 m E	5376964.4 m N	149	Jan 18, Feb 3, Feb 18, and March 18
RTF-NAR-W1	Seepage	465230.5 m E	5376815.7 m N	149	Jan 18, Feb 18, and March 18

Notes: m asl = metres above sea level

[1] Due to dense forest canopy, cloud cover and GPS limitations, the elevation has an error of +/- 5 m.

[2] Updated results only (January 1, 2021 onwards)

[3] In the spill pathway, Spill Area 3

2.2.3 Groundwater

Groundwater samples were collected by Corvidae from five nearby monitoring wells on March 3, 2021. Table 2-2 presents the coordinates for the five groundwater wells and includes the relative location of the wells to the spill material. The groundwater wells are used as part of the ongoing landfill monitoring program. Well 44-1-1 is located approximately 115 m upgradient from the Site and was sampled for comparison to background groundwater quality. It

should be noted that all of the monitoring wells are completed into bedrock and as a result, represent the groundwater in the upper portion of the bedrock aquifer. Borehole logs indicate that at the time of drilling, no shallow groundwater was observed above the bedrock.

Prior to sampling the bedrock groundwater, in general accordance with BC EMV Technical Guidance 8, Corvidae and CRD Hartland Landfill staff purged the monitoring wells to remove at least three well volumes, until field parameters stabilized, using a foot-valve inertial pumping system (as per standard practice). When groundwater monitoring wells are installed in relatively low permeability formations (such as fractured bedrock), purging such wells is sometimes difficult and results in purging the well dry. In such situations the recommended procedure is to carefully and slowly purge the well to avoid drawing the water level in the well to the well screen. Where water-level recovery may take several hours or days, it must be recognized that the sampled water has likely established partial or full equilibrium with atmospheric conditions and a truly representative groundwater sample may not be possible. Well 41-1-1 was sampled with a bailer after sufficient water had recharged (the next day). Field parameters (i.e., temperature, conductivity, pH, oxidation-reduction potential, and turbidity) were recorded by Corvidae for all groundwater sampling locations, including during the well purging.

In addition to groundwater well samples, six drive-point piezometers were installed from the north and west end of the upper wetland, to the south edge of the lower wetland to a depth of approximately 1m. This was to evaluate the groundwater quality immediately downgradient of the wetland, prior to reaching Durrance Lake. Once installed, the piezometers were purged three times before field parameters stabilized, then were sampled. Corvidae able to collect groundwater samples from all the piezometer locations. BC CSR technical guidance was generally followed during groundwater sampling; however, in some location the low permeability of the saturated formation prohibited the water-level in the well to be maintained above the screened interval during development and purging. It is not anticipated that the low permeability of the saturated formation would have substantially biased analytical results for groundwater sampled and analyzed for microbial parameters.

Groundwater samples were collected in laboratory-supplied bottles, filtered and preserved in the field (where necessary), placed in coolers with ice, and shipped via chain-of-custody protocol to the laboratory. The groundwater samples were analyzed for the following:

- Microbiological (*E. coli*, fecal coliforms and total coliforms);
- Total and dissolved metals;
- Ammonia-N, nitrite-N, nitrate-N, TKN, organic nitrogen, and total nitrogen;
- Total phosphorus (P), total dissolved P, ortho-P;
- Anions (chloride, bromide, fluoride, sulphate);
- Alkalinity;
- Total dissolved solids; and
- Biochemical Oxygen Demand (5-day).

Table 2-2
Groundwater sampling location details

Monitoring Well	UTM Coordinates (U 10)		Ground Elevation (m asl)[1]	Screen Depth (m btoc)	Static Water Level (m btoc) (Oct 17)	Well Location Relative to the Spill Material	Date(s) Sampled (2021)
41-1-1	465190.0 m E	5376852.0 m N	150	9.07	2.675	Downgradient	March 3
44-1-1	465322.3 m E	5376671.5 m N	162	11.00	1.540	Upgradient	March 3
55-1-1	465136.0 m E	5376910.0 m N	148	13.11	6.362	Downgradient	March 3
56-1-1	465287.0 m E	5376838.0 m N	149	17.38	4.247	Cross gradient	March 3
57-1-1	465528.0 m E	5376873.0 m N	133	13.56	3.370	Downgradient	March 3
Shallow Groundwater (DP = piezometers)							
RTF-W-DP1	465087.9 m E	5376970.0 m N	151	N/A	0.03	Downgradient	Jan 26 and Feb 24[2]
RTF-W-DP2	465048.6 m E	5376968.9 m N	153	N/A	DRY	Downgradient	Feb 24[3]
RTF-W-DP3	465040.8 m E	5376992.7 m N	153	N/A	0.387	Downgradient	Jan 21, Feb 22, March 23
RTF-W-DP4	465018.3 m E	5376998.3 m N	154	N/A	0.276	Downgradient	Jan 21, Feb 22, March 23
RTF-W-DP5	464997.1 m E	5377003.2 m N	155	N/A	0.206	Downgradient	Jan 26, Feb 23, March 23
RTF-W-DP6	465087.1 m E	5376941.4 m N	150	N/A	0.505	Downgradient	Jan 26, Feb 23, March 23

Notes: m asl = metres above sea level; m bgs = metres below ground surface

[1] Due to dense forest canopy, cloud cover and GPS limitations, the elevation has an error of +/- 5 m.

[2] RTF-W-DP1 was dry during the March sampling event and was not sampled

[3] RTF-W-DP2 was drying during the January and March sampling events and was not sampled

2.2.4 Soil

Soil samples were collected by Corvidae from around the wetland area in a dry or not typically wetted location (Table 2-3). Soils were advanced to 1 m depth where possible. Each soil sample was collected using the following guidance:

- Collected from similar *in situ* fill or soil at one location;
- Confined to collection within a contiguous volume of 1 m^3;
- Collected over a maximum depth of approximately 0.5 m within the upper 1 m from the existing surface, or from an identifiable historical Site surface; or collected over a maximum depth of 1 m at depths greater than 1 m from the surface;

- Not collected from two distinct fill or soil zones;
- Not collected on two sides of an air/water interface (or unsaturated/saturated soil zone interface); and
- Not made up of a mixture of obviously contaminated material and obviously noncontaminated material as determined by field observations such as sight and odour, even if these materials have similar physical characteristics (e.g., both are silty sands).

Within the soil pits, soil matrix characteristics (texture and visible horizons) were documented. The samples were taken approximately once every 10 m^2 within the Site. The 2021 sampling events consisted of only one location in an area in which microbial results were high, above typical levels.

All soil samples were collected in clean laboratory-supplied jars, placed in a cooler with ice (to maintain sample temperature at 4°C or lower) and shipped the same day using chain-of-custody protocol to the laboratory. Analysis included heavy metals, total nitrogen, nitrate, nitrite, ammonia, fecal coliforms, and *E. coli.*

Table 2-3
Soil sampling location details

Sample ID	Sample Type	UTM Coordinates (U 10)[1]		Date Sampled (2020)	Depth of Sample (composite m)
RTF-P-S4	Soil	465202	5376722	Jan 18, May 13	0.25-0.27

Note: Samples from within the RTF are represented by a P in the sample name); and samples along the northwest access road are represented by NAR in the sample name.

[1] Due to dense forest canopy, cloud cover and GPS limitations, the elevation has an error of +/- 5 m.

2.2.5 Sediment

Seventeen sediment sample locations were sampled by Corvidae in the wetland area during the 2021 sampling events (Table 2-4), specifically below the high-water mark or areas that are typically wetted. Because sediments are difficult in the same precise location, re-sampling occurred in the same general location as previous samples. Sediment samples were grab samples collected at the water-sediment interface.

All sediment samples were collected in clean laboratory-supplied jars, placed in a cooler with ice (to maintain sample temperature at 4°C or lower) and shipped the same day using chain-of-custody protocol to the laboratory. Samples were then sent to the lab for analysis of heavy metals, total nitrogen, nitrate, nitrite, ammonia, fecal coliforms, and *E. coli*.

Table 2-4
Sediment sampling location details

Sample ID	Sample Type	Coordinates (U 10)[1]		Date Sampled (2021)
RTF-W-SED7	Sediment	465162	5376881	Jan 21 and May 13
RTF-W-SED8	Sediment	465151	5376904	Jan 21 and May 13
RTF-W-SED9	Sediment	465136	5376886	Jan 21 and May 13
RTF-W-SED10	Sediment	465148	5376911	Jan 21 and May 13
RTF-W-SED11	Sediment	465138	5376934	Jan 21 and May 13
RTF-W-SED12	Sediment	465137	5376947	Jan 19 and April 29
RTF-W-SED13	Sediment	466901	5376435	Jan 19 and April 29
RTF-W-SED14	Sediment	465111	5376953	Jan 19 and April 29
RTF-W-SED15	Sediment	465093	5376947	Jan 19 and April 29
RTF-W-SED16	Sediment	465095	5376981	Jan 19 and April 29
RTF-W-SED17	Sediment	465058	5376982	Jan 19 and April 29

[1] Due to dense forest canopy, cloud cover and GPS limitations, the elevation has an error of +/- 5 m.

2.3 Amphibian Survey

Vancouver Island hosts several frogs and toads including bullfrog (*Lithobates catesbeiana*), green frog (*Lithobates clamitans*), Northern red-legged frog (*Rana aurora*), tailed frog (*Ascaphus truei*), Western toad (*Anaxyrus boreas*) and the Pacific treefrog (*Pseudacris regilla*)[1]. Frog calls heard in the Pacific Northwest are most commonly from a male Pacific treefrog because other frog species have much quieter calls and do not sing over a long period of the spring, as the Pacific treefrog does. Given the likelihood and record of occurrence of the Pacific treefrog to be present near the CRD Residual Treatment Facility, the amphibian survey focused on this species.

A qualified environmental professional (QEP) from Corvidae conducted 5 monitoring events at the Site between March 18th, 2021 and May 13th, 2021. Visual encounter surveys were conducted by searching for egg masses, hatchlings, tadpoles and adults. They were completed at dusk between 17:30 and 20:00. Auditory call surveys were conducted at the same time for adult frogs were conducted after sunset between 19:00-21:30 and comprised of 15-minute surveys at each surveying station location. Surveying station locations are shown on Figure 2-1.

N
W
E
S

AS - Station 4

AS - Station 5

AS - Station 3

AS - Station 2

Willis Point Road

AS - Station 1

Stormceptor

0 20 40 60 80 100 Meters

amphib_survey.mxd / 2021-05-18 / 3:58:15 PM

Associated Environmental

Spill areas
Berm
Surface drainage path
Sub-surface drainage path
Wetland extent
Amphibian Survey Location

PROJECT NO.: 2020-8732
DATE: May 2021
DRAWN BY: BdJ

FIGURE 2-1: AMPHIBIAN SURVEY LOCATIONS

Maple Reinders Bird Joint Venture

CRD Residual Treatment Facility Spill

3 RESULTS

The spill investigation results included in this report are for the 2021 sampling events. Previous results are available in the End of Spill Report (Associated 2021). The summarized results are presented by sample media in Section 3.1 to 3.4, while tabulated analytical results compared to standards and guidelines are provided in Appendix A. Section 3.5 summarizes the amphibian monitoring results.

3.1 Surface Water

There were no guideline exceedances of E. *coli* at any of the surface water sample locations and the E. *coli* concentrations are similar at all sample locations (Table 3-1). Fecal coliforms were typically in greater concentrations along the spill pathway than in Durrance Lake (DL-SE), which was likely associated with the spill. The elevated fecal coliform concentrations in DL-SE were taken after a rain on snow event on February 18th, and it may be that the additional runoff from the even wasted bacteria into the lake from the surface stream that enters the lake near that location, potentially from animal feces. This is likely *unrelated* to the spill because there is not surface water flow connection from the spill pathway to Durrance Lake.

Table 3-1
Concentrations of parameters of concern in surface water

Parameter	Concentration or Range of Concentrations at Sample Location					Most stringent applicable guideline or standard	
	DL-SE	RTF-1-WPRO	RTF-2-WPRO	RTF-3-WPRO	RTF-NAR-W1	Guideline or standard value	Guideline or standard type
Number of Sampling Events	3	2	2	3	3	-	-
Date Sampled (2021)	Jan 18, Feb 18, March 18	Feb 18, March 18	Feb 18, March 18	Jan 18, Feb 18, March 18	Jan 18, Feb 18, March 18	-	-
E. coli (MPN/100 mL)	<1-179	<1-3	<1-1	<1-2	<1	200	BC Recreational WQG
Fecal Coliforms (MPN/ 100/mL)	<1-313	233.26-435	100-2420	99-980.39	326->2420	NG	NG

Notes: All results, tabulated and compared to guidelines, are shown in Appendix D in the End of Spill Report.
NG = no guideline

3.2 Groundwater

Bedrock groundwater sample results indicated no exceedances of the applicable standards or guidelines, with the exception of total metals, but not dissolved metals (Table 3-2; detailed results in Appendix A). Total metals do not move easily through the aquifer; therefore, only dissolved metals are considered when discussing potential threats to the groundwater and under BC CSR for drinking water. As well, all the results at the wellsites met applicable standards and guidelines for bacteria (*E. coli* and fecal coliforms, Table 3-2). The microbial parameters are the focus because of their potential correlation to the spill.

Table 3-2
E.coli and fecal results in groundwater wells

Parameter	Concentration at Sample Location					Most stringent applicable guideline or standard	
	41-1-1	44-1-1	55-1-1	56-1-1	57-1-1	Guideline or standard value	Guideline or standard type
Number of Sampling Events	1	1	1	1	1	-	-
Date Sampled (2021)	March 3	March 3	March 3	March 3	March 3	-	-
E. coli (MPN/100 mL)	<1	<1	<1	<1	<1	10	BC SDWQG MAC
Fecal Coliforms (MPN/100 mL)	<1	<1	<1	<1	<1	NG[1]	BC SDWQG MAC

Bold values indicate an exceedance of the applicable guidelines or standards.
SDWQG = Source Drinking Water Quality Guideline
MAC = Maximum Acceptable Concentration
1 Previously 10 MPN/100 mL, but the guideline was recently archived because fecal coliforms are considered a poor risk indicator for illness in humans.

For shallow groundwater, the analytical results from samples obtained from the drive point piezometers completed in the overburden soils indicated metals concentrations similar to background, *E.coli* at <1 MPN/100mL, and fecal coliform concentrations that range from 1 to 10 MPN/100 mL, with one outlier of 202 MPN/100mL *E.coli* at DP5 during the February 23 sampling event. The DP5 location is not within the spill pathway and there is no evidence of connectivity, so it is assumed that the high microbial concentrations during the February sampling event are associated with a different, unknown source. As well, none of the other DP locations show an increase in microbials at that time. The most recent sampling event shows bacteria concentrations within guidelines at all sites, and the elevated levels were likely elevated due to the rainfall and snowmelt event during that time period. All bacteria levels have declined since the 2020 sampling events.

DP5 previously had elevated fluoride, as discussed in the End of Spill report (Associated 2021), that has since declined below the guideline value and is likely unassociated with the spill.

Exceedances of some dissolved metal guidelines were shown in the piezometers (Table 3-3). The metal levels are *not* similar to the spill material characteristics or surrounding natural conditions, so they are considered an anomaly (see End of Spill Report for a more detailed explanation).

Table 3-3
Concentrations of parameters that exceeded guidelines or standards and *E.coli* and fecal results in shallow groundwater

Parameter	Concentration or Range of Concentrations at Sample Location						Most stringent applicable guideline or standard	
	RTF-W-DP1	RTF-W-DP2	RTF-W-DP3	RTF-W-DP4	RTF-W-DP5	RTF-W-DP6	Guideline or standard value	Guideline or standard type
Number of Sampling Events	2	1	3	3	3	3	-	-
Sample Dates	Jan 26 and Feb 24	Jan 21	Jan 21, Feb 22, March 23	Jan 20, Feb 22, March 23	Jan 26, Feb 23, March 23	Jan 21, Feb 22, March 23	-	-
Aluminum (dissolved; µg/L)	41-64	42	45-110	4-10	12-174	<2-25	100	BCAWQG AL
Chromium (dissolved, µg/L)	<0.5-0.6	<0.5	<0.5	<0.5	1.1-11	<0.5	1 10	BCWWQG AL[1] BC CSR AW[2]
Iron (dissolved, µg/L)	708-3200	27	52-1070	<10	6180-27300	12-76	350	BCAWQG AL
Nickel (dissolved, µg/L)	5.4-14.5	2.7	1.3-1.5	0.3-0.6	19.1-56.0	0.7-2.6	25	BCWWQG AL[3]
Zinc (dissolved, µg/L)	1120-2830	1040	41-126	28-249	8250-24200	85-952	3000	BC CSR DW
E. coli and Fecal Coliform Results								
E. coli (MPN/100 mL)	<1	<1	<1-2	<1	<1-202	<1-7	10	BC SDWQG MAC
Fecal Coliforms (MPN/100 mL)	<1	<1	<1-1	<1	<1-10	<1-3	NG[4]	BC SDWQG MAC

Notes: All results, tabulated and compared to guidelines, are shown in Appendix A.
Bold values indicate an exceedance of the applicable guidelines or standards.
NG = No Guideline
[1] Guideline value of 1 µg/L is the BC guideline for Cr(VI). The guideline for Cr(III) is 8.9 µg/L. Because speciated chromium was not analyzed, results were compared with the more stringent of the two guidelines.
[2] Standard of 10 µg/L is the CSR AW standard for Cr(VI). The standard for Cr(III) is 90 µg/L. Because speciated chromium was not analyzed, results were compared with the more stringent of the two standards.
[3] Guideline is 25 µg/L when water hardness is unknown.

[4] Previously 10 MPN/100mL, but fecal coliform as an indicator was archived as they are a poor risk indicator for illness in humans (ENV 2020b).

3.3 Soil

Only two sampling locations were carried forward for the 2021 sampling events, RTF-NAR-S2 and RTF-P-SS4, due to elevated levels of bacteria in the 2020 sampling event. Soil sample results for 2021 are shown in Table 3-4. The metals are not reported, but chromium, iron, selenium and vanadium exceeded standards in one or both samples. Although these metals exceeded standards, these metals are naturally high in the soil locally, as explained in the End of Spill Report (Associated 2021; Table 3-5).

No standards exist for E. *coli* or fecal coliforms in soil, but the parameters were included to assess the ecological risk and the risk of the spill to human health. The results demonstrate that microbial parameters are decreasing overtime based on consecutive results (Table 3-4).

Table 3-4
Concentrations of parameters that exceeded standards and *E.coli* and fecal coliform results in soil

Parameter	Concentration at Sample Location		CSR Standards (most stringent)[1]
	RTF-NAR-S2	RTF-P-SS4	
Number of Sampling Events	3	3	-
Dates Sampled (2021)[2]	Jan 20, April 27 and May 13	Jan 20, April 27 and May 13	-
E.coli and Fecal Coliform Results			
E. coli (MPN/g)	9804 (Jan), 5160 (May)	10000 (Jan), <10 (May)	NS
Fecal Coliforms (MPN/g)	43000 (Jan), 270 (May)	1600 (Jan), 2.6 (May)	NS

Notes: Table shows the range of values measured between January 1, April 27 and May 13th, 2021, for any parameter that exceeded standards in at least one sample. All results, tabulated and compared to guidelines, are shown in Appendix D. Bolded values indicate an exceedance of the applicable guidelines or standards.
[1]Applicable CSR standards include Industrial Land Use and Urban Park Land Use.
[2] The April 27th sampling event did not include *E. coli* or fecal coliforms due to an issue with lab holding time
NS = No standard

Table 3-5
Typical background value of metals in soils in the Saanich area compared to samples

Parameter (mg/kg)	Average value in undisturbed soils in Saanich Region	Average value in sampled soils
Barium	90	85.1
Chromium	23	54.7
Iron	2,4116	3,4858
Manganese	544	1,276
Selenium	<8	0.7
Sulfur	247	2,800
Vanadium	70	94.2
Zinc	54	78.9

Source: ENV 2017b

3.4 Wetland Sediments

Wetlands sediments exceeded copper standards in two locations and zinc standards in five locations but were deemed to be relevant to background conditions. Copper was highlighted as having potential to affect amphibian lifestyle completion, so results are shown in Table 3-6, and demonstrate a slight decline. As with the 2020 results, ammonia, nitrate or metals associated with the spill were not elevated in any of the locations, and therefore E. *coli* and fecal coliform counts were used to indicate the presence of residual solids in the sediments and are reported here (Table 3-6). E. *coli* and fecal coliform counts were elevated in two of the eleven sample locations (RTF-W-SED10 and RTF-W-SED11) in January. Half of the sample sites were sampled for microbials in April, but due to a laboratory error, the other half had to be resampled. The most recent results from April show lower levels of microbials throughout the sample sites and reduced again based on the May results.

Table 3-6
Concentrations of parameters that exceeded standards in sediment and *E.coli* and fecal coliform results

Parameter	Concentration at Sample Location											CSR Sensitive Sediment Standards (SedSSS)
	RTF-W-SED7	RTF-W-SED8	RTF-W-SED9	RTF-W-SED10	RTF-W-SED11	RTF-W-SED12	RTF-W-SED13	RTF-W-SED14	RTF-W-SED15	RTF-W-SED16	RTF-W-SED17	
Number of Sampling Events	1	1	1	1	1	2	2	2	2	2	2	-
Date Sampled (2020)	Jan 20, May 13	Jan 20, May 13	Jan 20, May 13	Jan 20, May 13	Jan 20, May 13	Jan 19, April 27	Jan 19, April 27	Jan 19, April 27	Jan 19, April 27	Jan 19, April 27	Jan 19, April 27	-
Copper (µg/g)	38.3, 47.6	36.9, 86.9	52.0, 47.3	73.5, 70.3	80.6, 57.5	41.2-179	26.9-160	37.4-60.5	38.1-41.2	34.2-51.8	79.2-92.8	120
E.coli and Fecal Coliform Results												

Parameter	Concentration at Sample Location											CSR Sensitive Sediment Standards (SedSSS)
	RTF-W-SED7	RTF-W-SED8	RTF-W-SED9	RTF-W-SED10	RTF-W-SED11	RTF-W-SED12	RTF-W-SED13	RTF-W-SED14	RTF-W-SED15	RTF-W-SED16	RTF-W-SED17	
E. coli (MPN/g)[2]	<10, 100	21, 10	84, 10	22818, <10	388, 202	<10-100	<10	20-42	10-<100	<10	<10	NS
Fecal Coliforms (MPN/g)[2]	<2, 4	35, 22	220, 280	28000, 17	700, 350	<2-11	<2-24	0.8-92	11-54	<0.2-3	<0.2-14	NS

Notes:
Bolded values indicate an exceedance of the applicable standards.
NS= no standard

3.5 Amphibian Monitoring

Spring weather in the region was cooler than average in 2021, and the Site is in an area with a cool microclimate. During surveys it was observed that the wetland had quickly diminishing water levels, high algae content, and limited emergent vegetation.

During the visual encounter surveys on April 29th, 2021, one adult Pacific treefrog was observed at the main, larger wetland in the spill pathway, north of Willis Point Road (Figure 2-2). On May 13th, two adult Northern red-legged frogs, one adult Pacific Tree frog and egg masses of Northern red-legged frog were observed the same wetland, just north of Willis Point Road. No amphibians were observed during any of the other surveying events.

During the auditory surveys at the Site on March 25th and April 29th, one adult Pacific treefrog was heard calling. No frogs were heard calling during any of the other surveying events. However, on March 24th, April 27th and April 27th, 2021 during groundwater and sediment sampling events, 1 to 4 Pacific treefrogs were heard calling at in the main wetland, just north of Willis Point Road. Detailed field data is provided in Appendix B.

No amphibians were observed or detected in the other wetlands in the spill pathway. These wetlands represented low quality breeding habitat due to a lack of standing water.

4 CONCLUSION

The 2021 sampling events consisted of sampling of surface water, groundwater, soil and sediments within the spill pathway and its receptors to assess the risk of the spill to ecological and human health. Based on the sampling results contrasted with the appropriate BC CSR standards and the BC water quality guidelines, the spill poses low risk. Since the End of Spill Report (Associated 2021), parameters of concern, specifically E. *coli* and fecal coliforms, have declined overtime, with no evidence of more being added to the system. Also, there is no evidence of the microbial parameters migrating out of the wetland system to Durrance Lake, or shallow or deep groundwater. Based on these results sampling can be considered complete, with no additional sampling recommended.

Amphibians were observed and heard at low density in the largest wetland at the Site, including adults and one egg mass. There were no obvious impediments to the completion of the lifecycle from the spill; however, amphibian use and successful breeding would be affected by annual water fluctuations and variable water quality that naturally

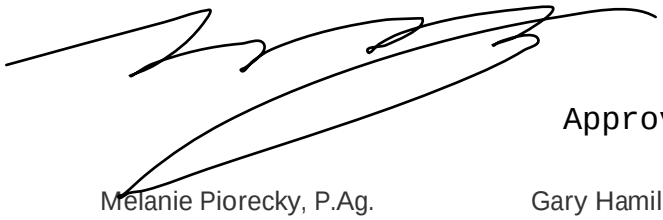
occurs in the wetland. Based on lab analysis of the fate of the spill, successful use of the wetland by amphibians to date, and natural variability of the wetland water levels, no additional amphibian monitoring is recommended.

CLOSURE

This report was prepared for the Hartland Resource Management Group to summarize sampling results and finalization of sampling related to the October 2020 residuals spill at the CRD facility.

The services provided by Associated Environmental Consultants Inc. in the preparation of this report were conducted in a manner consistent with the level of skill ordinarily exercised by members of the profession currently practicing under similar conditions. No other warranty expressed or implied is made.

Respectfully submitted,
Associated Environmental Consultants Inc.



Approved May 27, 2021 report via email.

Melanie Piorecky, P.Ag.
Project Manager

Gary Hamilton, P.Geo., CSAP.
Quality Review

REFERENCES

AECOM Canada Ltd. (AECOM). 2019. Hartland Landfill Groundwater, Surface Water and Leachate Monitoring Program Annual Report. Prepared for the Capital Regional District

British Columbia Ministry of Environment (MOE). 2009. BC Environment Technical Guidance Document 1, Site Characterization and Confirmation Testing.

British Columbia Ministry of Environment (MOE). 2013. B.C. Field Sampling Manual, Part E: Water and Wastewater Sampling.

British Columbia Ministry of Environment and Climate Change Strategy (ENV). 2017a. Protocol 21 for Contaminated Sites. Water Use Determination. Version 2.0. November 1, 2017.

British Columbia Ministry of Environment and Climate Change Strategy (ENV). 2017b. Background Concentrations in Soil Database. Technical Guidance 17.

British Columbia Ministry of Environment and Climate Change Strategy (ENV). 2019a. BC Approved Water Quality Guidelines for Aquatic Life, Wildlife and Agriculture.

British Columbia Ministry of Environment and Climate Change Strategy (ENV). 2019b. BC Recreational Water Quality Guidelines.

British Columbia Ministry of Environment and Climate Change Strategy (ENV). 2020a. BC Working Water Quality Guidelines: Aquatic Life, Wildlife and Agriculture.

British Columbia Ministry of Environment and Climate Change Strategy (ENV). 2020b. BC Source Drinking Water Guidelines.

Island Health. 2020. South Vancouver Island Beach Sampling Results, Sampling Season for 2020.

APPENDIX A - DETAILED LAB RESULTS

Residual Treatment Facility Spill
Surface Water Quality Results

Analyte	Unit	Guideline					Sampling Location	Durrance Lake SE	Durrance Lake SE	Durrance Lake SE	RTF-1-WPRO	RTF-1-WPRO	RTF-1-WPRO	RTF-3-WPRO	RTF-3-WPRO	RTF-3-WPRO	RTF-3-WPRO	RTF-NAR-W1	RTF-NAR-W1	RTF-NAR-W1	RTF-WPRO-02	RTF-WPRO-02	RTF-WPRO-02	RTF-WPRO-02	Stormceptor
							Date Sampled	18-Jan-21	18-Feb-21	18-Mar-21	03-Feb-21	18-Feb-21	18-Mar-21	18-Jan-21	03-Feb-21	18-Feb-21	18-Mar-21	18-Jan-21	18-Feb-21	18-Mar-21	03-Feb-21	18-Feb-21	18-Mar-21	18-Mar-21	03-Mar-21
							Lab Sample ID	1973494	2117963	2237534	2048592	2117973	2237540	1973935	2048604	2117975	2237542	1973936	2117972	2237539	2048603	2117974	2237541	2237543	2173259
							Sample Type																			
		BCAWQG AL (LT)	BCAWQG AL (ST)	BCWWQG AL	*BC RWQG*	BCAWQG WL																				
Lab Results																										
Anions and Cations in meq/L unit																										
Aluminum (meq/L) (calculated)	meq/L	NG	NG	NG	NG	NG		0.0004	0.0003	0.0002		0.0062	0.0004	0.0007		0.0004	<0.0002	0.0007	0.0006	0.0006		0.0003	<0.0002	<0.0002	
Barium (meq/L) (calculated)	meq/L	NG	NG	NG	NG	NG		0.00001	0.000017	0.000016		0.000064	0.000060	0.000068		0.000063	0.000045	0.000020	0.000020	0.000016		0.000058	0.000045	0.000039	
Boron (meq/L) (calculated)	meq/L	NG	NG	NG	NG	NG		0.0042	0.0053	0.0053		0.0039	0.0042	0.0042		0.0036	0.0036	0.0042	0.0033	0.0039		0.0033	0.0031	0.0042	
Bromide (meq/L) (calculated)	meq/L	NG	NG	NG	NG	NG		<0.0006	<0.0006	<0.0006		<0.0006	<0.0006	<0.0006		<0.0006	<0.0006	<0.0006	<0.0006	<0.0006		<0.0006	<0.0006	<0.0006	
Calcium (meq/L) (calculated)	meq/L	NG	NG	NG	NG	NG		1.1926	1.4571	1.6417		3.1786	3.0189	2.6098		2.3503	2.7196	1.8712	1.9311	1.9361		2.3054	2.6746	2.6896	
Calcium (total, meq/L) (calculated)	meq/L	NG	NG	NG	NG	NG		1.0728	1.482	1.5619		2.9541	3.3283	2.475		2.2305	2.7096	1.8912	2.1158	2.1507		2.1457	2.7096	2.7146	
Chloride (meq/L) (calculated)	meq/L	NG	NG	NG	NG	NG		0.162	0.171	0.231		0.191	0.392	0.324		0.251	0.513	0.106	0.109	0.122		0.203	0.632	0.629	
Chromium (meq/L) (calculated)	meq/L	NG	NG	NG	NG	NG		<0.00003	<0.00003	<0.00003		<0.00003	<0.00003	<0.00003		<0.00003	<0.00003	<0.00003	<0.00003	<0.00003		<0.00003	<0.00003	<0.00003	
Copper (meq/L) (calculated)	meq/L	NG	NG	NG	NG	NG		<0.000006	0.000009	0.000006		0.00002	<0.000006	0.000009		0.000006	0.000009	<0.000006	<0.000006	<0.000006		0.000009	0.000009	0.000009	
Fluoride (meq/L) (calculated)	meq/L	NG	NG	NG	NG	NG		<0.001	<0.001	<0.001		<0.001	<0.001	<0.001		<0.001	0.002	<0.001	<0.001	<0.001		0.001	0.001	<0.001	
Lead (meq/L) (calculated)	meq/L	NG	NG	NG	NG	NG		<0.0000005	<0.0000005	<0.0000005		0.0000009	<0.0000005	<0.0000005		<0.0000005	<0.0000005	<0.0000005	<0.0000005	<0.0000005		<0.0000005	<0.0000005	<0.0000005	
Lithium (meq/L) (calculated)	meq/L	NG	NG	NG	NG	NG		<0.00007	<0.00007	<0.00007		<0.00007	<0.00007	<0.00007		<0.00007	<0.00007	<0.00007	<0.00007	<0.00007		<0.00007	<0.00007	<0.00007	
Magnesium (meq/L) (calculated)	meq/L	NG	NG	NG	NG	NG		0.2370	0.2888	0.3209		0.6114	0.5818	0.5332		0.4880	0.5587	0.3473	0.3522	0.3431		0.5061	0.5670	0.5703	
Magnesium (total, meq/L) (calculated)	meq/L	NG	NG	NG	NG	NG		0.2238	0.2954	0.3045		0.5966	0.6386	0.5069		0.4756	0.5555	0.3588	0.4073	0.3892		0.4723	0.5711	0.5694	
Potassium (meq/L) (calculated)	meq/L	NG	NG	NG	NG	NG		0.00640	0.00806	0.00826		0.02788	0.02891	0.04016		0.03504	0.03607	0.0110	0.0107	0.0105		0.03223	0.04144	0.04093	
Potassium (total, meq/L) (calculated)	meq/L	NG	NG	NG	NG	NG		0.00665	0.00941	0.00844		0.02916	0.02993	0.03811		0.03581	0.03402	0.0114	0.0134	0.0112		0.03300	0.04093	0.04042	
Sodium (meq/L) (calculated)	meq/L	NG	NG	NG	NG	NG		0.1918	0.1975	0.2192		0.2319	0.2549	0.3119		0.2584	0.3280	0.1666	0.1492	0.1562		0.2092	0.3715	0.3684	
Sodium (total, meq/L) (calculated)	meq/L	NG	NG	NG	NG	NG		0.1901	0.2140	0.2188		0.2427	0.2710	0.3045		0.2758	0.3332	0.1744	0.1692	0.1740		0.2184	0.3641	0.3628	
Strontium (meq/L) (calculated)	meq/L	NG	NG	NG	NG	NG		0.00110	0.00161	0.00177		0.00324	0.00331	0.00308		0.00285	0.00326	0.00180	0.00187	0.00194		0.00240	0.00340	0.00340	
Sulfate (meq/L) (calculated)	meq/L	NG	NG	NG	NG	NG		0.242	0.269	0.306		1.23	1.25	1.2		1.01	1.03	0.627	0.487	0.514		0.972	1.17	1.17	
Zinc (meq/L) (calculated)	meq/L	NG	NG	NG	NG	NG		<0.00006	<0.00006	<0.00006		<0.00006	<0.00006	<0.00006		0.0001	<0.00006	<0.00006	<0.00006	<0.00006		<0.00006	0.0002	0.0002	
General and Inorganic Parameters																										
Alkalinity (total, as CaCO3)	mg/L	NG	NG	N [1.1]	NG	NG		59	78	92		121	120	102		97	108	87	92	96		92	97	97	
Ammonia (total, as N)	µg/L	Calc [1.1]	Calc [2.1]	NG	NG	NG		<10	<10	60		<10	50	<10		<10	40	<10	<10	60		50	50	50	<10
Ammonia, total (dissolved as N)	µg/L	NG	NG	NG	NG	NG																			
Biochemical oxygen demand	mg/L	NG	NG	NG	NG	NG		<4	<4	<4		8	26	<4		6	4	21	4	20		<4	<4	<4	
Bromide	µg/L	NG	NG	NG	NG	NG		<50	<50	<50		<50	<50	<50		<50	<50	<50	<50	<50		<50	<50	<50	
Chloride ion	mg/L	150 [1.2]	600 [2.2]	NG	NG	600		5.76	6.07	8.18		6.77	13.9	11.5		8.89	18.2	3.77	3.85	4.31		7.19	22.4	22.3	
Conductivity	µS/cm	NG	NG	NG	NG	NG																			
Fluoride	µg/L	Calc [1.3]	Calc [2.3]	NG	NG	1500 [5.1]		<20	<20	<20		<20	<20	<20		<20	30	<20	<20	<20		20	20	<20	
Nitrate (as N)	mg/L	3.0 [1.4]	32.8 [2.4]	NG	10	100 [5.2]		0.017	0.018	0.014		0.154	0.120	0.132		0.082	0.007	0.103	0.111	0.050		0.099	0.181	0.159	0.008
Nitrate + Nitrite (as N) (calculated)	mg/L	3.0 [1.5]	32.8 [2.5]	NG	NG	100 [5.3]		0.017	0.018	0.014		0.154	0.120	0.132		0.082	<0.007	0.103	0.111	0.050		0.099	0.181	0.159	0.770
Nitrite (as N)	µg/L	Calc [1.6]	Calc [2.6]	NG	1000	10000		<5	<5	<5		<5	<5	<5		<5	<5	<5	<5	<5		<5	<5	<5	762
Dissolved kjeldahl nitrogen	µg/L	NG	NG	NG	NG	NG																			
Total kjeldahl nitrogen	µg/L	NG	NG	NG	NG	NG		<50	<50	<50		<50	<50	<50		100	50	60	<50	<50		140	<50	<50	
Total organic nitrogen	µg/L	NG	NG	NG	NG	NG			<100	<100		<100	<100			100	<100		<100	<100		<100	<100	<100	
Nitrogen, dissolved inorganic	µg/L	NG	NG	NG	NG	NG																			
Nitrogen, dissolved organic	µg/L	NG	NG	NG	NG	NG																			
Nitrogen, total	µg/L	NG	NG	NG	NG	NG		<50	<50	<50		190	150	150		180	60	160	160	90		240	190	190	
Nitrogen, total dissolved	µg/L	NG	NG	NG	NG	NG																			
Orthophosphate (dissolved, as P)	µg/L	NG	NG	NG	NG	NG		1	2	<1		2	<1	11		4	<1	<1	<1	<1		6	<1	<1	
Oxidation reduction potential	mV	NG	NG	NG	NG	NG																			
pH		N [1.7]	N [2.7]	NG	5.0 - 9.0	NG																			
Sulfate	mg/L	Calc [1.8]	Calc [2.8]	NG	NG	NG		11.6	12.9	14.7		58.9	59.9	57.8		48.6	49.5	30.1	23.4	24.7		46.7	56.3	56.3	
Temperature when received by lab	°C	NG	NG	NG	NG	NG																			
Total dissolved solids	mg/L	NG	NG	NG	NG	NG		95	120	132		228	240	210		198	208	148	145	152		180	225	215	
Total suspended solids	mg/L	N [1.9]	N [2.9]	NG	NG	N [1.4]																			
Turbidity	NTU	N [1.10]	N [2.10]	NG	50 [4.1]	N [1.5]																			
Microbiological																									
E. coli (counts)	CFU/100 mL	N [1.11]	N [2.11]	NG	200 [4.2]	NG																			
E. coli (MPN)	MPN/100 mL	N [1.12]	N [2.12]	NG	200 [4.3]	NG		<1	179	<1	<1	3	<1	<1	2	1	<1	<1	<1	<1	13	1	<1	<1	12
Fecal coliforms (counts)	CFU/100 mL	N [1.13]	N [2.13]	NG	NG	NG		<1	118	<1	1	1	<1	<1	<1	<1	<1	<1	<100	<100	10	2	<1	<1	8
Fecal coliforms (MPN)	MPN/100 mL	N [1.14]	N [2.14]	NG	NG	NG																			
Total coliforms (MPN)	MPN/100 mL	NG	NG	NG	NG	NG		108	313	<1	345	435	233.26	99	236	276	980.39	326	>2420	686.87	1554	687	100	2420	866
Total Metals																									
Aluminum (total)	µg/L	NG	NG	NG	NG	5000		19	21	28		447	39	12		10	<5	535	1260	558		26	8	8	
Antimony (total)	µg/L	NG	NG	9 [3.7]	NG	NG		<0.5	<0.5	<0.5		<0.5	<0.5	<0.5		<0.5	<0.5	<0.5	<0.5	<0.5		<0.5	<0.5	<0.5	
Arsenic (total)	µg/L	5	5	NG	NG	25		0.1	**14.5**	0.3		**11.9**	3.5	0.3		**14.9**	**7.6**	0.3	**14.2**	1.7		**12.7**	**5.8**	**9.7**	
Barium (total)	µg/L	NG	NG	1000	NG	NG		0.9	1.1	1.4		6.0	4.8	4.2		3.8	3.5	5.1	9.2	5.0		3.9	3.1	3.3	
Beryllium (total)	µg/L	NG	NG	0.13	NG	NG		<0.05	<0.05	<0.05		<0.05	<0.05	<0.05		<0.05	<0.05	<0.05	<0.05	<0.05		<0.05	<0.05	<0.05	
Bismuth (total)	µg/L	NG	NG	NG	NG	NG																			
Boron (total)	µg/L	1200	1200	NG	NG	5000		14	17	24		15	21	16		12	17	16	12	18		12	16	18	
Cadmium (total)	µg/L	NG	NG	NG	NG	NG		<0.01	<0.01	<0.01		<0.01	<0.01	<0.01		<0.01	0.01	<0.01	0.02	0.02		<0.01	<0.01	<0.01	
Calcium (total)	mg/L	NG	NG	NG	NG	NG		21.500	29.700	31.300		59.200	66.700	49.600		44.700	54.300	37.900	42.400	43.100		43.000	54.300	54.400	
Cesium (total)	µg/L	NG	NG	NG	NG	NG																			
Chromium (total)	µg/L	NG	NG	1 [3.8]	NG	NG		<0.5	<0.5	<0.5		0.8	<0.5	<0.5		<0.5	<0.5	**1.3**	**2.6**	**1.1**		<0.5	<0.5	<0.5	
Cobalt (total)	µg/L	4 [1.15]	110 [2.15]	NG	NG	NG		<0.05	<0.05	0.06		0.71	0.13	0.09		0.10	<0.05	0.52	1.41	0.61		0.19	<0.05	<0.05	
Copper (total)	µg/L	NG	NG	NG	NG	300		<0.5	1.0	0.9		2.0	0.5	<0.5		0.9	1.0	1.1	3.0	1.8		1.3	0.6	0.5	
Hardness, Total (total as CaCO3)	mg/L	NG	NG	NG	NG	NG		64.900	88.900	93.400		178.000	199.000	149.000		135.000	163.000	113.000	126.000	127.000		131.000	164.000	164.000	
Iron (total)	µg/L	1000	1000	NG	NG	NG		15	32	26		810	135	11		43	14	763	**1950**	782		185	15	13	
Lead (total)	µg/L	Calc [1.16]	Calc [2.16]	NG	NG	100		<0.05	0.06	<0.05		0.29	<0.05	<0.05		<0.05	<0.05	0.17	0.43	0.16		0.09	<0.05	<0.05	
Lithium (total)	µg/L	NG	NG	NG	NG	NG		<0.5	<0.5	0.5		<0.5	0.7	<0.5		<0.5	0.8	<0.5	<0.5	0.6		<0.5	0.6	<0.5	
Magnesium (total)	mg/L	NG	NG	NG	NG	NG		2.720	3.590	3.700		7.250	7.760	6.160		5.780	6.750	4.360	4.950	4.730		5.740	6.940	6.920	
Manganese (total)	µg/L	Calc [1.17]	Calc [2.17]	NG	NG	NG		2	3	3		223	151	6		28	3	395	999	346		86	10	9	
Mercury (total)	µg/L	0.020 [1.18]	0.020 [2.18]	NG	NG	0.020 [5.6]		<0.01	<0.01	<0.01		<0.01	<0.01	<0.01		<0.01	<0.01	<0.01	<0.01	<0.01		<0.01	<0.01	<0.01	
Molybdenum (total)	µg/L	1000 [1.19]	2000 [2.19]	NG	NG	50		<0.1	0.2	7.2		0.2	0.3	0.2		<0.1	0.3	0.2	0.2	0.3		<0.1	0.5	0.5	
Nickel (total)	µg/L	NG	NG	Calc [3.4]	NG	NG		<0.5	<0.5	<0.5		<0.5	<0.5	<0.5		<0.5	<0.5	0.5	2.2	1.3		<0.5	<0.5	<0.5	
Phosphorus (total, by ICPMS/ICPOES)	µg/L	N [1.20]	N [2.20]	NG	N [4.4]	NG																			
Phosphorus (total, APHA 4500-P)	µg/L	N [1.21]	N [2.21]	NG	N [4.5]	NG		<5	<5	<5		23	6	19		20	7	33	75	12		42	5	<5	
Potassium (total)	µg/L	NG	NG	NG	NG	NG		260	368	330		1140	1170	1490		1400	1330	445	524	437		1290	1600	1580	
Rubidium (total)	µg/L	NG	NG	NG	NG	NG																			
Selenium (total)	µg/L	2 [1.22]	2 [2.22]	NG	NG	2 [5.7]		<0.5	<0.5	<0.5		<0.5	<0.5	<0.5		<0.5	<0.5	<0.5	<0.5	<0.5		<0.5	<0.5	<0.5	
Silicon (total, as Si)	µg/L	NG	NG	NG	NG	NG																			
Silver (total)	µg/L	Calc [1.23]	Calc [2.23]	NG	NG	NG		0.02	<0.02	<0.02		<0.02	<0.02	<0.02		<0.02	<0.02	<0.02	<0.02	<0.02		<0.02	<0.02	<0.02	
Sodium (total)	mg/L	NG	NG	NG	NG	NG		4.370	4.920	5.030		5.580	6.230	7.000		6.340	7.660	4.010	3.890	4.000		5.020	8.370	8.340	
Strontium (total)	µg/L	NG	NG	NG	NG	NG		49.7	65.8	74.8		136	148	130		118	134	85.9	87.4	90.3		97.5	140	144	
Sulphur (total)	µg/L	NG	NG	NG	NG	NG																			
Tellurium (total)	µg/L	NG	NG	NG	NG	NG																			
Thallium (total)	µg/L	NG	NG	0.8 [3.5]	NG	NG		<0.02	<0.02	0.03		<0.02	<0.02	<0.02		<0.02	<0.02	<0.02	<0.02	<0.02		<0.02	<0.02	<0.02	
Thorium (total)	µg/L	NG	NG	NG	NG	NG																			
Tin (total)	µg/L	NG	NG	NG	NG	NG		0.05	<0.05	<0.05		<0.05	<0.05	<0.05		<0.05	<0.05	<0.05	<0.05	<0.05		<0.05	<0.05	<0.05	
Titanium (total)	µg/L	NG	NG	NG	NG	NG		1.7	2.0	1.1		25.3	2.3	1.3		1.1	<0.5	27.3	61.5	29.7		1.7	<0.5	0.9	
Tungsten (total)	µg/L	NG	NG	NG	NG	NG		<0.1	<0.1	<0.1		<0.1	<0.1	<0.1		<0.1	<0.1	<0.1	<0.1	<0.1		<0.1	<0.1	<0.1	
Uranium (total)	µg/L	NG	NG	8.5	NG	NG		0.04	0.07	0.07		0.14	0.10	0.09		0.09	0.10	0.15	0.29	0.19		0.09	0.19	0.18	

Analyte	Unit	Guideline					Sampling Location	Durrance Lake SE	Durrance Lake SE	Durrance Lake SE	RTF-1-WPRO	RTF-1-WPRO	RTF-1-WPRO	RTF-3-WPRO	RTF-3-WPRO	RTF-3-WPRO	RTF-3-WPRO	RTF-NAR-W1	RTF-NAR-W1	RTF-NAR-W1	RTF-WPRO-02	RTF-WPRO-02	RTF-WPRO-02	RTF-WPRO-02	Stormceptor
							Date Sampled	18-Jan-21	18-Feb-21	18-Mar-21	03-Feb-21	18-Feb-21	18-Mar-21	18-Jan-21	03-Feb-21	18-Feb-21	18-Mar-21	18-Jan-21	18-Feb-21	18-Mar-21	03-Feb-21	18-Feb-21	18-Mar-21	18-Mar-21	03-Mar-21
							Lab Sample ID	1973494	2117963	2237534	2048592	2117973	2237540	1973935	2048604	2117975	2237542	1973936	2117972	2237539	2048603	2117974	2237541	2237543	2173259
							Sample Type																		
		BCAWQG AL (LT)	BCAWQG AL (ST)	BCWWQG AL	*BC RWQG*	BCAWQG WL																			
Vanadium (total)	µg/L	NG	NG	NG	NG	NG		<1	<1	2		2	1	<1		<1	1	2	5	3		1	2	2	
Zinc (total)	µg/L	Calc [1.24]	Calc [2.24]	NG	NG	NG		<5	<5	<5		<5	<5	<5		<5	<5	<5	<5	<5		<5	<5	<5	
Zirconium (total)	µg/L	NG	NG	NG	NG	NG																			
Dissolved Metals																									
Aluminum (dissolved)	µg/L	Calc [1.25]	Calc [2.25]	NG	NG	5000		4	3	2		**56**	4	6		4	<2	6	5	5		3	<2	<2	
Antimony (dissolved)	µg/L	NG	NG	9 [3.6]	NG	NG		<0.2	<0.2	<0.2		<0.2	<0.2	<0.2		<0.2	<0.2	<0.2	<0.2	<0.2		<0.2	<0.2	<0.2	
Arsenic (dissolved)	µg/L	5 [1.26]	5 [2.26]	NG	NG	25		0.1	<0.1	<0.1		0.2	0.2	0.1		<0.1	<0.1	0.2	0.1	0.1		0.1	<0.1	<0.1	
Barium (dissolved)	µg/L	NG	NG	1000	NG	NG		0.8	1.2	1.1		4.4	4.1	4.7		4.3	3.1	1.4	1.4	1.1		4.0	3.1	2.7	
Beryllium (dissolved)	µg/L	NG	NG	0.13	NG	NG		<0.01	<0.01	<0.01		<0.01	<0.01	<0.01		<0.01	<0.01	<0.01	<0.01	<0.01		<0.01	<0.01	<0.01	
Bismuth (dissolved)	µg/L	NG	NG	NG	NG	NG																			
Boron (dissolved)	µg/L	1200 [1.27]	1200 [2.27]	NG	NG	5000		15	19	19		14	15	15		13	13	15	12	14		12	11	15	
Cadmium (dissolved)	µg/L	Calc [1.28]	Calc [2.28]	NG	NG	NG		<0.01	<0.01	0.01		<0.01	<0.01	0.02		<0.01	<0.01	0.02	<0.01	<0.01		<0.01	0.01	<0.01	
Calcium (dissolved)	mg/L	NG	NG	N [3.7]	NG	NG		23.900	29.200	32.900		63.700	60.500	52.300		47.100	54.500	37.500	38.700	38.800		46.200	53.600	53.900	
Cesium (dissolved)	µg/L	NG	NG	NG	NG	NG																			
Chromium (dissolved)	µg/L	NG	NG	1 [3.8]	NG	NG		<0.5	<0.5	<0.5		<0.5	<0.5	<0.5		<0.5	<0.5	<0.5	<0.5	<0.5		<0.5	<0.5	<0.5	
Cobalt (dissolved)	µg/L	4 [1.29]	110 [2.29]	NG	NG	NG		<0.05	<0.05	<0.05		0.12	0.09	<0.05		<0.05	<0.05	<0.05	<0.05	<0.05		0.09	<0.05	<0.05	
Copper (dissolved)	µg/L	N [1.30]	N [2.30]	NG	NG	300 [5.8]		<0.2	0.3	0.2		0.6	<0.2	0.3		0.2	0.3	<0.2	<0.2	<0.2		0.3	0.3	0.3	
Hardness, Total (dissolved as CaCO3)	mg/L	NG	NG	NG	NG	NG		71.500	87.400	98.200		190.000	180.000	157.000		142.000	164.000	111.000	114.000	114.000		141.000	162.000	163.000	
Iron (dissolved)	µg/L	350	350	NG	NG	NG		<10	<10	<10		149	42	<10		17	<10	<10	<10	<10		38	<10	<10	
Lead (dissolved)	µg/L	Calc [1.31]	Calc [2.31]	NG	NG	100		<0.05	<0.05	<0.05		0.09	<0.05	<0.05		<0.05	<0.05	<0.05	<0.05	<0.05		<0.05	<0.05	<0.05	
Lithium (dissolved)	µg/L	NG	NG	NG	NG	NG		<0.5	<0.5	<0.5		<0.5	<0.5	<0.5		<0.5	<0.5	<0.5	<0.5	<0.5		<0.5	<0.5	<0.5	
Magnesium (dissolved)	mg/L	NG	NG	NG	NG	NG		2.880	3.510	3.900		7.430	7.070	6.480		5.930	6.790	4.220	4.280	4.170		6.150	6.890	6.930	
Manganese (dissolved)	µg/L	Calc [1.32]	Calc [2.32]	NG	NG	NG		<1	1	1		82	112	7		25	3	3	<1	2		84	13	13	
Mercury (dissolved)	µg/L	0.020 [1.33]	0.020 [2.33]	NG	NG	0.020 [5.9]		<0.01		<0.01			<0.01	<0.01			<0.01	<0.01		<0.01			<0.01	<0.01	
Molybdenum (dissolved)	µg/L	1000 [1.34]	2000 [2.34]	NG	NG	50 [5.10]		0.14	0.28	0.27		0.23	0.21	0.33		0.28	0.26	<0.05	0.15	0.15		0.27	0.35	0.37	
Nickel (dissolved)	µg/L	NG	NG	Calc [3.9]	NG	NG		0.4	<0.2	<0.2		0.3	<0.2	<0.2		<0.2	<0.2	0.3	<0.2	<0.2		<0.2	<0.2	<0.2	
Phosphorus (dissolved, by ICPMS/ICPOES)	µg/L	N [1.35]	N [2.35]	NG	N [4.6]	NG																			
Phosphorus (dissolved, APHA 4500-P)	µg/L	N [1.36]	N [2.36]	NG	N [4.7]	NG			<5	<5		<5	<5			7	<5		<5	<5		8	<5	<5	
Potassium (dissolved)	µg/L	NG	NG	NG	NG	NG		250	315	323		1090	1130	1570		1370	1410	430	417	412		1260	1620	1600	
Rubidium (dissolved)	µg/L	NG	NG	NG	NG	NG																			
Selenium (dissolved)	µg/L	2 [1.37]	2 [2.37]	NG	NG	2 [5.11]		<0.5	<0.5	<0.5		<0.5	<0.5	<0.5		<0.5	<0.5	<0.5	<0.5	<0.5		<0.5	<0.5	<0.5	
Silicon (dissolved, as Si)	µg/L	NG	NG	NG	NG	NG																			
Silver (dissolved)	µg/L	Calc [1.38]	Calc [2.38]	NG	NG	NG		<0.02	<0.02	<0.02		<0.02	<0.02	<0.02		<0.02	<0.02	<0.02	<0.02	<0.02		<0.02	<0.02	<0.02	
Sodium (dissolved)	mg/L	NG	NG	NG	NG	NG		4.410	4.540	5.040		5.330	5.860	7.170		5.940	7.540	3.830	3.430	3.590		4.810	8.540	8.470	
Strontium (dissolved)	µg/L	NG	NG	NG	NG	NG		48.4	70.6	77.7		142	145	135		125	143	78.7	82.1	84.9		105	149	149	
Sulphur (dissolved)	µg/L	NG	NG	NG	NG	NG																			
Tellurium (dissolved)	µg/L	NG	NG	NG	NG	NG																			
Thallium (dissolved)	µg/L	NG	NG	0.8 [3.10]	NG	NG		0.01	<0.01	<0.01		<0.01	<0.01	<0.01		<0.01	<0.01	<0.01	<0.01	<0.01		<0.01	<0.01	<0.01	
Thorium (dissolved)	µg/L	NG	NG	NG	NG	NG																			
Tin (dissolved)	µg/L	NG	NG	NG	NG	NG		<0.05	<0.05	<0.05		<0.05	<0.05	<0.05		<0.05	<0.05	<0.05	<0.05	<0.05		<0.05	<0.05	<0.05	
Titanium (dissolved)	µg/L	NG	NG	NG	NG	NG		0.6	<0.5	<0.5		2.2	<0.5	0.9		<0.5	<0.5	0.9	0.7	0.6		<0.5	<0.5	<0.5	
Tungsten (dissolved)	µg/L	NG	NG	NG	NG	NG		<0.01	<0.01	<0.01		<0.01	<0.01	<0.01		<0.01	<0.01	<0.01	<0.01	<0.01		<0.01	<0.01	<0.01	
Uranium (dissolved)	µg/L	NG	NG	8.5	NG	NG		0.03	0.05	0.07		0.12	0.10	0.09		0.10	0.12	0.04	0.06	0.09		0.10	0.21	0.22	
Vanadium (dissolved)	µg/L	NG	NG	NG	NG	NG		<0.5	0.7	0.9		<0.5	<0.5	0.6		<0.5	<0.5	<0.5	<0.5	<0.5		<0.5	<0.5	0.6	
Zinc (dissolved)	µg/L	Calc [1.39]	Calc [2.39]	NG	NG	NG		<2	<2	<2		<2	<2	<2		4	<2	<2	<2	<2		<2	5	6	
Zirconium (dissolved)	µg/L	NG	NG	NG	NG	NG																			

Guideline Notes for Reports for 2020-8732 CRD Spill Surface Water Quality Results

1. Notes for BC Approved Water Quality Guidelines for freshwater aquatic life (Long-term chronic) (BCAWQG AL (LT))

General Notes:

For some parameters, there are two water quality guidelines: the short-term acute guideline (i.e. maximum), and the long-term chronic guideline (i.e. average). The long-term chronic guideline was used in this criteria set for parameters that have both guideline values.

Note 1.1 for Ammonia (total, as N):

The maximum guideline for ammonia varies as a function of pH and temperature. See Table 3 in Overview Report Update September 2009.

The 30-day average guideline for ammonia varies as a function of pH and temperature. See Table 4 in Overview Report Update September 2009. / The lab pH and field temperature results were used for determining the maximum ammonia concentration for this report. If a lab pH result was not available then the field pH result was used.

Note 1.2 for Chloride ion:

To protect freshwater aquatic life from acute and lethal effects, the maximum concentration of chloride (mg/L as NaCl) at any time should not exceed 600 mg/L.

To protect freshwater aquatic life from chronic effects, the average (arithmetic mean computed from five weekly samples collected over a 30-day period) concentration of chloride (mg/L as NaCl) should not exceed 150 mg/L.

Note 1.3 for Fluoride:

Correction by BC MOE Sept. 2011: The criteria for Fluoride (total) in mg/L is 0.4 as a maximum where the water hardness (as CaCO3) is less than or equal to 10 mg/L. Otherwise use the equation:

LC50 fluoride = -51.73 + 92.57 log10 (Hardness) and multiply by 0.01.

Hardness is as CaCO3 in units mg/L.

Note 1.4 for Nitrate (as N):

The guideline maximum for nitrate (as N) is 32.8 mg/l.

The 30-day average guideline for nitrate (as N) is 3.0 mg /L. The 30-day average (chronic) concentration is based on 5 weekly samples collected within a 30-day period.

Where nitrate and nitrite are present, the total nitrate+nitrite nitrogen should not exceed these values.

Note 1.5 for Nitrate + Nitrite (as N) (calculated):

The guideline maximum for nitrate (as N) is 32.8 mg/l.

The 30-day average guideline for nitrate (as N) is 3.0 mg /L. The 30-day average (chronic) concentration is based on 5 weekly samples collected within a 30-day period.

Where nitrate and nitrite are present, the total nitrate+nitrite nitrogen should not exceed these values.

Note 1.6 for Nitrite (as N):

The guideline maximum for nitrite as N is:
0.06 mg/L if chloride less than 2 mg/L
0.12 mg/L if chloride is 2 to 4 mg/L
0.18 mg/L if chloride is 4 to 6 mg/L
0.24 mg/L if chloride is 6 to 8 mg/L
0.30 mg/L if chloride is 8 to 10 mg/L
0.60 mg/L if chloride is greater than 10 mg/L.
The guideline 30-day average for nitrite as N is:
0.02 mg/L if chloride less than 2 mg/L
0.04 mg/L if chloride is 2 to 4 mg/L
0.06 mg/L if chloride is 4 to 6 mg/L
0.08 mg/L if chloride is 6 to 8 mg/L
0.10 mg/L if chloride is 8 to 10 mg/L
0.20 mg/L if chloride is greater than 10 mg/L.

Note 1.7 for pH:
pH less than 6.5: No statistically significant decrease in pH from background.
pH from 6.5 to 9.0: Unrestricted change permitted within this range.
pH over 9.0: No statistically significant increase in pH from background.
See BC MOE Overview Report for additional details.

Note 1.8 for Sulfate:
The approved 30-day average (minimum of 5 evenly-spaced samples collected in 30 days) water quality guidelines to protect aquatic life in BC for sulphate are:
128 mg/L at hardness of 0 to 30 mg/L as CaCO3
218 mg/L at hardness of 31 to 75 mg/L as CaCO3
309 mg/L at hardness of 76 to 180mg/L as CaCO3
429 mg/L at hardness 181 to 250 mg/L as CaCO3
Need to determine guideline based on site water for hardness greater than 250 mg/L as CaCO3.
For screening purposes in this report, exceedance were flagged for sulphate greater than 429 mg/L at hardness greater than 250 mg/L as CaCO3.

Note 1.9 for Total suspended solids:
Maximum Induced Suspended Sediments - mg/L or % of background:
- 25 mg/L in 24 hours when background is less than or equal to 25;
- Mean of 5 mg/L in 30 days when background is less than or equal to 25;
- 25 mg/L when background is between 25 and 250;
- 10% when background is greater than or equal to 250.

Note 1.10 for Turbidity:
When background is less than or equal to 8 NTU:
- Maximum Induced Turbidity of 8 NTU in 24 hours.
- For sediment inputs that last between 24 hours and 30 days (daily sampling preferred) the mean turbidity should not exceed background by more than 2 NTU.

Maximum Induced Turbidity of 5 NTU when background is between 8 and 50 NTU.
Maximum Induced Turbidity of 10% when background is greater than 50 NTU.

Note 1.11 for E. coli (counts):
The escherichia coli density in fresh and marine waters used for the growing and harvesting of shellfish for human consumption should not exceed a median MPN of 14/100 mL over 30 days, and at least 90% of the samples in a 30-day period should not exceed 43/100 mL.

Note 1.12 for E. coli (MPN):
The escherichia coli density in fresh and marine waters used for the growing and harvesting of shellfish for human consumption should not exceed a median MPN of 14/100 mL over 30 days, and at least 90% of the samples in a 30-day period should not exceed 43/100 mL.

Note 1.13 for Fecal coliforms (counts):
The guideline for fecal coliforms is as follows: “The fecal coliform density in fresh and marine waters used for the growing and harvesting of shellfish for human consumption should not exceed a median MPN of 14/100 mL over 30 days, and at least 90% of the samples in a 30-day period should not exceed 43/100 mL.”

Note 1.14 for Fecal coliforms (MPN):
The guideline for fecal coliforms is as follows: “The fecal coliform density in fresh and marine waters used for the growing and harvesting of shellfish for human consumption should not exceed a median MPN of 14/100 mL over 30 days, and at least 90% of the samples in a 30-day period should not exceed 43/100 mL.”

Note 1.15 for Cobalt (total):
The interim maximum concentration for total cobalt is 110 µg/L to protect aquatic life in the freshwater environment from acute effects of cobalt.
The interim 30-day average concentration for total cobalt (based on five weekly samples) is 4 µg/L to protect aquatic life from chronic effects of cobalt.

Note 1.16 for Lead (total):
The maximum guideline for total lead in water, at a water hardness less than or equal to 8 mg/L as CaCO3 is set at 3.0 µg/L. When water hardness exceeds 8.0 mg/L CaCO3 the maximum guideline for lead at any time is given by the following equation:
Maximum Criteria (µg/L) = exp (1.273 ln(hardness) - 1.460).
The 30-day average guideline for total lead in water, when water hardness exceeds 8 mg/L as CaCO3, is as follows:
30-Day Average (µg/L) is less than or equal to 3.31 + exp (1.273 ln (mean hardness) - 4.704).
For hardness less than or equal to 8.0 mg/L there is no 30-day average guideline; hence the maximum concentration of 3.0 µg/L is used.

Note 1.17 for Manganese (total):
The maximum concentration of total manganese in mg/L at any time should not exceed the value as determined by the following relationship:
0.01102 hardness + 0.54
where water hardness is reported as mg/L of CaCO3.
The 30-day mean concentration of total manganese in mg/L should be less than or equal to the value as determined by the following relationship:
0.0044 hardness + 0.605
where water hardness is reported as mg/L of CaCO3.

Note 1.18 for Mercury (total):
The average concentration of total mercury in water as measured over a 30-day period (based on five weekly samples) should not exceed 0.02 µg/L when the methyl mercury (MeHg) constitutes less than or equal to 0.5% of the total mercury concentration. When the proportion of MeHg is greater than 0.5%, the guideline should be adjusted as indicated in the Table 1 and Table 4 of the BC MOE Overview Report - First Update, February 2001.
There is no guideline maximum for total mercury in water, for freshwater aquatic life.

Note 1.19 for Molybdenum (total):
The maximum concentration for total molybdenum is 2 mg/L.
The 30-day average concentration for total molybdenum (based on at least five weekly samples in a period of 30 days) is less than or equal to 1 mg/L.

Note 1.20 for Phosphorus (total, by ICPMS/ICPOES):

Streams: None proposed for streams.
Lakes: It is not possible to specify a single phosphorous concentration to achieve protection of aquatic life in lakes. A range of total phosphorous concentrations (5-15 µg/L) is suggested as the criterion which can be used as the basis for site specific water quality objectives.

Note 1.21 for Phosphorus (total, APHA 4500-P):
Streams: None proposed for streams.
Lakes: It is not possible to specify a single phosphorous concentration to achieve protection of aquatic life in lakes. A range of total phosphorous concentrations (5-15 µg/L) is suggested as the criterion which can be used as the basis for site specific water quality objectives.

Note 1.22 for Selenium (total):
The 30-day average water quality guideline for protection of aquatic life is 2 µg/L determined as the mean concentration of 5 evenly spaced samples collected over 30 days, and measured as total selenium.
The 30-day average alert concentration for the protection of aquatic life in sensitive ecosystems is 1 µg/L determined as the mean concentration of 5 evenly spaced samples collected over 30 days, and measured as total selenium.

Note 1.23 for Silver (total):
The guideline maximum for total silver is:
0.1 µg/L maximum if hardness less than or equal to 100 mg/L
3.0 µg/L maximum if hardness greater than 100 mg/L.
The guideline 30-day average for total silver is:
0.05 µg/L as 30-day mean if hardness less than or equal to 100 mg/L
1.5 µg/L as 30-day mean if hardness greater than 100 mg/L.

Note 1.24 for Zinc (total):
The maximum concentration of total zinc (µg/L) at any time should not exceed 33 µg/L when water hardness is less than or equal to 90 mg/L as CaCO3.
When water hardness exceeds 90 mg/L CaCO3, the guideline maximum in µg/L for total zinc is the value determined by the following relationship:
33 + 0.75 * (hardness - 90)
where water hardness is reported as mg/L of CaCO3.
The 30-day average concentration of total zinc (µg/L) at any time should not exceed 7.5 µg/L when water hardness is less than or equal to 90 mg/L as CaCO3.
When water hardness exceeds 90 mg/L CaCO3, the guideline maximum in µg/L for total zinc is the value determined by the following relationship:
7.5 + 0.75 * (hardness - 90)
where water hardness is reported as mg/L of CaCO3.

Note 1.25 for Aluminum (dissolved):
The maximum concentration of dissolved aluminum at any time should not exceed:
1. 0.10 mg/L when the pH is greater than or equal to 6.5
2. The value (in mg/L) determined by the following relationship if pH less than 6.5
Dissolved Aluminum = e (1.209-2.426 (pH) + 0.286 $(pH)^2$)
The 30-day average concentration of dissolved aluminum (based on a minimum of 5 approximately weekly samples) should not exceed:
1. 0.05 mg/L when the median pH over 30 days is greater than or equal to 6.5
2. the value determined by the following relationship at median pH less than 6.5
Dissolved Aluminum = e (1.6-3.327 (median pH) + 0.402 (median $pH)^2$) / The lab pH results were used for determining the maximum aluminum (dissolved) concentration for this report. If a lab pH result was not available then the field pH result was used.

Note 1.26 for Arsenic (dissolved):
The recommended guideline is for total arsenic.
Note 1.27 for Boron (dissolved):
The recommended guideline is for total boron.
Note 1.28 for Cadmium (dissolved):
The guideline for cadmium is determined on a site-specific basis according to the local water hardness. The guideline for cadmium (dissolved) in µg/L is determined by the following equations for long term exposure:
1. If hardness (as CaCO3) is less than 3.4 mg/L then maximum is 0.0176 µg/L
2. If hardness (as CaCO3) is from 3.4 to 285 mg/L then maximum is based on equation:
e raised to the power of {0.736[ln(hardness)] - 4.943}
3. If hardness (as CaCO3) is greater than 285 mg/L then maximum is 0.457 µg/L.
When water hardness is greater than the upper bound (i.e., highest water hardness tested), a site-specific assessment may be required.
Note 1.29 for Cobalt (dissolved):
The interim maximum concentration for total cobalt is 110 µg/L to protect aquatic life in the freshwater environment from acute effects of cobalt.
The interim 30-day average concentration for total cobalt (based on five weekly samples) is 4 µg/L to protect aquatic life from chronic effects of cobalt.
Note 1.30 for Copper (dissolved):
The guideline is for dissolved copper and is dependent on the specific chemistry of the water body and can only be calculated using the British Columbia Biotic Ligand Model (BC BLM) software.
Note 1.31 for Lead (dissolved):
The maximum guideline for total lead in water, at a water hardness less than or equal to 8 mg/L as CaCO3 is set at 3.0 µg/L. When water hardness exceeds 8.0 mg/L CaCO3 the maximum guideline for lead at any time is given by the following equation:
Maximum Criteria (µg/L) = exp (1.273 ln(hardness) - 1.460).
The 30-day average guideline for total lead in water, when water hardness exceeds 8 mg/L as CaCO3, is as follows:
30-Day Average (µg/L) is less than or equal to 3.31 + exp (1.273 ln (mean hardness) - 4.704).
For hardness less than or equal to 8.0 mg/L there is no 30-day average guideline; hence the maximum concentration of 3.0 µg/L is used.
Note 1.32 for Manganese (dissolved):
The maximum concentration of total manganese in mg/L at any time should not exceed the value as determined by the following relationship:
0.01102 hardness + 0.54
where water hardness is reported as mg/L of CaCO3.
The 30-day mean concentration of total manganese in mg/L should be less than or equal to the value as determined by the following relationship:
0.0044 hardness + 0.605
where water hardness is reported as mg/L of CaCO3.
Note 1.33 for Mercury (dissolved):
The average concentration of total mercury in water as measured over a 30-day period (based on five weekly samples) should not exceed 0.02 µg/L when the methyl mercury (MeHg) constitutes less than or equal to 0.5% of the total mercury concentration. When the proportion of MeHg is greater than 0.5%, the guideline should be adjusted as indicated in the Table 1 and Table 4 of the BC MOE Overview Report - First Update, February 2001.
There is no guideline maximum for total mercury in water, for freshwater aquatic life.
Note 1.34 for Molybdenum (dissolved):

The maximum concentration for total molybdenum is 2 mg/L.
The 30-day average concentration for total molybdenum (based on at least five weekly samples in a period of 30 days) is less than or equal to 1 mg/L.

Note 1.35 for Phosphorus (dissolved, by ICPMS/ICPOES):
Streams: None proposed for streams.
Lakes: It is not possible to specify a single phosphorous concentration to achieve protection of aquatic life in lakes. A range of total phosphorous concentrations (5-15 µg/L) is suggested as the criterion which can be used as the basis for site specific water quality objectives.

Note 1.36 for Phosphorus (dissolved, APHA 4500-P):
Streams: None proposed for streams.
Lakes: It is not possible to specify a single phosphorous concentration to achieve protection of aquatic life in lakes. A range of total phosphorous concentrations (5-15 µg/L) is suggested as the criterion which can be used as the basis for site specific water quality objectives.

Note 1.37 for Selenium (dissolved):
The 30-day average water quality guideline for protection of aquatic life is 2 µg/L determined as the mean concentration of 5 evenly spaced samples collected over 30 days, and measured as total selenium.
The 30-day average alert concentration for the protection of aquatic life in sensitive ecosystems is 1 µg/L determined as the mean concentration of 5 evenly spaced samples collected over 30 days, and measured as total selenium.

Note 1.38 for Silver (dissolved):
The guideline maximum for total silver is:
0.1 µg/L maximum if hardness less than or equal to 100 mg/L
3.0 µg/L maximum if hardness greater than 100 mg/L.
The guideline 30-day average for total silver is:
0.05 µg/L as 30-day mean if hardness less than or equal to 100 mg/L
1.5 µg/L as 30-day mean if hardness greater than 100 mg/L.

Note 1.39 for Zinc (dissolved):
The Short-term Maximum concentration of total zinc (µg/L) at any time should not exceed 33 µg/L when water hardness is less than or equal to 90 mg/L as CaCO3.
When water hardness exceeds 90 mg/L CaCO3, the Short-term Maximum guideline in µg/L for total zinc is the value determined by the following relationship:
33 + 0.75 * (hardness - 90)
where water hardness is reported as mg/L of CaCO3.
Short-term maximum WQG formula applies to water hardness between 90 – 500 mg/L CaCO3.
The Long-term Average concentration of total zinc (µg/L) at any time should not exceed 7.5 µg/L when water hardness is less than or equal to 90 mg/L as CaCO3.
When water hardness exceeds 90 mg/L CaCO3, the Long-term Average guideline in µg/L for total zinc is the value determined by the following relationship:
7.5 + 0.75 * (hardness - 90)
where water hardness is reported as mg/L of CaCO3.
Long-term average WQG formula applies to water hardness between 90 – 330 mg/L CaCO3.

2. Notes for BC Approved Water Quality Guidelines for freshwater aquatic life (Short-term acute) (BCAWQG AL (ST))
General Notes:
For some parameters, there are two water quality guidelines: the short-term acute guideline (i.e. maximum), and the long-term chronic guideline (i.e. average). The short-term acute guideline was used in this criteria set for parameters that have both guideline values.

Note 2.1 for Ammonia (total, as N):
The maximum guideline for ammonia varies as a function of pH and temperature. See Table 3 in Overview Report Update September 2009.
The 30-day average guideline for ammonia varies as a function of pH and temperature. See Table 4 in Overview Report Update September 2009. / The lab pH and field temperature results were used for determining the maximum ammonia for this report. If a lab pH result was not available then the field pH result was used.

Note 2.2 for Chloride ion:
To protect freshwater aquatic life from acute and lethal effects, the maximum concentration of chloride (mg/L as NaCl) at any time should not exceed 600 mg/L.
To protect freshwater aquatic life from chronic effects, the average (arithmetic mean computed from five weekly samples collected over a 30-day period) concentration of chloride (mg/L as NaCl) should not exceed 150 mg/L.

Note 2.3 for Fluoride:
Correction by BC MOE Sept. 2011: The criteria for Fluoride (total) in mg/L is 0.4 as a maximum where the water hardness (as CaCO3) is less than or equal to 10 mg/L. Otherwise use the equation:
LC50 fluoride = -51.73 + 92.57 log10 (Hardness) and multiply by 0.01.
Hardness is as CaCO3 in units mg/L.

Note 2.4 for Nitrate (as N):
The guideline maximum for nitrate (as N) is 32.8 mg/l.
The 30-day average guideline for nitrate (as N) is 3.0 mg /L. The 30-day average (chronic) concentration is based on 5 weekly samples collected within a 30-day period.
Where nitrate and nitrite are present, the total nitrate+nitrite nitrogen should not exceed these values.

Note 2.5 for Nitrate + Nitrite (as N) (calculated):
The guideline maximum for nitrate (as N) is 32.8 mg/l.
The 30-day average guideline for nitrate (as N) is 3.0 mg /L. The 30-day average (chronic) concentration is based on 5 weekly samples collected within a 30-day period.
Where nitrate and nitrite are present, the total nitrate+nitrite nitrogen should not exceed these values.

Note 2.6 for Nitrite (as N):
The guideline maximum for nitrite as N is:
0.06 mg/L if chloride less than 2 mg/L
0.12 mg/L if chloride is 2 to 4 mg/L
0.18 mg/L if chloride is 4 to 6 mg/L
0.24 mg/L if chloride is 6 to 8 mg/L
0.30 mg/L if chloride is 8 to 10 mg/L
0.60 mg/L if chloride is greater than 10 mg/L.
The guideline 30-day average for nitrite as N is:
0.02 mg/L if chloride less than 2 mg/L
0.04 mg/L if chloride is 2 to 4 mg/L
0.06 mg/L if chloride is 4 to 6 mg/L
0.08 mg/L if chloride is 6 to 8 mg/L
0.10 mg/L if chloride is 8 to 10 mg/L
0.20 mg/L if chloride is greater than 10 mg/L.

Note 2.7 for pH:
pH less than 6.5: No statistically significant decrease in pH from background.
pH from 6.5 to 9.0: Unrestricted change permitted within this range.
pH over 9.0: No statistically significant increase in pH from background.
See BC MOE Overview Report for additional details.

Note 2.8 for Sulfate:
The approved 30-day average (minimum of 5 evenly-spaced samples collected in 30 days) water quality guidelines to protect aquatic life in BC for sulphate are:
128 mg/L at hardness of 0 to 30 mg/L as CaCO3
218 mg/L at hardness of 31 to 75 mg/L as CaCO3
309 mg/L at hardness of 76 to 180mg/L as CaCO3
429 mg/L at hardness 181 to 250 mg/L as CaCO3
Need to determine guideline based on site water for hardness greater than 250 mg/L as CaCO3.
For screening purposes in this report, exceedance were flagged for sulphate greater than 429 mg/L at hardness greater than 250 mg/L as CaCO3.

Note 2.9 for Total suspended solids:
Maximum Induced Suspended Sediments - mg/L or % of background:
- 25 mg/L in 24 hours when background is less than or equal to 25;
- Mean of 5 mg/L in 30 days when background is less than or equal to 25;
- 25 mg/L when background is between 25 and 250;
- 10% when background is greater than or equal to 250.

Note 2.10 for Turbidity:
When background is less than or equal to 8 NTU:
- Maximum Induced Turbidity of 8 NTU in 24 hours.
- For sediment inputs that last between 24 hours and 30 days (daily sampling preferred) the mean turbidity should not exceed background by more than 2 NTU.

Maximum Induced Turbidity of 5 NTU when background is between 8 and 50 NTU.
Maximum Induced Turbidity of 10% when background is greater than 50 NTU.

Note 2.11 for E. coli (counts):
The escherichia coli density in fresh and marine waters used for the growing and harvesting of shellfish for human consumption should not exceed a median MPN of 14/100 mL over 30 days, and at least 90% of the samples in a 30-day period should not exceed 43/100 mL.

Note 2.12 for E. coli (MPN):
The escherichia coli density in fresh and marine waters used for the growing and harvesting of shellfish for human consumption should not exceed a median MPN of 14/100 mL over 30 days, and at least 90% of the samples in a 30-day period should not exceed 43/100 mL.

Note 2.13 for Fecal coliforms (counts):
The guideline for fecal coliforms is as follows: “The fecal coliform density in fresh and marine waters used for the growing and harvesting of shellfish for human consumption should not exceed a median MPN of 14/100 mL over 30 days, and at least 90% of the samples in a 30-day period should not exceed 43/100 mL.”

Note 2.14 for Fecal coliforms (MPN):
The guideline for fecal coliforms is as follows: “The fecal coliform density in fresh and marine waters used for the growing and harvesting of shellfish for human consumption should not exceed a median MPN of 14/100 mL over 30 days, and at least 90% of the samples in a 30-day period should not exceed 43/100 mL.”

Note 2.15 for Cobalt (total):
The interim maximum concentration for total cobalt is 110 µg/L to protect aquatic life in the freshwater environment from acute effects of cobalt.
The interim 30-day average concentration for total cobalt (based on five weekly samples) is 4 µg/L to protect aquatic life from chronic effects of cobalt.

Note 2.16 for Lead (total):

The maximum guideline for total lead in water, at a water hardness less than or equal to 8 mg/L as CaCO3 is set at 3.0 µg/L. When water hardness exceeds 8.0 mg/L CaCO3 the maximum guideline for lead at any time is given by the following equation:
Maximum Criteria (µg/L) = exp (1.273 ln(hardness) - 1.460).
The 30-day average guideline for total lead in water, when water hardness exceeds 8 mg/L as CaCO3, is as follows:
30-Day Average (µg/L) is less than or equal to 3.31 + exp (1.273 ln (mean hardness) - 4.704).
For hardness less than or equal to 8.0 mg/L there is no 30-day average guideline; hence the maximum concentration of 3.0 µg/L is used.

Note 2.17 for Manganese (total):
The maximum concentration of total manganese in mg/L at any time should not exceed the value as determined by the following relationship:
0.01102 hardness + 0.54
where water hardness is reported as mg/L of CaCO3.
The 30-day mean concentration of total manganese in mg/L should be less than or equal to the value as determined by the following relationship:
0.0044 hardness + 0.605
where water hardness is reported as mg/L of CaCO3.

Note 2.18 for Mercury (total):
The average concentration of total mercury in water as measured over a 30-day period (based on five weekly samples) should not exceed 0.02 µg/L when the methyl mercury (MeHg) constitutes less than or equal to 0.5% of the total mercury concentration. When the proportion of MeHg is greater than 0.5%, the guideline should be adjusted as indicated in the Table 1 and Table 4 of the BC MOE Overview Report - First Update, February 2001.
There is no guideline maximum for total mercury in water, for freshwater aquatic life.

Note 2.19 for Molybdenum (total):
The maximum concentration for total molybdenum is 2 mg/L.
The 30-day average concentration for total molybdenum (based on at least five weekly samples in a period of 30 days) is less than or equal to 1 mg/L.

Note 2.20 for Phosphorus (total, by ICPMS/ICPOES):
Streams: None proposed for streams.
Lakes: It is not possible to specify a single phosphorous concentration to achieve protection of aquatic life in lakes. A range of total phosphorous concentrations (5-15 µg/L) is suggested as the criterion which can be used as the basis for site specific water quality objectives.

Note 2.21 for Phosphorus (total, APHA 4500-P):
Streams: None proposed for streams.
Lakes: It is not possible to specify a single phosphorous concentration to achieve protection of aquatic life in lakes. A range of total phosphorous concentrations (5-15 µg/L) is suggested as the criterion which can be used as the basis for site specific water quality objectives.

Note 2.22 for Selenium (total):
The 30-day average water quality guideline for protection of aquatic life is 2 µg/L determined as the mean concentration of 5 evenly spaced samples collected over 30 days, and measured as total selenium.
The 30-day average alert concentration for the protection of aquatic life in sensitive ecosystems is 1 µg/L determined as the mean concentration of 5 evenly spaced samples collected over 30 days, and measured as total selenium.

Note 2.23 for Silver (total):

The guideline maximum for total silver is:
0.1 µg/L maximum if hardness less than or equal to 100 mg/L
3.0 µg/L maximum if hardness greater than 100 mg/L.
The guideline 30-day average for total silver is:
0.05 µg/L as 30-day mean if hardness less than or equal to 100 mg/L
1.5 µg/L as 30-day mean if hardness greater than 100 mg/L.

Note 2.24 for Zinc (total):

The maximum concentration of total zinc (µg/L) at any time should not exceed 33 µg/L when water hardness is less than or equal to 90 mg/L as CaCO3.
When water hardness exceeds 90 mg/L CaCO3, the guideline maximum in µg/L for total zinc is the value determined by the following relationship:
33 + 0.75 * (hardness - 90)
where water hardness is reported as mg/L of CaCO3.
The 30-day average concentration of total zinc (µg/L) at any time should not exceed 7.5 µg/L when water hardness is less than or equal to 90 mg/L as CaCO3.
When water hardness exceeds 90 mg/L CaCO3, the guideline maximum in µg/L for total zinc is the value determined by the following relationship:
7.5 + 0.75 * (hardness - 90)
where water hardness is reported as mg/L of CaCO3.

Note 2.25 for Aluminum (dissolved):

The maximum concentration of dissolved aluminum at any time should not exceed:
1. 0.10 mg/L when the pH is greater than or equal to 6.5
2. The value (in mg/L) determined by the following relationship if pH less than 6.5
Dissolved Aluminum = e (1.209-2.426 (pH) + 0.286 $(pH)^2$)
The 30-day average concentration of dissolved aluminum (based on a minimum of 5 approximately weekly samples) should not exceed:
1. 0.05 mg/L when the median pH over 30 days is greater than or equal to 6.5
2. the value determined by the following relationship at median pH less than 6.5
Dissolved Aluminum = e (1.6-3.327 (median pH) + 0.402 (median $pH)^2$)

Note 2.26 for Arsenic (dissolved):

The recommended guideline is for total arsenic.

Note 2.27 for Boron (dissolved):

The recommended guideline is for total boron.

Note 2.28 for Cadmium (dissolved):

The guideline for cadmium is determined on a site-specific basis according to the local water hardness. The guideline for cadmium (dissolved) in µg/L is determined by the following equations for short term exposure:
1. If hardness (as CaCO3) is less than 7 mg/L then maximum is 0.0380 µg/L
2. If hardness (as CaCO3) is from 7 to 45 mg/L then maximum is based on equation:
e to the power of {1.03[ln(hardness)] - 5.274}
3. If hardness (as CaCO3) is greater than 455 mg/L then maximum is 2.8 µg/L.
When water hardness is greater than the upper bound (i.e., highest water hardness tested), a site-specific assessment may be required.

Note 2.29 for Cobalt (dissolved):

The interim maximum concentration for total cobalt is 110 µg/L to protect aquatic life in the freshwater environment from acute effects of cobalt.
The interim 30-day average concentration for total cobalt (based on five weekly samples) is 4 µg/L to protect aquatic life from chronic effects of cobalt.

Note 2.30 for Copper (dissolved):
The guideline is for dissolved copper and is dependent on the specific chemistry of the water body and can only be calculated using the British Columbia Biotic Ligand Model (BC BLM) software. (Update August 2019)

Note 2.31 for Lead (dissolved):
The maximum guideline for total lead in water, at a water hardness less than or equal to 8 mg/L as CaCO3 is set at 3.0 µg/L. When water hardness exceeds 8.0 mg/L CaCO3 the maximum guideline for lead at any time is given by the following equation:
Maximum Criteria (µg/L) = exp (1.273 ln(hardness) - 1.460).
The 30-day average guideline for total lead in water, when water hardness exceeds 8 mg/L as CaCO3, is as follows:
30-Day Average (µg/L) is less than or equal to 3.31 + exp (1.273 ln (mean hardness) - 4.704).
For hardness less than or equal to 8.0 mg/L there is no 30-day average guideline; hence the maximum concentration of 3.0 µg/L is used.

Note 2.32 for Manganese (dissolved):
The maximum concentration of total manganese in mg/L at any time should not exceed the value as determined by the following relationship:
0.01102 hardness + 0.54
where water hardness is reported as mg/L of CaCO3.
The 30-day mean concentration of total manganese in mg/L should be less than or equal to the value as determined by the following relationship:
0.0044 hardness + 0.605
where water hardness is reported as mg/L of CaCO3.

Note 2.33 for Mercury (dissolved):
The average concentration of total mercury in water as measured over a 30-day period (based on five weekly samples) should not exceed 0.02 µg/L when the methyl mercury (MeHg) constitutes less than or equal to 0.5% of the total mercury concentration. When the proportion of MeHg is greater than 0.5%, the guideline should be adjusted as indicated in the Table 1 and Table 4 of the BC MOE Overview Report - First Update, February 2001.
There is no guideline maximum for total mercury in water, for freshwater aquatic life.

Note 2.34 for Molybdenum (dissolved):
The maximum concentration for total molybdenum is 2 mg/L.
The 30-day average concentration for total molybdenum (based on at least five weekly samples in a period of 30 days) is less than or equal to 1 mg/L.

Note 2.35 for Phosphorus (dissolved, by ICPMS/ICPOES):
Streams: None proposed for streams.
Lakes: It is not possible to specify a single phosphorous concentration to achieve protection of aquatic life in lakes. A range of total phosphorous concentrations (5-15 µg/L) is suggested as the criterion which can be used as the basis for site specific water quality objectives.

Note 2.36 for Phosphorus (dissolved, APHA 4500-P):
Streams: None proposed for streams.
Lakes: It is not possible to specify a single phosphorous concentration to achieve protection of aquatic life in lakes. A range of total phosphorous concentrations (5-15 µg/L) is suggested as the criterion which can be used as the basis for site specific water quality objectives.

Note 2.37 for Selenium (dissolved):

The 30-day average water quality guideline for protection of aquatic life is 2 µg/L determined as the mean concentration of 5 evenly spaced samples collected over 30 days, and measured as total selenium.
The 30-day average alert concentration for the protection of aquatic life in sensitive ecosystems is 1 µg/L determined as the mean concentration of 5 evenly spaced samples collected over 30 days, and measured as total selenium.

Note 2.38 for Silver (dissolved):

The guideline maximum for total silver is:
0.1 µg/L maximum if hardness less than or equal to 100 mg/L
3.0 µg/L maximum if hardness greater than 100 mg/L.
The guideline 30-day average for total silver is:
0.05 µg/L as 30-day mean if hardness less than or equal to 100 mg/L
1.5 µg/L as 30-day mean if hardness greater than 100 mg/L.

Note 2.39 for Zinc (dissolved):

The Short-term Maximum concentration of total zinc (µg/L) at any time should not exceed 33 µg/L when water hardness is less than or equal to 90 mg/L as CaCO3.
When water hardness exceeds 90 mg/L CaCO3, the Short-term Maximum guideline in µg/L for total zinc is the value determined by the following relationship:
33 + 0.75 * (hardness - 90)
where water hardness is reported as mg/L of CaCO3.
Short-term maximum WQG formula applies to water hardness between 90 – 500 mg/L CaCO3.
The Long-term Average concentration of total zinc (µg/L) at any time should not exceed 7.5 µg/L when water hardness is less than or equal to 90 mg/L as CaCO3.
When water hardness exceeds 90 mg/L CaCO3, the Long-term Average guideline in µg/L for total zinc is the value determined by the following relationship:
7.5 + 0.75 * (hardness - 90)
where water hardness is reported as mg/L of CaCO3.
Long-term average WQG formula applies to water hardness between 90 – 330 mg/L CaCO3.

3. Notes for BC Working Water Quality Guidelines for Freshwater Aquatic Life (2020) (BCWWQG AL)

General Notes:

Reference: B.C. Working Water Quality Guidelines: Aquatic Life, Wildlife & Agriculture (2020). WWQG values are long-term (i.e. average) concentrations unless identified as a short-term maximum in the “Notes” for a specific analyte. Long-term WWQGs represent average substance concentrations calculated from 5 samples in 30 days. WWQG are given for total substance concentrations unless otherwise noted.

Note 3.1 for Alkalinity (total, as CaCO3):

The guideline for alkalinity (total as CaCO3) is as follows:
- Less than 10 mg/L, highly sensitive to acid inputs
- 10 to 20 mg/L, moderately sensitive to acid inputs
- Greater than 20 mg/L, low sensitivity to acid inputs.

Sensitivity to acid inputs can be determined by the concentration of dissolved calcium: < 4 mg/L is highly sensitive to acid inputs; 4 to 8 mg/L is moderately sensitive; and > 8 mg/L is low sensitivity.

Note 3.2 for Antimony (total):

The guideline is for antimony (III).

Note 3.3 for Chromium (total):

The guideline for Cr(VI) is 1 µg/L (total). The guideline for Cr(III) is 8.9 µg/L (total). The guideline of 1 µg/L for Cr(VI) was used, in this report, to identify exceedances for dissolved chromium, and total chromium as a means for determining the potential for exceeding the Cr(VI) and/or Cr(III) guidelines.

Note 3.4 for Nickel (total):

The guideline for nickel in µg/L is determined as follows:
When the water hardness is 0 to ≤ 60 mg/L, the maximum is 25 µg/L
At hardness > 60 to ≤ 180 mg/L the maximum is calculated using the equation:
e raised to the power of {0.76[ln(hardness)] + 1.06}
At hardness >180 mg/L, the maximum is 150 µg/L
Where water hardness is reported as mg/L CaCO3.
If the water hardness is unknown, the maximum is 25 µg/L.

Note 3.5 for Thallium (total):
30-day average, site-specific objective for the lower Columbia River, BC

Note 3.6 for Antimony (dissolved):
The guideline is for antimony (III).

Note 3.7 for Calcium (dissolved):
The guideline for dissolved calcium in mg/L is as follows:
- Less than 4, highly sensitive to acid inputs
- 4 to 8, moderately sensitive
- Greater than 8, low sensitivity.

Note 3.8 for Chromium (dissolved):
The guideline for Cr(VI) is 1 µg/L (total). The guideline for Cr(III) is 8.9 µg/L (total). The guideline of 1 µg/L for Cr(VI) was used, in this report, to identify exceedances for dissolved chromium, and total chromium as a means for determining the potential for exceeding the Cr(VI) and/or Cr(III) guidelines.

Note 3.9 for Nickel (dissolved):
The guideline for nickel in µg/L is determined as follows:
When the water hardness is 0 to ≤ 60 mg/L, the maximum is 25 µg/L
At hardness > 60 to ≤ 180 mg/L the maximum is calculated using the equation:
e raised to the power of {0.76[ln(hardness)] + 1.06}
At hardness >180 mg/L, the maximum is 150 µg/L
Where water hardness is reported as mg/L CaCO3.
If the water hardness is unknown, the maximum is 25 µg/L.

Note 3.10 for Thallium (dissolved):
30-day average, site-specific objective for the lower Columbia River, BC

4. Notes for BC Recreational Water Quality Guidelines (2019) (BC RWQG)

General Notes:
The guidelines are for primary contact recreational uses. Primary contact is defined as activities, such as swimming (this includes bathing/wading for the purposes of this document), windsurfing and waterskiing, as well as secondary contact activities, such as canoeing or fishing, in natural waters through intentional or incidental immersion.

Note 4.1 for Turbidity:
The guideline for turbidity is an aesthetic objective of 50 NTU.

Note 4.2 for E. coli (counts):
The geometric mean guideline is ≤ 200 E. coli /100 mL and is a geometric mean of a minimum of 5 samples in 30 days. The single sample maximum concentration guideline is ≤ 400 E. coli /100 mL. / The most stringent guideline was used in this report.

Note 4.3 for E. coli (MPN):
The geometric mean guideline is ≤ 200 E. coli /100 mL and is a geometric mean of a minimum of 5 samples in 30 days. The single sample maximum concentration guideline is ≤ 400 E. coli /100 mL. / The most stringent guideline was used in this report.

Note 4.4 for Phosphorus (total, by ICPMS/ICPOES):

The guideline for lakes is 0.01 mg/L.

Note 4.5 for Phosphorus (total, APHA 4500-P):
The guideline for lakes is 0.01 mg/L.

Note 4.6 for Phosphorus (dissolved, by ICPMS/ICPOES):
The guideline for lakes is 0.01 mg/L.

Note 4.7 for Phosphorus (dissolved, APHA 4500-P):
The guideline for lakes is 0.01 mg/L.

5. Notes for BC Approved Water Quality Guidelines for wildlife (BCAWQG WL)

General Notes:
The Water Quality Guidelines (Criteria) Reports by BC Ministry of Environment were used as references for the guidelines. (Internet address: http://www.env.gov.bc.ca/wat/wq/wq_guidelines.html). Overview Reports (BC MOE) were used as the references for the guidelines unless the note for specific analyte indicates that the Technical Appendix (BC MOE) was used.

Note 5.1 for Fluoride:
Total fluoride should not exceed 1.0 mg/L as a 30-day average or 1.5 mg/L as a maximum in fresh water used by wildlife.

Note 5.2 for Nitrate (as N):
The guideline maximum for Wildlife for nitrate as nitrogen is 100 mg/l. Where nitrate and nitrite are present, the total nitrate+nitrite nitrogen should not exceed this value.

Note 5.3 for Nitrate + Nitrite (as N) (calculated):
The guideline maximum for Wildlife for nitrate as nitrogen is 100 mg/l. Where nitrate and nitrite are present, the total nitrate+nitrite nitrogen should not exceed this value.

Note 5.4 for Total suspended solids:
Induced suspended sediments should not exceed 20 mg/L when background suspended sediments is less than or equal to 100 mg/L, nor should induced suspended sediments be more than 20 % of background when background is greater than 100 mg/L.

Note 5.5 for Turbidity:
Induced turbidity should not exceed 10 NTU when background turbidity is less than or equal to 50 NTU, nor should induced turbidity be more than 20 % of background when background is greater than 50 NTU.

Note 5.6 for Mercury (total):
The average concentration of total mercury in water as measured over a 30-day period (based on five weekly samples) should not exceed 0.02 µg/L when the methyl mercury (MeHg) constitutes less than or equal to 0.5% of the total mercury concentration. When the proportion of MeHg is greater than 0.5%, the guideline should be adjusted as indicated in the Table 1 and Table 4 of the BC MOE Overview Report - First Update, February 2001.

Note 5.7 for Selenium (total):
The water column (aquatic life) guideline of 2 µg/L, and the dietary guideline of 4 µg/g in food items, are applicable to wildlife species. The 30-day average water quality guideline for protection of aquatic life is 2 µg/L determined as the mean concentration of 5 evenly spaced samples collected over 30 days, and measured as total selenium.
The chronic tissue guideline for the protection of wildlife, using birds as a surrogate, is 6 µg/g (dw) in bird egg tissue, calculated as the mean concentration of at least 8 eggs (from 8 individual nests) in a representative area, reported as dry weight.

Note 5.8 for Copper (dissolved):
The guideline maximum is for total copper.

Note 5.9 for Mercury (dissolved):

The average concentration of total mercury in water as measured over a 30-day period (based on five weekly samples) should not exceed 0.02 µg/L when the methyl mercury (MeHg) constitutes less than or equal to 0.5% of the total mercury concentration. When the proportion of MeHg is greater than 0.5%, the guideline should be adjusted as indicated in the Table 1 and Table 4 of the BC MOE Overview Report - First Update, February 2001.

Note 5.10 for Molybdenum (dissolved):

The guideline maximum is for total molybdenum.

Note 5.11 for Selenium (dissolved):

The water column (aquatic life) guideline of 2 µg/L, and the dietary guideline of 4 µg/g in food items, are applicable to wildlife species. The 30-day average water quality guideline for protection of aquatic life is 2 µg/L determined as the mean concentration of 5 evenly spaced samples collected over 30 days, and measured as total selenium.

The chronic tissue guideline for the protection of wildlife, using birds as a surrogate, is 6 µg/g (dw) in bird egg tissue, calculated as the mean concentration of at least 8 eggs (from 8 individual nests) in a representative area, reported as dry weight.

Legend for Reports for 2020-8732 CRD Spill Surface Water Quality Results

<	Less than reported detection limit
>	Greater than reported upper detection limit
>=	Greater than or equal to
A	Absent
BC RWQG	BC Recreational Water Quality Guidelines (2019)
BCAWQG AL (LT)	BC Approved Water Quality Guidelines for freshwater aquatic life (Long-term chronic)
BCAWQG AL (ST)	BC Approved Water Quality Guidelines for freshwater aquatic life (Short-term acute)
BCAWQG WL	BC Approved Water Quality Guidelines for wildlife
BCWWQG AL	BC Working Water Quality Guidelines for Freshwater Aquatic Life (2020)
Calc	Calculated guideline or standard. The guideline or standard is dependent on the value of one or more other analytes, and is calculated from a formula or table.
L	Laboratory reading type (Lab result)
m asl	metres above sea level
N	Narrative type of guideline or standard, or Result Note.
ND	Non-detect. Result is less than lower detection limit.
NG	No Guideline
NR	No Result
NS	No Standard
NT	Not Tested
OG	Overgrown
P	Present
PR	Presumptive
TK	Test kit reading type (Field result)
TNTC	Too numerous to count
	Highlighted value has a lower detection limit that is greater than the guideline/standard maximum and/or the guideline/standard minimum, or has an upper detection limit that is less than the guideline/standard maximum and/or the guideline/standard minimum.
	The maximum guideline/standard value cannot be determined because a result for a dependent analyte is not available for the sample.
BC RWQG	Highlighted value exceeds BC RWQG
BCAWQG AL (LT)	Highlighted value exceeds BCAWQG AL (LT)
BCAWQG AL (ST)	Highlighted value exceeds BCAWQG AL (ST)
BCAWQG WL	Highlighted value exceeds BCAWQG WL
BCWWQG AL	Highlighted value exceeds BCWWQG AL

SL Criteria Override Highlighted value exceeds sampling location criteria override

Residual Treatment Facility Spill
Deep Groundwater Quality Results

Analyte	Unit	Guideline				Sampling Location	41-1-1	55-1-1	56-1-1	57-1-1
						Date Sampled	03-Mar-21	03-Mar-21	03-Mar-21	03-Mar-21
						Lab Sample ID	2173213	2173256	2173257	2173258
						Sample Type				
		CSR AW	CSR DW	BC SDWQG MAC	BC SDWQG AO					
Microbiological										
E. coli (MPN)	MPN/100 mL	NG	NG	10 [3.1]	NG		<1	<1	<1	<1
Fecal coliforms (counts)	CFU/100 mL	NG	NG	10 [3.2]	NG		<1	<1	<1	<1
Fecal coliforms (MPN)	MPN/100 mL	NG	NG	10 [3.3]	NG					
Total coliforms (MPN)	MPN/100 mL	NG	NG	NG	NG		<1	<1	<1	5
Total Metals										
Aluminum (total)	µg/L	NG	9500 [2.5]	9500	NG		269	36	71	10
Antimony (total)	µg/L	90	6	6	NG		0.9	0.8	0.8	0.7
Arsenic (total)	µg/L	50	10	10	NG		6.5	0.4	0.4	0.2
Barium (total)	µg/L	10000	1000	NG	NG		4.8	6.2	21.9	11.9
Beryllium (total)	µg/L	1.5	8	NG	NG		<0.05	<0.05	<0.05	<0.05
Bismuth (total)	µg/L	NG	NG	NG	NG					
Boron (total)	µg/L	12000	5000	5000	NG		45	33	26	46
Cadmium (total)	µg/L	Calc [1.8]	5	5	NG		0.02	0.03	0.03	0.09
Calcium (total)	mg/L	NG	NG	NG	NG		72.700	84.600	75.800	88.700
Cesium (total)	µg/L	NG	NG	NG	NG					
Chromium (total)	µg/L	10 [1.9]	50 [2.6]	50	NG		<0.5	<0.5	<0.5	<0.5
Cobalt (total)	µg/L	40	20 [2.7]	1	NG		0.71	0.33	0.29	0.06
Copper (total)	µg/L	Calc [1.10]	1500 [2.8]	2000 [3.4]	1000		1.1	4.0	0.8	0.9
Hardness, Total (total as CaCO3)	mg/L	NG	NG	NG	NG		216.000	246.000	215.000	248.000
Iron (total)	µg/L	NG	6500 [2.9]	NG	300		525	65	139	22
Lead (total)	µg/L	Calc [1.11]	10	5	NG		0.27	0.06	0.06	0.06
Lithium (total)	µg/L	NG	8	NG	NG		0.5	<0.5	0.7	<0.5
Magnesium (total)	mg/L	NG	NG	NG	NG		8.420	8.450	6.300	6.550
Manganese (total)	µg/L	NG	1500 [2.10]	120	20		647	103	7	10
Mercury (total)	µg/L	0.25	1	1	NG		<0.01	<0.01	<0.01	<0.01
Molybdenum (total)	µg/L	10000	250	88	NG		2.2	0.4	0.9	0.3
Nickel (total)	µg/L	Calc [1.12]	80	80	NG		<0.5	1.0	<0.5	<0.5
Phosphorus (total, by ICPMS/ICPOES)	µg/L	NG	NG	NG	N [4.1]					
Phosphorus (total, APHA 4500-P)	µg/L	NG	NG	NG	N [4.2]		<5	<5	<5	<5
Potassium (total)	µg/L	NG	NG	NG	NG		924	1840	347	485
Rubidium (total)	µg/L	NG	NG	NG	NG					
Selenium (total)	µg/L	20	10	10	NG		<0.5	<0.5	<0.5	<0.5
Silicon (total, as Si)	µg/L	NG	NG	NG	NG					
Silver (total)	µg/L	Calc [1.13]	20	NG	NG		<0.02	<0.02	<0.02	<0.02
Sodium (total)	mg/L	NG	200 [2.11]	NG	NG		5.410	13.600	4.960	10.100
Strontium (total)	µg/L	NG	2500	7000	NG		211	263	270	279
Sulphur (total)	µg/L	NG	NG	NG	NG					
Tellurium (total)	µg/L	NG	NG	NG	NG					
Thallium (total)	µg/L	3	NG	NG	NG		<0.02	<0.02	<0.02	<0.02
Thorium (total)	µg/L	NG	NG	NG	NG					
Tin (total)	µg/L	NG	2500	NG	NG		0.06	<0.05	<0.05	0.11
Titanium (total)	µg/L	1000	NG	NG	NG		5.3	4.1	6.4	1.3
Tungsten (total)	µg/L	NG	3	NG	NG		<0.1	<0.1	<0.1	<0.1
Uranium (total)	µg/L	85	20	20	NG		0.27	0.29	0.12	0.03
Vanadium (total)	µg/L	NG	20	NG	NG		<1	<1	<1	<1
Zinc (total)	µg/L	Calc [1.14]	3000 [2.12]	3000	5000		<5	<5	<5	<5
Zirconium (total)	µg/L	NG	NG	NG	NG					
Dissolved Metals										
Aluminum (dissolved)	µg/L	NG	9500 [2.13]	9500	NG					
Antimony (dissolved)	µg/L	90	6	6	NG					

Residual Treatment Facility Spill
Deep Groundwater Quality Results

					Sampling Location	41-1-1	55-1-1	56-1-1	57-1-1
					Date Sampled	03-Mar-21	03-Mar-21	03-Mar-21	03-Mar-21
					Lab Sample ID	2173213	2173256	2173257	2173258
					Sample Type				
Analyte	**Unit**	**Guideline**							
		CSR AW	**CSR DW**	BC SDWQG MAC	BC SDWQG AO				
Arsenic (dissolved)	µg/L	50	10	10	NG				
Barium (dissolved)	µg/L	10000	1000	NG	NG				
Beryllium (dissolved)	µg/L	1.5	8	NG	NG				
Bismuth (dissolved)	µg/L	NG	NG	NG	NG				
Boron (dissolved)	µg/L	12000	5000	5000	NG				
Cadmium (dissolved)	µg/L	Calc [1.15]	5	5	NG				
Calcium (dissolved)	mg/L	NG	NG	NG	NG				
Cesium (dissolved)	µg/L	NG	NG	NG	NG				
Chromium (dissolved)	µg/L	10 [1.16]	50 [2.14]	50	NG				
Cobalt (dissolved)	µg/L	40	20 [2.15]	1	NG				
Copper (dissolved)	µg/L	Calc [1.17]	1500 [2.16]	2000 [3.5]	1000				
Hardness, Total (dissolved as CaCO3)	mg/L	NG	NG	NG	NG				
Iron (dissolved)	µg/L	NG	6500 [2.17]	NG	300				
Lead (dissolved)	µg/L	Calc [1.18]	10	5	NG				
Lithium (dissolved)	µg/L	NG	8	NG	NG				
Magnesium (dissolved)	mg/L	NG	NG	NG	NG				
Manganese (dissolved)	µg/L	NG	1500 [2.18]	120	20				
Mercury (dissolved)	µg/L	0.25	1	1	NG				
Molybdenum (dissolved)	µg/L	10000	250	88	NG				
Nickel (dissolved)	µg/L	Calc [1.19]	80	80	NG				
Phosphorus (dissolved, by ICPMS/ICPOES)	µg/L	NG	NG	NG	N [4.3]				
Phosphorus (dissolved, APHA 4500-P)	µg/L	NG	NG	NG	N [4.4]	<5	<5	<5	<5
Potassium (dissolved)	µg/L	NG	NG	NG	NG				
Rubidium (dissolved)	µg/L	NG	NG	NG	NG				
Selenium (dissolved)	µg/L	20	10	10	NG				
Silicon (dissolved, as Si)	µg/L	NG	NG	NG	NG				
Silver (dissolved)	µg/L	Calc [1.20]	20	NG	NG				
Sodium (dissolved)	mg/L	NG	200 [2.19]	NG	NG				
Strontium (dissolved)	µg/L	NG	2500	7000	NG				
Sulphur (dissolved)	µg/L	NG	NG	NG	NG				
Tellurium (dissolved)	µg/L	NG	NG	NG	NG				
Thallium (dissolved)	µg/L	3	NG	NG	NG				
Thorium (dissolved)	µg/L	NG	NG	NG	NG				
Tin (dissolved)	µg/L	NG	2500	NG	NG				
Titanium (dissolved)	µg/L	1000	NG	NG	NG				
Tungsten (dissolved)	µg/L	NG	3	NG	NG				
Uranium (dissolved)	µg/L	85	20	20	NG				
Vanadium (dissolved)	µg/L	NG	20	NG	NG				
Zinc (dissolved)	µg/L	Calc [1.21]	3000 [2.20]	3000	5000				
Zirconium (dissolved)	µg/L	NG	NG	NG	NG				

Guideline Notes for Reports for 2020-8732 CRD Spill Deep Groundwater Quality Results

1. Notes for BC CSR Generic Numerical Water Standards for Freshwater Aquatic Life (CSR AW)

General Notes:

BC Contaminated Sites Regulation, Generic Numerical Water Standards, Schedule 3.2; includes amendments up to B.C. Reg. 13/2019, January 24, 2019.

Aquatic life standards assume minimum 1:10 dilution available, and are to protect freshwater life.

Standards for all organic substances are for total substance concentrations. Any water sample to be analyzed for organic substances should not be filtered.

Standards for surface water samples to be analyzed for heavy metals, metalloids and inorganic ions are total substance concentrations. In addition, it is recommended that surface water samples being analyzed for heavy metals, metalloids and inorganic ions should also be analyzed for dissolved substance concentrations.

Standards for groundwater samples for heavy metals, metalloids and inorganic ions are for dissolved substance concentrations. In addition, it is recommended that groundwater samples being analyzed for heavy metals, metalloids and inorganic ions should also be analyzed for total substance concentrations.

Note 1.1 for Ammonia (total, as N):

Standard varies with pH and temperature. 10 degrees C is assumed. Consult a director for further advice.

The standard for ammonia, total (as N) is:

1,310 µg/L @ pH ≥ to 8.5

3,700 µg/L @ pH 8.0 - < 8.5

11,300 µg/L @ pH 7.5 - < 8.0

18,500 µg/L @ pH 7.0 - < 7.5

18,400 µg/L @ pH < 7.0

Note 1.2 for Ammonia, total (dissolved as N):

Standard varies with pH and temperature. 10 degrees C is assumed. Consult a director for further advice.

The standard for ammonia, total (as N) is:

1,310 µg/L @ pH ≥ to 8.5

3,700 µg/L @ pH 8.0 - < 8.5

11,300 µg/L @ pH 7.5 - < 8.0

18,500 µg/L @ pH 7.0 - < 7.5

18,400 µg/L @ pH < 7.0

Note 1.3 for Fluoride:

The standard for fluoride is:

2000 µg/L @ H < 50

3000 µg/L @ H ≥ 50

Where H means water hardness in mg/L as CaCO3.

Note 1.4 for Nitrate (as N):

Standard may not protect all amphibians. Consult director for further advice.

Note 1.5 for Nitrate + Nitrite (as N) (calculated):

Standard may not protect all amphibians. Consult director for further advice.

Note 1.6 for Nitrite (as N):

Standard varies with chloride concentration. Consult a director for further advice.
The standard for nitrite (as N) is:
200 µg/L (Cl < 2 mg/L)
400 µg/L (Cl 2 - < 4 mg/L)
600 µg/L (Cl 4 - < 6 mg/L)
800 µg/L (Cl 6 - < 8 mg/L)
1,000 µg/L (Cl 8 - < 10 mg/L)
2,000 µg/L (Cl ≥ 10 mg/L)

Note 1.7 for Sulfate:
The standard for sulfate is:
1280 mg/L @ H ≤ 30
2180 mg/L @ H 31 - 75
3090 mg/L @ H 76 - 180
4290 mg/L @ H > 180
Where H means water hardness in mg/L as CaCO3.

Note 1.8 for Cadmium (total):
The standard for cadmium is as follows:
0.5 µg/L @ H < 30
1.5 µg/L @ H 30 - < 90
2.5 µg/L @ H 90 - < 150
3.5 µg/L @ H 150 - < 210
4 µg/L @ H ≥ 210
Where H means water hardness in mg/L as CaCO3.

Note 1.9 for Chromium (total):
Analytical results for chromium (all species) in water may be used to demonstrate compliance with the standards. Where the standards cannot be met based on analytical results for chromium (all species), chromium speciation may be necessary.
Standard is 10 µg/L for chromium, hexavalent. Standard is 90 µg/L for chromium, trivalent. The standard of 10 µg/L was used to identify exceedances for total chromium in order to demonstrate compliance with the standards.

Note 1.10 for Copper (total):
The standard for copper is as follows:
20 µg/L @ H < 50
30 µg/L @ H 50 - < 75
40 µg/L @ H 75 - < 100
50 µg/L @ H 100 - < 125
60 µg/L @ H 125 - < 150
70 µg/L @ H 150 - < 175
80 µg/L @ H 175 - < 200
90 µg/L @ H ≥ 200
Where H means water hardness in mg/L as CaCO3.

Note 1.11 for Lead (total):

The standard for lead is as follows:
40 µg/L @ H < 50
50 µg/L @ H 50 - < 100
60 µg/L @ H 100 - < 200
110 µg/L @ H 200 - < 300
160 µg/L @ ≥ 300
Where H means water hardness in mg/L as CaCO3.

Note 1.12 for Nickel (total):
The standard for nickel is as follows:
250 µg/L @ H < 60
650 µg/L @ H 60 - < 120
1,100 µg/L @ H 120 - < 180
1,500 µg/L @ H ≥ 180
Where H means water hardness in mg/L as CaCO3.

Note 1.13 for Silver (total):
The standard for silver is:
0.5 µg/L @ H ≤ 100
15 µg/L @ H > 100
Where H means water hardness in mg/L as CaCO3.

Note 1.14 for Zinc (total):
The standard for zinc is as follows:
75 µg/L @ H < 90
150 µg/L @ H = 90 - < 100
900 µg/L @ H = 100 - < 200
1,650 µg/L @ H = 200 - < 300
2,400 µg/L @ H = 300 - < 400
3,150 µg/L @ H = 400 - < 500
If H ≥ 500 then use following formula:
Standard (µg/L) = 10 x [7.5 +{(0.75)(H – 90)}]
Where H means water hardness in mg/L as CaCO3.
There are special ministry approval and data reporting requirements for water hardness values ≥ 500 mg/L as CaCO3.
Reference is Schedule 3.2 and Protocol 10.

Note 1.15 for Cadmium (dissolved):
The standard for cadmium is as follows:
0.5 µg/L @ H < 30
1.5 µg/L @ H 30 - < 90
2.5 µg/L @ H 90 - < 150
3.5 µg/L @ H 150 - < 210
4 µg/L @ H ≥ 210
Where H means water hardness in mg/L as CaCO3.

Note 1.16 for Chromium (dissolved):
Analytical results for chromium (all species) in water may be used to demonstrate compliance with the standards. Where the standards cannot be met based on analytical results for chromium (all species), chromium speciation may be necessary.
Standard is 10 µg/L for chromium, hexavalent. Standard is 90 µg/L for chromium, trivalent. The standard of 10 µg/L was used to identify exceedances for dissolved chromium in order to demonstrate compliance with the standards.

Note 1.17 for Copper (dissolved):
The standard for copper is as follows:
20 µg/L @ H < 50
30 µg/L @ H 50 - < 75
40 µg/L @ H 75 - < 100
50 µg/L @ H 100 - < 125
60 µg/L @ H 125 - < 150
70 µg/L @ H 150 - < 175
80 µg/L @ H 175 - < 200
90 µg/L @ H ≥ 200
Where H means water hardness in mg/L as CaCO3.

Note 1.18 for Lead (dissolved):
The standard for lead is as follows:
40 µg/L @ H < 50
50 µg/L @ H 50 - < 100
60 µg/L @ H 100 - < 200
110 µg/L @ H 200 - < 300
160 µg/L @ ≥ 300
Where H means water hardness in mg/L as CaCO3.

Note 1.19 for Nickel (dissolved):
The standard for nickel is as follows:
250 µg/L @ H < 60
650 µg/L @ H 60 - < 120
1,100 µg/L @ H 120 - < 180
1,500 µg/L @ H ≥ 180
Where H means water hardness in mg/L as CaCO3.

Note 1.20 for Silver (dissolved):
The standard for silver is:
0.5 µg/L @ H ≤ 100
15 µg/L @ H > 100
Where H means water hardness in mg/L as CaCO3.

Note 1.21 for Zinc (dissolved):
The standard for zinc is as follows:
75 µg/L @ H < 90
150 µg/L @ H = 90 - < 100
900 µg/L @ H = 100 - < 200
1,650 µg/L @ H = 200 - < 300
2,400 µg/L @ H = 300 - < 400
3,150 µg/L @ H = 400 - < 500
If H ≥ 500 then use following formula:
Standard (µg/L) = 10 x [7.5 +{(0.75)(H – 90)}]
Where H means water hardness in mg/L as CaCO3.
There are special ministry approval and data reporting requirements for water hardness values ≥ 500 mg/L as CaCO3.
Reference is Schedule 3.2 and Protocol 10.

2. Notes for BC CSR Generic Numerical Water Standards for Drinking Water (CSR DW)
General Notes:

BC Contaminated Sites Regulation, Generic Numerical Water Standards, Schedule 3.2; includes amendments up to B.C. Reg. 13/2019, January 24, 2019.
Drinking water standards are for unfiltered samples obtained at the point of consumption. Heavy metals, metalloids and inorganic ions are expressed as total substance concentrations unless otherwise indicated.

Note 2.1 for Chloride ion:
Standard to protect against taste and odour concerns.

Note 2.2 for Nitrate (as N):
Where nitrate and nitrite are present, total nitrate plus nitrite-nitrogen should not exceed this value.

Note 2.3 for Nitrate + Nitrite (as N) (calculated):
Where nitrate and nitrite are present, total nitrate plus nitrite-nitrogen should not exceed this value.

Note 2.4 for Sulfate:
Standard to protect against taste and odour concerns.

Note 2.5 for Aluminum (total):
Standard is specific to protection of human health. Standard is derived with TRV protective of adults. Standard may not adequately protect other age groups.
Standard may not address aesthetic (organoleptic) concerns related to drinking water quality. Water treatment may be required.

Note 2.6 for Chromium (total):
Analytical results for chromium (all species) in water may be used to demonstrate compliance with the standards. Where the standards cannot be met based on analytical results for chromium (all species), chromium speciation may be necessary.
Standard is 50 µg/L for chromium, hexavalent. Standard is 6000 µg/L for chromium, trivalent. The standard of 50 µg/L was used to identify exceedances for total chromium in order to demonstrate compliance with the standards.

Note 2.7 for Cobalt (total):
The standard in Schedule 3.2 is 1 µg/L. However the BC Ministry of Environment and Climate Change Strategy has set an interim background groundwater concentration estimate of 20 ug/L for Cobalt at sites in the Province. Therefore a standard of 20 ug/L has been used for this criteria set.

Note 2.8 for Copper (total):
Standard is specific to protection of human health. Standard is derived with TRV protective of adults. Standard may not adequately protect other age groups.
Standard may not address aesthetic (organoleptic) concerns related to drinking water quality. Water treatment may be required.

Note 2.9 for Iron (total):
Standard applies to a site used for an industrial or commercial purpose or activity set out in Schedule 2 as
(a) item A6, A7, A8 or A11
(b) item C1, C2, C3, C4 or C6,
(c) item D2, D3, D5, or D6
(d) item E4, or
(e) item H14.
Standard applies to a site used for an industrial or commercial purpose or activity set out in Schedule 2 as item H11 or H20, but only if the site was used for the purpose or activity in conjunction with or as a result of the site also being used for at least one of the purposes or activities set out above.
Standard is specific to protection of human health. Standard is derived with TRV protective of adults. Standard may not adequately protect other age groups.
Standard may not address aesthetic (organoleptic) concerns related to drinking water quality. Water treatment may be required.

Note 2.10 for Manganese (total):
Standard applies to a site used for an industrial or commercial purpose or activity set out in Schedule 2 as
(a) item B1
(b) item C1, C3 or C4
(c) item D2, D3, D5, or D6
(d) item E4, or
(e) item H3 or H14.
Standard applies to a site used for an industrial or commercial purpose or activity set out in Schedule 2 as item H11 or H20, but only if the site was used for the purpose or activity in conjunction with or as a result of the site also being used for at least one of the purposes or activities set out above.
Standard is specific to protection of human health. Standard is derived with TRV protective of adults. Standard may not adequately protect other age groups.
Standard may not address aesthetic (organoleptic) concerns related to drinking water quality. Water treatment may be required.
Note 2.11 for Sodium (total):
Standard is specific to protection of human health. Standard is derived with TRV protective of adults. Standard may not adequately protect other age groups.
Note 2.12 for Zinc (total):
Standard is specific to protection of human health. Standard is derived with TRV protective of adults. Standard may not adequately protect other age groups.
Note 2.13 for Aluminum (dissolved):
Standard is specific to protection of human health. Standard is derived with TRV protective of adults. Standard may not adequately protect other age groups.
Standard may not address aesthetic (organoleptic) concerns related to drinking water quality. Water treatment may be required.
Note 2.14 for Chromium (dissolved):
Analytical results for chromium (all species) in water may be used to demonstrate compliance with the standards. Where the standards cannot be met based on analytical results for chromium (all species), chromium speciation may be necessary.
Standard is 50 µg/L for chromium, hexavalent. Standard is 6000 µg/L for chromium, trivalent. The standard of 50 µg/L was used to identify exceedances for dissolved chromium in order to demonstrate compliance with the standards.
Note 2.15 for Cobalt (dissolved):
The standard in Schedule 3.2 is 1 µg/L. However the BC Ministry of Environment and Climate Change Strategy has set an interim background groundwater concentration estimate of 20 ug/L for Cobalt at sites in the Province. Therefore a standard of 20 ug/L has been used for this criteria set.
Note 2.16 for Copper (dissolved):
Standard is specific to protection of human health. Standard is derived with TRV protective of adults. Standard may not adequately protect other age groups.
Standard may not address aesthetic (organoleptic) concerns related to drinking water quality. Water treatment may be required.
Note 2.17 for Iron (dissolved):

Standard applies to a site used for an industrial or commercial purpose or activity set out in Schedule 2 as
(a) item A6, A7, A8 or A11
(b) item C1, C2, C3, C4 or C6,
(c) item D2, D3, D5, or D6
(d) item E4, or
(e) item H14.
Standard applies to a site used for an industrial or commercial purpose or activity set out in Schedule 2 as item H11 or H20, but only if the site was used for the purpose or activity in conjunction with or as a result of the site also being used for at least one of the purposes or activities set out above.
Standard is specific to protection of human health. Standard is derived with TRV protective of adults. Standard may not adequately protect other age groups. Standard may not address aesthetic (organoleptic) concerns related to drinking water quality. Water treatment may be required.

Note 2.18 for Manganese (dissolved):
Standard applies to a site used for an industrial or commercial purpose or activity set out in Schedule 2 as
(a) item B1
(b) item C1, C3 or C4
(c) item D2, D3, D5, or D6
(d) item E4, or
(e) item H3 or H14.
Standard applies to a site used for an industrial or commercial purpose or activity set out in Schedule 2 as item H11 or H20, but only if the site was used for the purpose or activity in conjunction with or as a result of the site also being used for at least one of the purposes or activities set out above.
Standard is specific to protection of human health. Standard is derived with TRV protective of adults. Standard may not adequately protect other age groups.
Standard may not address aesthetic (organoleptic) concerns related to drinking water quality. Water treatment may be required.

Note 2.19 for Sodium (dissolved):
Standard is specific to protection of human health. Standard is derived with TRV protective of adults. Standard may not adequately protect other age groups.

Note 2.20 for Zinc (dissolved):
Standard is specific to protection of human health. Standard is derived with TRV protective of adults. Standard may not adequately protect other age groups.

3. Notes for BC Source Drinking Water Quality Guidelines - Maximum Acceptable Concentrations (2020 and updates) (BC SDWQG MAC)

General Notes:
The source drinking water quality guidelines apply to the ambient water before it is treated and distributed for domestic use.
The guidelines apply to drinking water sources from surface water and groundwater.

Note 3.1 for E. coli (MPN):
The MAC is ≤ 10 E. coli /100 mL; 90th percentile (minimum of 5 samples).

Note 3.2 for Fecal coliforms (counts):
The MAC is ≤ 10 coliforms/100 mL; 90th percentile (minimum of 5 samples).

Note 3.3 for Fecal coliforms (MPN):
The MAC is ≤ 10 coliforms/100 mL; 90th percentile (minimum of 5 samples).

Note 3.4 for Copper (total):
Includes short-term and long-term exposure.

Note 3.5 for Copper (dissolved):

Includes short-term and long-term exposure.

4. Notes for BC Source Drinking Water Quality Guidelines - Aesthetic Objectives (2020 and updates) (BC SDWQG AO)

General Notes:

The source drinking water quality guidelines apply to the ambient water before it is treated and distributed for domestic use. The guidelines apply to drinking water sources from surface water and groundwater.

Note 4.1 for Phosphorus (total, by ICPMS/ICPOES):

The AO for lakes is 0.01 mg/L. For lakes with residence time > 6 months, measure total P during spring overturn. For lakes with residence time < 6 months, measure mean epilimnetic total P during the growing season (ENV 1985).

Note 4.2 for Phosphorus (total, APHA 4500-P):

The AO for lakes is 0.01 mg/L. For lakes with residence time > 6 months, measure total P during spring overturn. For lakes with residence time < 6 months, measure mean epilimnetic total P during the growing season (ENV 1985).

Note 4.3 for Phosphorus (dissolved, by ICPMS/ICPOES):

The AO for lakes is 0.01 mg/L. For lakes with residence time > 6 months, measure total P during spring overturn. For lakes with residence time < 6 months, measure mean epilimnetic total P during the growing season (ENV 1985).

Note 4.4 for Phosphorus (dissolved, APHA 4500-P):

The AO for lakes is 0.01 mg/L. For lakes with residence time > 6 months, measure total P during spring overturn. For lakes with residence time < 6 months, measure mean epilimnetic total P during the growing season (ENV 1985).

Legend for Reports for 2020-8732 CRD Spill Deep Groundwater Quality Results

<	Less than reported detection limit
>	Greater than reported upper detection limit
>=	Greater than or equal to
A	Absent
BC SDWQG AO	BC Source Drinking Water Quality Guidelines - Aesthetic Objectives (2020 and updates)
BC SDWQG MAC	BC Source Drinking Water Quality Guidelines - Maximum Acceptable Concentrations (2020 and updates)
Calc	Calculated guideline or standard. The guideline or standard is dependent on the value of one or more other analytes, and is calculated from a formula or table.
CSR AW	BC CSR Generic Numerical Water Standards for Freshwater Aquatic Life
CSR DW	BC CSR Generic Numerical Water Standards for Drinking Water
L	Laboratory reading type (Lab result)
m asl	metres above sea level
N	Narrative type of guideline or standard, or Result Note.
ND	Non-detect. Result is less than lower detection limit.
NG	No Guideline
NR	No Result
NS	No Standard
NT	Not Tested
OG	Overgrown
P	Present
PR	Presumptive
TK	Test kit reading type (Field result)
TNTC	Too numerous to count
	Highlighted value has a lower detection limit that is greater than the guideline/standard maximum and/or the guideline/standard minimum, or has an upper detection limit that is less than the guideline/standard maximum and/or the guideline/standard minimum.
	The maximum guideline/standard value cannot be determined because a result for a dependent analyte is not available for the sample.
BC SDWQG AO	Highlighted value exceeds BC SDWQG AO
BC SDWQG MAC	Highlighted value exceeds BC SDWQG MAC
CSR AW	Highlighted value exceeds CSR AW
CSR DW	Highlighted value exceeds CSR DW
SL Criteria Override	Highlighted value exceeds sampling location criteria override

Analyte	Unit	Guideline									Sampling Location	RTF-W-DP1	RTF-W-DP1	RTF-W-DP2	RTF-W-DP2	RTF-W-DP3	RTF-W-DP3	RTF-W-DP3	RTF-W-DP4	RTF-W-DP4	RTF-W-DP4	RTF-W-DP5	RTF-W-DP5	RTF-W-DP5	RTF-W-DP6	RTF-W-DP6	RTF-W-DP6	RTF-W-DP6
											Date Sampled	26-Jan-21	24-Feb-21	17-Dec-20	24-Feb-21	21-Jan-21	22-Feb-21	23-Mar-21	20-Jan-21	22-Feb-21	23-Mar-21	26-Jan-21	23-Feb-21	23-Mar-21	26-Jan-21	26-Jan-21	22-Feb-21	23-Mar-21
											Lab Sample ID	2008740	2141597	VA20C3702-013	2141606	1989845	2132174	2256004	1983600	2132177	2257281	2008738	2136439	2257282	2008731	2008739 Duplicate	2132178	2132179	2257283
											Sample Type																		
		CSR AW	CSR DW	BCAWQG AL (LT)	BCAWQG AL (ST)	BCWWQG AL	BC RWQG	BC SDWOG MAC	BC SDWOG AO	BCAWQG WL																		
Lab Results																												
Anions and Cations in meq/L unit																												
Aluminum (meq/L) (calculated)	meq/L	NG	NG	NG	NG	NG	NG	NG	NG	NG		0.0071	0.0046	0.00569	0.0047	0.0072	0.0122	0.0050	0.0009	0.0011	0.0004	0.0193	0.0036	0.0013	0.0007	0.0008	0.0028	0.0028	<0.0002
Barium (meq/L) (calculated)	meq/L	NG	NG	NG	NG	NG	NG	NG	NG	NG		0.00013	0.000079	0.000360	0.00010	0.000036	0.000055	0.000052	0.000038	0.000032	0.000038	0.000181	0.000051	0.000035	0.000089	0.000080	0.000052	0.000054	0.000087
Boron (meq/L) (calculated)	meq/L	NG	NG	NG	NG	NG	NG	NG	NG	NG		0.0047	0.002	0.0061	0.0031	0.002	0.002	0.0033	0.011	0.014	0.013	0.017	0.016	0.016	0.0044	0.0056	0.002	0.0028	0.0031
Bromide (meq/L) (calculated)	meq/L	NG	NG	NG	NG	NG	NG	NG	NG	NG		<0.0006	<0.0006	<0.00063	<0.0006	<0.0006	<0.0006	<0.0006	0.001	<0.0006	<0.0006	<0.0006	<0.0006	<0.0006	<0.0006	<0.0006	0.001	0.0013	<0.0006
Calcium (meq/L) (calculated)	meq/L	NG	NG	NG	NG	NG	NG	NG	NG	NG		1.6118	1.2375	3.66	1.2824	1.7365	1.5569	2.1806	2.7694	2.49	2.9591	3.5629	2.7395	2.5848	2.2255	2.1956	1.7265	1.6866	2.7046
Calcium (total, meq/L) (calculated)	meq/L	NG	NG	NG	NG	NG	NG	NG	NG	NG		1.5718	1.3523		1.4970	1.991	1.6916	2.3702	2.8144	2.6197	2.9092	2.5649	2.4601	2.5748	2.47	2.4601	1.9162	1.8563	2.7545
Chloride (meq/L) (calculated)	meq/L	NG	NG	NG	NG	NG	NG	NG	NG	NG		0.227	0.108	0.224	0.150	0.223	0.212	0.412	0.341	0.319	0.525	0.243	0.266	0.291	0.280	0.280	0.229	0.229	0.550
Chromium (meq/L) (calculated)	meq/L	NG	NG	NG	NG	NG	NG	NG	NG	NG		0.00003	<0.00003	<0.000029	<0.00003	<0.00003	<0.00003	<0.00003	<0.00003	<0.00003	<0.00003	0.000635	0.00016	0.000063	<0.00003	<0.00003	<0.00003	<0.00003	<0.00003
Copper (meq/L) (calculated)	meq/L	NG	NG	NG	NG	NG	NG	NG	NG	NG		<0.000006	0.00001	0.0000362	0.000035	0.00002	0.00002	<0.000006	0.00002	<0.000006	0.000009	0.000031	0.000009	0.000009	0.000031	0.000031	0.00002	0.00001	0.000069
Fluoride (meq/L) (calculated)	meq/L	NG	NG	NG	NG	NG	NG	NG	NG	NG		<0.001	<0.001	0.0250	0.002	<0.001	0.002	<0.001	0.001	0.002	<0.001	0.003	0.017	<0.001	0.001	0.001	0.001	0.001	<0.001
Lead (meq/L) (calculated)	meq/L	NG	NG	NG	NG	NG	NG	NG	NG	NG		<0.0000005	<0.0000005	<0.0000048	<0.0000005	<0.0000005	<0.0000005	<0.0000005	<0.0000005	<0.0000005	<0.0000005	0.0000014	<0.0000005	<0.0000005	<0.0000005	<0.0000005	<0.0000005	<0.0000005	<0.0000005
Lithium (meq/L) (calculated)	meq/L	NG	NG	NG	NG	NG	NG	NG	NG	NG		<0.00007	<0.00007	<0.00014	<0.00007	<0.00007	<0.00007	<0.00007	<0.00007	<0.00007	<0.00007	0.00009	<0.00007	<0.00007	<0.00007	<0.00007	<0.00007	<0.00007	<0.00007
Magnesium (meq/L) (calculated)	meq/L	NG	NG	NG	NG	NG	NG	NG	NG	NG		0.3637	0.2757	0.848	0.2798	0.3522	0.3456	0.4526	0.4789	0.4345	0.4896	0.4822	0.3859	0.4040	0.4633	0.4567	0.3752	0.3654	0.5546
Magnesium (total, meq/L) (calculated)	meq/L	NG	NG	NG	NG	NG	NG	NG	NG	NG		0.4008	0.3201		0.3316	0.4123	0.3884	0.5160	0.4937	0.4551	0.4904	0.3826	0.3720	0.4057	0.5036	0.5028	0.4189	0.4049	0.5917
Potassium (meq/L) (calculated)	meq/L	NG	NG	NG	NG	NG	NG	NG	NG	NG		0.03760	0.02967	0.203	0.02660	0.0234	0.0236	0.02763	0.0232	0.0255	0.0224	0.59857	0.2330	0.08825	0.03402	0.03428	0.02814	0.02763	0.03684
Potassium (total, meq/L) (calculated)	meq/L	NG	NG	NG	NG	NG	NG	NG	NG	NG		0.04067	0.03095		0.02839	0.0254	0.0249	0.03095	0.0239	0.0242	0.0227	0.1287	0.1586	0.1064	0.03760	0.02865	0.02814	0.03939	
Sodium (meq/L) (calculated)	meq/L	NG	NG	NG	NG	NG	NG	NG	NG	NG		0.1814	0.1579	0.335	0.2053	0.2519	0.2832	0.2610	0.3698	0.3510	0.3441	0.4267	0.2854	0.2954	0.3028	0.2980	0.2445	0.2388	0.2975
Sodium (total, meq/L) (calculated)	meq/L	NG	NG	NG	NG	NG	NG	NG	NG	NG		0.1801	0.1570		0.2188	0.2771	0.3093	0.2849	0.3793	0.3715	0.3458	0.3141	0.3023	0.2958	0.3106	0.3080	0.2745	0.2671	0.3228
Strontium (meq/L) (calculated)	meq/L	NG	NG	NG	NG	NG	NG	NG	NG	NG		0.00222	0.00143	0.00438	0.00112	0.00217	0.00225	0.00279	0.00347	0.00342	0.00324	0.00413	0.00272	0.00244	0.00295	0.00283	0.00204	0.00213	0.00263
Sulfate (meq/L) (calculated)	meq/L	NG	NG	NG	NG	NG	NG	NG	NG	NG		0.537	0.248	1.61	0.475	0.668	0.766	0.862	1.1	0.831	1.06	0.504	0.393	0.479	1.12	1.11	0.781	0.783	0.810
Zinc (meq/L) (calculated)	meq/L	NG	NG	NG	NG	NG	NG	NG	NG	NG		0.08657	0.03426	0.192	0.03181	0.0017	0.0013	0.00385	0.00086	0.0018	0.00762	0.74028	0.43438	0.2524	0.0141	0.00945	0.0030	0.0026	0.0291
General and Inorganic Parameters																												
Alkalinity (total, as CaCO3)	mg/L	NG	NG	NG	NG	N [3.1]	NG	NG	NG	NG		71	47	171	65	79	69	88	123	122	130	130	132	125	100	99	78	77	104
Ammonia (total, as N)	µg/L	Calc [3.2]	NG	Calc [4.1]	Calc [4.1]	NG	NG	NG	NG	NG		20	<10	<5.0	50	<10	<10	180	<10	<10	130	100	90	560	<10	<10	<10	<10	150
Ammonia, total (dissolved as N)	µg/L	Calc [3.2]	NG	NG	NG	NG	NG	NG	NG	NG				12.3															
Biochemical oxygen demand	mg/L	NG	NG	NG	NG	NG	NG	NG	NG	NG		<9	<4		<4	<4	<4	<4	<4	<4	<4	97	165	43	<4	<4	<4	<4	<4
Bromide	µg/L	NG	NG	NG	NG	NG	NG	NG	NG	NG		<50	<50	<50	<50	<50	<50	<50	90	<50	<50	<50	<50	<50	<50	<50	90	100	<50
Chloride ion	mg/L	1500	250 [4.3]	150 [4.2]	600 [4.3]	NG	NG	NG	250	600		8.04	3.84	7.94	5.30	7.91	7.51	14.6	12.1	11.3	18.6	8.61	9.43	10.3	9.93	9.91	8.11	8.10	19.5
Conductivity	µS/cm	NG	NG	NG	NG	NG	NG	NG	NG	NG																			
Fluoride	µg/L	Calc [3.2]	1500	Calc [4.3]	Calc [4.3]	NG	NG	NG	1500	NG		<20	<20	474	30	<20	30	<20	20	30	<20	50	320	<20	20	20	20	20	<20
Nitrate (as N)	mg/L	400 [3.4]	10 [3.3]	3.0 [3.5]	32.8 [4.4]	NG	10	10	NG	100 [4.2]		<0.005	0.059	0.0153	0.192	0.006	0.009	<0.005	0.066	0.066	0.114	0.026	0.018	0.022	0.160	0.162	0.363	0.358	0.054
Nitrate + Nitrite (as N) (calculated)	mg/L	400 [3.5]	10 [3.3]	3.0 [3.5]	32.8 [4.5]	NG	NG	NG	NG	100 [4.2]		<0.007	0.059	0.0207	0.192	<0.007	0.009	<0.007	0.066	0.066	0.114	0.026	0.018	0.022	0.160	0.162	0.363	0.358	0.054
Nitrite (as N)	µg/L	Calc [3.6]	1000	Calc [4.6]	Calc [4.6]	NG	1000	1000	NG	10000		<5	<5	5.4	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Total kjeldahl nitrogen	µg/L	NG	NG	NG	NG	NG	NG	NG	NG	NG		120	<50	1920	<50	100	100	190	<50	<50	<50	940	570	840	<50	<50	<50	<50	80
Total organic nitrogen	µg/L	NG	NG	NG	NG	NG	NG	NG	NG	NG		100	<100		<100		100			<100		800	500		<100	<100	<100	<100	
Nitrogen, dissolved inorganic	µg/L	NG	NG	NG	NG	NG	NG	NG	NG	NG				33															
Nitrogen, dissolved organic	µg/L	NG	NG	NG	NG	NG	NG	NG	NG	NG				<50															
Nitrogen, total	µg/L	NG	NG	NG	NG	NG	NG	NG	NG	NG		120	100	829	210	110	110	190	<50	60	80	970	590	860	200	170	380	370	130
Nitrogen, total dissolved	µg/L	NG	NG	NG	NG	NG	NG	NG	NG	NG				77															
Orthophosphate (dissolved, as P)	µg/L	NG	NG	NG	NG	NG	NG	NG	NG	NG		<1	<1	2.8	3	<1	<1	<1	<1	<1	<1	<1	<1	<1	2	2	2	2	<1
Oxidation reduction potential	mV	NG	NG	NG	NG	NG	NG	NG	NG	NG				153															
pH		NG	NG	N [3.7]	N [4.7]	NG	5.0 - 9.0	NG	NG	NG				7.49															
Sulfate	mg/L	Calc [3.2]	500 [3.8]	Calc [4.8]	Calc [4.8]	NG	NG	NG	500	NG		25.8	11.9	77.4	22.8	32.1	36.8	41.4	52.9	39.9	50.7	24.2	18.9	23.0	53.6	53.5	37.5	37.6	38.9
Total dissolved solids	mg/L	NG	NG	NG	NG	NG	NG	NG	NG	NG		158	70	379	130	162	155	178	258	212	218	305	338	200	230	225	148	160	198
Total suspended solids	mg/L	NG	NG	N [3.9]	N [4.9]	NG	NG	NG	NG	N [4.9]				108															
Microbiological																													
E. coli (MPN)	MPN/100 mL	NG	NG	N [4.10]	N [4.10]	NG	200 [4.1]	$10^{2.3}$	NG	NG		<1	<1	<1	<1	2	<1	<1	<1	<1	<1	200	<1	3	<1	<1	2	7	<1
Fecal coliforms (counts)	CFU/100 mL	NG	NG	N [4.11]	N [4.11]	NG	NG	$10^{2.3}$	NG	NG		<1	<1	<1	<1	<1	1	<1	<1	<1	<1	<10	<1		<1	<1	1	3	<1
Fecal coliforms (MPN)	MPN/100 mL	NG	NG	N [4.12]	N [4.12]	NG	NG	$10^{2.3}$	NG	NG				51															
Total coliforms (MPN)	MPN/100 mL	NG	NG	NG	NG	NG	NG	NG	NG	NG		123	57	88	687	822	649	389	36	111	15	51721	29093	5653	236	72	649	817	3
Total Metals																													
Aluminum (total)	µg/L	NG	9500 [3.9]	NG	NG	NG	NG	9500	NG	5000		7380	2630		620	351	1100	1050	34	35	114	1540	378	1050	73	35	114	118	295
Antimony (total)	µg/L	90	6	NG	NG	g [4.2]	NG	6	NG	NG		<0.5	<0.5		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Arsenic (total)	µg/L	50	10	5	5	NG	NG	10	NG	25		1.7	0.4		0.3	0.3	59.5	0.7	<0.1	47.7	0.3	16.4	29.8	13.7	0.8	1.1	52.4	58.1	0.3
Barium (total)	µg/L	10000	1000	NG	NG	1000	NG	NG	NG	NG		18.2	11.2		10.4	4.5	5.2	5.3	2.8	2.8	2.6	5.8	4.2	3.8	5.4	5.3	4.0	4.3	7.7
Beryllium (total)	µg/L	1.5	8	NG	NG	0.13	NG	NG	NG	NG		0.10	0.08		0.11	<0.05	0.07	0.05	<0.05	<0.05	<0.05	0.06	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Bismuth (total)	µg/L	NG	NG	NG	NG	NG	NG	NG	NG	NG																			
Boron (total)	µg/L	12000	5000	1200	1200	NG	NG	5000	NG	5000		10	6		12	15	14	15	38	52	59	65	65	69	13	15	13	13	17
Cadmium (total)	µg/L	Calc [3.6]	5	NG	NG	NG	NG	5	NG	NG		0.01	<0.01		0.03	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	0.08	0.02	0.02	<0.01	<0.01	<0.01	<0.01	<0.01
Calcium (total)	mg/L	NG	NG	NG	NG	NG	NG	NG	NG	NG		31.500	27.100		30.000	39.900	33.900	47.500	56.400	52.500	58.300	51.400	49.100	51.600	49.500	49.300	38.400	37.200	55.200
Cesium (total)	µg/L	NG	NG	NG	NG	NG	NG	NG	NG	NG																			
Chromium (total)	µg/L	10 [3.6]	50 [3.6]	NG	NG	1 [4.3]	NG	50	NG	NG		13.1	6.1		13.5	<0.5	0.9	2.1	<0.5	<0.5	<0.5	15.2	4.9	16.4	0.6	<0.5	0.9	1.9	0.5
Cobalt (total)	µg/L	40	20 [3.7]	4 [4.14]	110 [4.14]	NG	NG	1	NG	NG		4.38	2.14		0.46	0.71	40	0.38	1.37	<0.05	<0.05	0.18	3.54	2.77	3.06	0.11	0.09	0.06	0.06	0.40
Copper (total)	µg/L	Calc [3.10]	1500 [3.8]	NG	NG	NG	NG	2000 [7.6]	1000	300		6.8	6.4		5.8	1.3	1.5	0.8	0.6	<0.5	0.6	7.9	2.2	4.1	1.1	1.3	1.6	1.6	3.3
Hardness, Total (total as CaCO3)	mg/L	NG	NG	NG	NG	NG	NG	NG	NG	NG		98.700	83.700		91.500	120.000	104.000	144.000	166.000	154.000	170.000	147.000	141.000	149.000	149.000	148.000	117.000	113.000	167.000
Iron (total)	µg/L	NG	6500 [3.9]	1000	1000	NG	NG	NG	300	NG		10600	3650		979	571	998	2140	37	38	114	6540	8130	7820	74	54	131	126	286
Lead (total)	µg/L	Calc [3.11]	10	Calc [4.15]	Calc [4.15]	NG	NG	5	NG	100		0.92	0.38		0.14	<0.05	0.22	0.27	<0.05	<0.05	<0.05	0.41	0.11	0.30	<0.05	<0.05	<0.05	<0.05	0.08
Lithium (total)	µg/L	8	NG	NG	NG	NG	NG	NG	NG	NG		0.9	0.5		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.8	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Magnesium (total)	mg/L	NG	NG	NG	NG	NG	NG	NG	NG	NG		4.870	3.890		4.030	5.010	4.720	6.270	6.000	5.530	5.960	4.650	4.520	4.930	6.120	6.110	5.090	4.920	7.190
Manganese (total)	µg/L	NG	1500 [3.10]	Calc [3.13]	Calc [4.15]	NG	NG	120	20	NG		214	87		15	46	13	101	<1	<1	2	67	75	53	31	46	3	2	107
Mercury (total)	µg/L	0.25	1	0.020 [4.16]	0.020 [4.16]	NG	NG	1	NG	0.020 [4.3]		0.01	<0.01		0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Molybdenum (total)	µg/L	10000	250	1000 [4.17]	2000 [4.17]	NG	NG	88	NG	50		1.8	0.7		0.7	0.2	0.4	0.4	0.2	0.7	0.6	0.9	0.7	1.0	0.2	0.2	0.4	0.3	0.4
Nickel (total)	µg/L	Calc [3.12]	80	NG	NG	Calc [4.4]	NG	80	NG	NG		33.3	10.3		7.1	1.6	1.5	2.8	0.8	<0.5	1.4	36.3	19.2	54.6	1.6	1.3	1.8	2.1	2.6
Phosphorus (total, by ICPMS/ICPOES)	µg/L	NG	NG	N [3.10]	N [4.18]	NG	N [4.3]	NG	N [4.3]	NG																			
Phosphorus (total, APHA 4500-P)	µg/L	NG	NG	N [3.10]	N [4.18]	NG	N [4.3]	NG	N [4.2]	NG		69	136	5.3	94	<5	6	16	<5	<5	<5	133	52	79	14	9	12	7	9
Potassium (total)	µg/L	NG	NG	NG	NG	NG	NG	NG	NG	NG		1590	1210		1110	994	973	1210	936	946	886	5030	6200	4160	1470	1470	1120	1100	1540
Rubidium (total)	µg/L	NG	NG	NG	NG	NG	NG	NG	NG	NG																			
Selenium (total)	µg/L	20	10	$2^{3.10}$	$2^{4.18}$	NG	NG	10	NG	$2^{4.4}$		1.0	<0.5		<0.5	<0.5	20	<0.5	<0.5	<0.5	0.6	<0.5	<0.5	1.0	0.8	<0.5	<0.5	0.9	<0.5	<0.5
Silicon (total, as Si)	µg/L	NG	NG	NG	NG	NG	NG	NG	NG	NG																			
Silver (total)	µg/L	Calc [3.11]	20	Calc [3.21]	Calc [4.21]	NG	NG	NG	NG	NG		<0.02	<0.02		<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.03	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Sodium (total)	mg/L	NG	200 [3.11]	NG	NG	NG	NG	NG	NG	NG		4.140	3.610		5.030	6.370	7.110	6.550	8.720	8.540	7.950	7.220	6.950	6.800	7.140	7.080	6.310	6.140	7.420
Strontium (total)	µg/L	NG	2500	NG	NG	NG	NG	7000	NG	NG		92.4	64.6		63.2	123	112	126	153	153	149	143	138	132	121	118	99.0	104	131
Sulphur (total)	µg/L	NG	NG	NG	NG	NG	NG	NG	NG	NG																			
Tellurium (total)	µg/L	NG	NG	NG	NG	NG	NG	NG	NG	NG																			
Thallium (total)	µg/L	3	NG	NG	NG	0.8 [3.5]	NG	NG	NG	NG		<0.02	0.02		0.02	<0.02	<0.02	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Thorium (total)	µg/L	NG	NG	NG	NG	NG	NG	NG	NG	NG																			
Tin (total)	µg/L	NG	2500	NG	NG	NG	NG	NG	NG	NG		0.15	0.06		0.12	<0.05	0.09	0.09	<0.05	<0.05	<0.05	0.24	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Titanium (total)	µg/L	1000	NG	NG	NG	NG	NG	NG	NG	NG		259	113		19.3	19.2	34.5	56.0	2.5	3.2	6.6	55.7	15.5	47.0	3.0	2.3	3.2	3.9	10.8
Tungsten (total)	µg/L	NG	3	NG	NG	NG	NG	NG	NG	NG		0.2	<0.1		<0.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1	<0.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Uranium (total)	µg/L	85	20	NG	NG	8.5	NG	20	NG	NG		0.13	0.06		0.05	0.06	0.10	0.15	0.12	0.15	0.17	0.21	0.11	0.12	0.08	0.08	0.04	0.04	0.11
Vanadium (total)	µg/L	NG	20	NG	NG	NG	NG	NG	NG	NG		11	5		2	3	2	4	<1	1	2	4	2	5	<1	<1	<1	<1	2
Zinc (total)	µg/L	Calc [3.6]	3000 [3.12]	Calc [3.22]	Calc [4.22]	NG	NG	3000	5000	NG		5640	1560		1060	80	71	733	28	75	251	7430	13400	8160	349	323	133	124	931
Zirconium (total)	µg/L	NG	NG	NG	NG	NG	NG	NG	NG	NG																			
Dissolved Metals																													
Aluminum (dissolved)	µg/L	NG	9500 [3.10]	Calc [3.23]	Calc [4.23]	NG	NG	9500	NG	5000		64	41	51.2	42	65	110	45	8	10	4	174	32	12	6	7	25	25	<2
Antimony (dissolved)	µg/L	90	6	NG	NG	g [4.2]	NG	6	NG	NG		<0.2	<0.2	0.14	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Arsenic (dissolved)	µg/L	50	10	$5^{3.24}$	$5^{4.24}$	NG	NG	10	NG	25		0.4	0.1	0.19	<0.1	0.3	<0.1	0.5	0.1	<0.1	0.1	29.2	13.5	15.6	0.2	0.4	<0.1	0.2	0.2
Barium (dissolved)	µg/L	10000	1000	NG	NG	1000	NG	NG	NG	NG		8.9	5.4	24.7	6.9	2.5	3.8	3.6	2.6	2.2	2.6	12.4	3.5	2.4	6.1	5.5	3.6	3.7	6.0
Beryllium (dissolved)	µg/L	1.5	8	NG	NG	0.13	NG	NG	NG	NG		<0.01	<0.01	<0.020	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.02	<0.01	0.04	0.01	0.02	0.01	<0.01	0.02
Bismuth (dissolved)	µg/L	NG	NG	NG	NG	NG	NG	NG	NG	NG				<0.050															
Boron (dissolved)	µg/L	12000	5000	1200 [3.25]	1200 [4.25]	NG	NG	5000	NG	5000		17	7	22	11	9	9	12	41	51	47	63	59	57	16	20	8	10	11
Cadmium (dissolved)	µg/L	Calc [3.6]	5	Calc [3.26]	Calc [4.26]	NG	NG	5	NG	NG		<0.01	<0.01	0.0177	0.01	<0.01	<0.01	<0.01	0.01	<0.01	0.03	0.02	0.02	0.02	<0.01	<0.01	<0.01	<0.01	0.01
Calcium (dissolved)	mg/L	NG	NG	NG	NG	N [3.7]	NG	NG	NG	NG		32.300	24.800	73.4	25.700	34.800	31.200	43.700	55.500	49.900	59.300	71.400	54.900	51.800	44.600	44.000	34.600	33.800	54.200
Cesium (dissolved)	µg/L	NG	NG	NG	NG	NG	NG	NG	NG	NG				<0.010															
Chromium (dissolved)	µg/L	10 [3.16]	50 [3.14]	NG	NG	1 [3.8]	NG	50	NG	NG		0.6	<0.5	<0.50	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	11.6	2.8	1.1	<0.5	<0.5	<0.5	<0.5	<0.5

Analyte	Unit	Guideline									Sampling Location	RTF-W-DP1	RTF-W-DP1	RTF-W-DP2	RTF-W-DP2	RTF-W-DP3	RTF-W-DP3	RTF-W-DP3	RTF-W-DP4	RTF-W-DP4	RTF-W-DP4	RTF-W-DP5	RTF-W-DP5	RTF-W-DP5	RTF-W-DP6	RTF-W-DP6	RTF-W-DP6	RTF-W-DP6	RTF-W-DP6
											Date Sampled	26-Jan-21	24-Feb-21	17-Dec-20	24-Feb-21	21-Jan-21	22-Feb-21	23-Mar-21	20-Jan-21	22-Feb-21	23-Mar-21	26-Jan-21	23-Feb-21	23-Mar-21	26-Jan-21	26-Jan-21	22-Feb-21	22-Feb-21	23-Mar-21
											Lab Sample ID	2008740	2141597	VA20C3702-013	2141606	1989845	2132174	2256004	1983600	2132177	2257281	2008738	2136439	2257282	2008731	2008739	2132178	2132179	2257283
											Sample Type															Duplicate			
		CSR AW	CSR DW	BCAWQG AL (LT)	BCAWQG AL (ST)	BCWWQG AL	BC RWQG	BC SDWOG MAC	BC SDWOG AO	BCAWQG WL																			
Cobalt (dissolved)	µg/L	40	20 [1.15]	4 [3.27]	110 [3.27]	NG	NG	1	NG	NG		2.95	1.12	4.11	0.18	0.29	0.19	0.77	0.10	0.10	0.08	5.66	2.91	2.95	0.13	0.08	<0.05	0.16	0.27
Copper (dissolved)	µg/L	Calc [1.1]	1500 [2.16]	N [3.26]	N [3.26]	NG	NG	2000 [7.5]	1000	300 [6.7]		<0.2	0.4	1.15	1.1	0.7	0.5	<0.2	0.5	<0.2	0.3	1.0	0.3	0.3	1.0	1.0	0.7	0.4	2.2
Hardness, Total (dissolved as CaCO3)	mg/L	NG	NG	NG	NG	NG	NG	NG	NG	NG		98.900	75.700		78.200	105.000	95.200	132.000	163.000	146.000	173.000	202.000	156.000	150.000	135.000	133.000	105.000	103.000	163.000
Iron (dissolved)	µg/L	NG	6500 [2.17]	350	350	NG	NG	NG	300	NG		3200	785	55	27	165	52	1070	<10	<10	<10	27300	10800	6130	12	18	16	16	76
Lead (dissolved)	µg/L	Calc [1.18]	10	Calc [3.29]	Calc [3.29]	NG	NG	5	NG	100		<0.05	<0.05	<0.050	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.14	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Lithium (dissolved)	µg/L	NG	8	NG	NG	NG	NG	NG	NG	NG		<0.5	<0.5	<1.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Magnesium (dissolved)	mg/L	NG	NG	NG	NG	NG	NG	NG	NG	NG		4.420	3.350	10.3	3.400	4.280	4.200	5.500	5.820	5.280	5.950	5.860	4.690	4.910	5.630	5.550	4.560	4.440	6.740
Manganese (dissolved)	µg/L	NG	1500 [2.18]	Calc [3.30]	Calc [3.30]	NG	NG	120	20	NG		736	89	185	3	33	9	89	<1	<1	3	258	88	52	38	46	<1	<1	102
Mercury (dissolved)	µg/L	0.25	1	0.020 [3.31]	0.020 [3.31]	NG	NG	1	NG	0.020 [6.8]		<0.01	<0.01		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Molybdenum (dissolved)	µg/L	10000	250	1000 [3.32]	2000 [3.32]	NG	NG	88	NG	50 [6.9]		0.93	0.42	1.34	0.41	0.29	0.18	0.26	0.47	0.45	0.50	0.70	0.32	0.95	0.32	0.28	0.30	0.29	0.33
Nickel (dissolved)	µg/L	Calc [1.19]	80	NG	NG	Calc [3.5]	NG	80	NG	NG		14.5	5.4	20.7	2.7	1.5	1.3	1.3	0.3	0.4	0.6	56.0	19.1	35.4	1.9	1.5	0.8	0.7	2.6
Phosphorus (dissolved, by ICPMS/ICPOES)	µg/L	NG	NG	N [3.33]	N [3.33]	NG	N [4.2]	NG	N [6.9]	NG				<50															
Phosphorus (dissolved, APHA 4500-P)	µg/L	NG	NG	N [3.34]	N [3.34]	NG	N [4.3]	NG	N [6.9]	NG			<5	6.9	<5		<5	5	<5	<5	<5		18	9			9	<5	<5
Potassium (dissolved)	µg/L	NG	NG	NG	NG	NG	NG	NG	NG	NG		1470	1160	7930	1040	915	921	1080	908	997	876	23400	9110	3450	1330	1340	1100	1080	1440
Rubidium (dissolved)	µg/L	NG	NG	NG	NG	NG	NG	NG	NG	NG				2.64															
Selenium (dissolved)	µg/L	20	10	2 [3.35]	2 [3.35]	NG	NG	10	NG	2 [6.10]		<0.5	0.6	0.209	0.7	<0.5	<0.5	<0.5	0.8	<0.5	1.4	1.7	2.3	0.8	<0.5	<0.5	0.6	0.6	<0.5
Silicon (dissolved, as Si)	µg/L	NG	NG	NG	NG	NG	NG	NG	NG	NG				5830															
Silver (dissolved)	µg/L	Calc [1.20]	20	Calc [3.36]	Calc [3.36]	NG	NG	NG	NG	NG		<0.02	<0.02	<0.010	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Sodium (dissolved)	mg/L	NG	200 [2.19]	NG	NG	NG	NG	NG	NG	NG		4.170	3.630	7.71	4.720	5.790	6.510	6.000	8.500	8.070	7.910	9.810	6.560	6.790	6.960	6.850	5.620	5.490	6.840
Strontium (dissolved)	µg/L	NG	2500	NG	NG	NG	NG	7000	NG	NG		97.4	62.8	192	49.2	95.0	98.7	122	152	150	142	181	119	107	129	124	89.3	93.1	115
Sulphur (dissolved)	µg/L	NG	NG	NG	NG	NG	NG	NG	NG	NG				26400															
Tellurium (dissolved)	µg/L	NG	NG	NG	NG	NG	NG	NG	NG	NG				<0.20															
Thallium (dissolved)	µg/L	3	NG	NG	NG	0.8 [3.38]	NG	NG	NG	NG		<0.01	<0.01	<0.010	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Thorium (dissolved)	µg/L	NG	NG	NG	NG	NG	NG	NG	NG	NG				<0.10															
Tin (dissolved)	µg/L	NG	2500	NG	NG	NG	NG	NG	NG	NG		<0.05	<0.05	<0.10	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.23	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Titanium (dissolved)	µg/L	1000	NG	NG	NG	NG	NG	NG	NG	NG		2.3	0.6	<0.30	0.6	1.4	1.2	2.4	1.1	0.6	0.9	7.3	1.8	1.9	1.4	1.5	0.6	0.9	0.9
Tungsten (dissolved)	µg/L	NG	3	NG	NG	NG	NG	NG	NG	NG		0.02	<0.01	<0.10	<0.01	0.04	<0.01	<0.01	0.04	<0.01	<0.01	0.03	0.03	0.02	<0.01	<0.01	<0.01	<0.01	<0.01
Uranium (dissolved)	µg/L	85	20	NG	NG	8.5	NG	20	NG	NG		0.01	0.01	0.333	0.02	0.05	0.04	0.05	0.15	0.15	0.16	0.13	0.05	0.08	0.06	0.07	0.03	0.03	0.08
Vanadium (dissolved)	µg/L	NG	20	NG	NG	NG	NG	NG	NG	NG		<0.5	0.8	0.78	0.6	1.1	<0.5	1.2	0.7	0.7	1.2	1.6	<0.5	0.9	<0.5	<0.5	<0.5	<0.5	0.9
Zinc (dissolved)	µg/L	Calc [1.21]	3000 [2.20]	Calc [3.37]	Calc [3.37]	NG	NG	3000	5000	NG		2830	1120	6290	1040	56	41	126	28	58	249	24200	14200	8250	461	309	95	85	352
Zirconium (dissolved)	µg/L	NG	NG	NG	NG	NG	NG	NG	NG	NG				<0.30															

Guideline Notes for Reports for 2020-8732 CRD Spill Shallow Groundwater Quality Results

1. Notes for BC CSR Generic Numerical Water Standards for Freshwater Aquatic Life (CSR AW)

General Notes:

BC Contaminated Sites Regulation, Generic Numerical Water Standards, Schedule 3.2; includes amendments up to B.C. Reg. 13/2019, January 24, 2019.

Aquatic life standards assume minimum 1:10 dilution available, and are to protect freshwater life.

Standards for all organic substances are for total substance concentrations. Any water sample to be analyzed for organic substances should not be filtered.

Standards for surface water samples to be analyzed for heavy metals, metalloids and inorganic ions are total substance concentrations. In addition, it is recommended that surface water samples being analyzed for heavy metals, metalloids and inorganic ions should also be analyzed for dissolved substance concentrations.

Standards for groundwater samples for heavy metals, metalloids and inorganic ions are for dissolved substance concentrations. In addition, it is recommended that groundwater samples being analyzed for heavy metals, metalloids and inorganic ions should also be analyzed for total substance concentrations.

Note 1.1 for Ammonia (total, as N):

Standard varies with pH and temperature. 10 degrees C is assumed. Consult a director for further advice.

The standard for ammonia, total (as N) is:

1,310 µg/L @ pH ≥ to 8.5

3,700 µg/L @ pH 8.0 - < 8.5

11,300 µg/L @ pH 7.5 - < 8.0

18,500 µg/L @ pH 7.0 - < 7.5

18,400 µg/L @ pH < 7.0

Note 1.2 for Ammonia, total (dissolved as N):

Standard varies with pH and temperature. 10 degrees C is assumed. Consult a director for further advice.

The standard for ammonia, total (as N) is:

1,310 µg/L @ pH ≥ to 8.5

3,700 µg/L @ pH 8.0 - < 8.5

11,300 µg/L @ pH 7.5 - < 8.0

18,500 µg/L @ pH 7.0 - < 7.5

18,400 µg/L @ pH < 7.0

Note 1.3 for Fluoride:

The standard for fluoride is:

2000 µg/L @ H < 50

3000 µg/L @ H ≥ 50

Where H means water hardness in mg/L as CaCO3.

Note 1.4 for Nitrate (as N):

Standard may not protect all amphibians. Consult director for further advice.

Note 1.5 for Nitrate + Nitrite (as N) (calculated):

Standard may not protect all amphibians. Consult director for further advice.

Note 1.6 for Nitrite (as N):

Standard varies with chloride concentration. Consult a director for further advice.
The standard for nitrite (as N) is:
200 µg/L (Cl < 2 mg/L)
400 µg/L (Cl 2 - < 4 mg/L)
600 µg/L (Cl 4 - < 6 mg/L)
800 µg/L (Cl 6 - < 8 mg/L)
1,000 µg/L (Cl 8 - < 10 mg/L)
2,000 µg/L (Cl ≥ 10 mg/L)

Note 1.7 for Sulfate:
The standard for sulfate is:
1280 mg/L @ H ≤ 30
2180 mg/L @ H 31 - 75
3090 mg/L @ H 76 - 180
4290 mg/L @ H > 180
Where H means water hardness in mg/L as CaCO3.

Note 1.8 for Cadmium (total):
The standard for cadmium is as follows:
0.5 µg/L @ H < 30
1.5 µg/L @ H 30 - < 90
2.5 µg/L @ H 90 - < 150
3.5 µg/L @ H 150 - < 210
4 µg/L @ H ≥ 210
Where H means water hardness in mg/L as CaCO3.

Note 1.9 for Chromium (total):
Analytical results for chromium (all species) in water may be used to demonstrate compliance with the standards. Where the standards cannot be met based on analytical results for chromium (all species), chromium speciation may be necessary.
Standard is 10 µg/L for chromium, hexavalent. Standard is 90 µg/L for chromium, trivalent. The standard of 10 µg/L was used to identify exceedances for total chromium in order to demonstrate compliance with the standards.

Note 1.10 for Copper (total):
The standard for copper is as follows:
20 µg/L @ H < 50
30 µg/L @ H 50 - < 75
40 µg/L @ H 75 - < 100
50 µg/L @ H 100 - < 125
60 µg/L @ H 125 - < 150
70 µg/L @ H 150 - < 175
80 µg/L @ H 175 - < 200
90 µg/L @ H ≥ 200
Where H means water hardness in mg/L as CaCO3.

Note 1.11 for Lead (total):

The standard for lead is as follows:
40 µg/L @ H < 50
50 µg/L @ H 50 - < 100
60 µg/L @ H 100 - < 200
110 µg/L @ H 200 - < 300
160 µg/L @ ≥ 300
Where H means water hardness in mg/L as CaCO3.

Note 1.12 for Nickel (total):
The standard for nickel is as follows:
250 µg/L @ H < 60
650 µg/L @ H 60 - < 120
1,100 µg/L @ H 120 - < 180
1,500 µg/L @ H ≥ 180
Where H means water hardness in mg/L as CaCO3.

Note 1.13 for Silver (total):
The standard for silver is:
0.5 µg/L @ H ≤ 100
15 µg/L @ H > 100
Where H means water hardness in mg/L as CaCO3.

Note 1.14 for Zinc (total):
The standard for zinc is as follows:
75 µg/L @ H < 90
150 µg/L @ H = 90 - < 100
900 µg/L @ H = 100 - < 200
1,650 µg/L @ H = 200 - < 300
2,400 µg/L @ H = 300 - < 400
3,150 µg/L @ H = 400 - < 500
If H ≥ 500 then use following formula:
Standard (µg/L) = 10 x [7.5 +{(0.75)(H – 90)}]
Where H means water hardness in mg/L as CaCO3.
There are special ministry approval and data reporting requirements for water hardness values ≥ 500 mg/L as CaCO3.
Reference is Schedule 3.2 and Protocol 10.

Note 1.15 for Cadmium (dissolved):
The standard for cadmium is as follows:
0.5 µg/L @ H < 30
1.5 µg/L @ H 30 - < 90
2.5 µg/L @ H 90 - < 150
3.5 µg/L @ H 150 - < 210
4 µg/L @ H ≥ 210
Where H means water hardness in mg/L as CaCO3.

Note 1.16 for Chromium (dissolved):
Analytical results for chromium (all species) in water may be used to demonstrate compliance with the standards. Where the standards cannot be met based on analytical results for chromium (all species), chromium speciation may be necessary.
Standard is 10 µg/L for chromium, hexavalent. Standard is 90 µg/L for chromium, trivalent. The standard of 10 µg/L was used to identify exceedances for dissolved chromium in order to demonstrate compliance with the standards.

Note 1.17 for Copper (dissolved):
The standard for copper is as follows:
20 µg/L @ H < 50
30 µg/L @ H 50 - < 75
40 µg/L @ H 75 - < 100
50 µg/L @ H 100 - < 125
60 µg/L @ H 125 - < 150
70 µg/L @ H 150 - < 175
80 µg/L @ H 175 - < 200
90 µg/L @ H ≥ 200
Where H means water hardness in mg/L as CaCO3.

Note 1.18 for Lead (dissolved):
The standard for lead is as follows:
40 µg/L @ H < 50
50 µg/L @ H 50 - < 100
60 µg/L @ H 100 - < 200
110 µg/L @ H 200 - < 300
160 µg/L @ ≥ 300
Where H means water hardness in mg/L as CaCO3.

Note 1.19 for Nickel (dissolved):
The standard for nickel is as follows:
250 µg/L @ H < 60
650 µg/L @ H 60 - < 120
1,100 µg/L @ H 120 - < 180
1,500 µg/L @ H ≥ 180
Where H means water hardness in mg/L as CaCO3.

Note 1.20 for Silver (dissolved):
The standard for silver is:
0.5 µg/L @ H ≤ 100
15 µg/L @ H > 100
Where H means water hardness in mg/L as CaCO3.

Note 1.21 for Zinc (dissolved):
The standard for zinc is as follows:
75 µg/L @ H < 90
150 µg/L @ H = 90 - < 100
900 µg/L @ H = 100 - < 200
1,650 µg/L @ H = 200 - < 300
2,400 µg/L @ H = 300 - < 400
3,150 µg/L @ H = 400 - < 500
If H ≥ 500 then use following formula:
Standard (µg/L) = 10 x [7.5 +{(0.75)(H – 90)}]
Where H means water hardness in mg/L as CaCO3.
There are special ministry approval and data reporting requirements for water hardness values ≥ 500 mg/L as CaCO3.
Reference is Schedule 3.2 and Protocol 10.

2. Notes for BC CSR Generic Numerical Water Standards for Drinking Water (CSR DW)
General Notes:

BC Contaminated Sites Regulation, Generic Numerical Water Standards, Schedule 3.2; includes amendments up to B.C. Reg. 13/2019, January 24, 2019.
Drinking water standards are for unfiltered samples obtained at the point of consumption. Heavy metals, metalloids and inorganic ions are expressed as total substance concentrations unless otherwise indicated.

Note 2.1 for Chloride ion:
Standard to protect against taste and odour concerns.

Note 2.2 for Nitrate (as N):
Where nitrate and nitrite are present, total nitrate plus nitrite-nitrogen should not exceed this value.

Note 2.3 for Nitrate + Nitrite (as N) (calculated):
Where nitrate and nitrite are present, total nitrate plus nitrite-nitrogen should not exceed this value.

Note 2.4 for Sulfate:
Standard to protect against taste and odour concerns.

Note 2.5 for Aluminum (total):
Standard is specific to protection of human health. Standard is derived with TRV protective of adults. Standard may not adequately protect other age groups.
Standard may not address aesthetic (organoleptic) concerns related to drinking water quality. Water treatment may be required.

Note 2.6 for Chromium (total):
Analytical results for chromium (all species) in water may be used to demonstrate compliance with the standards. Where the standards cannot be met based on analytical results for chromium (all species), chromium speciation may be necessary.
Standard is 50 µg/L for chromium, hexavalent. Standard is 6000 µg/L for chromium, trivalent. The standard of 50 µg/L was used to identify exceedances for total chromium in order to demonstrate compliance with the standards.

Note 2.7 for Cobalt (total):
The standard in Schedule 3.2 is 1 µg/L. However the BC Ministry of Environment and Climate Change Strategy has set an interim background groundwater concentration estimate of 20 ug/L for Cobalt at sites in the Province. Therefore a standard of 20 ug/L has been used for this criteria set.

Note 2.8 for Copper (total):
Standard is specific to protection of human health. Standard is derived with TRV protective of adults. Standard may not adequately protect other age groups.
Standard may not address aesthetic (organoleptic) concerns related to drinking water quality. Water treatment may be required.

Note 2.9 for Iron (total):
Standard applies to a site used for an industrial or commercial purpose or activity set out in Schedule 2 as
(a) item A6, A7, A8 or A11
(b) item C1, C2, C3, C4 or C6,
(c) item D2, D3, D5, or D6
(d) item E4, or
(e) item H14.
Standard applies to a site used for an industrial or commercial purpose or activity set out in Schedule 2 as item H11 or H20, but only if the site was used for the purpose or activity in conjunction with or as a result of the site also being used for at least one of the purposes or activities set out above.
Standard is specific to protection of human health. Standard is derived with TRV protective of adults. Standard may not adequately protect other age groups.
Standard may not address aesthetic (organoleptic) concerns related to drinking water quality. Water treatment may be required.

Note 2.10 for Manganese (total):
Standard applies to a site used for an industrial or commercial purpose or activity set out in Schedule 2 as
(a) item B1
(b) item C1, C3 or C4
(c) item D2, D3, D5, or D6
(d) item E4, or
(e) item H3 or H14.
Standard applies to a site used for an industrial or commercial purpose or activity set out in Schedule 2 as item H11 or H20, but only if the site was used for the purpose or activity in conjunction with or as a result of the site also being used for at least one of the purposes or activities set out above.
Standard is specific to protection of human health. Standard is derived with TRV protective of adults. Standard may not adequately protect other age groups.
Standard may not address aesthetic (organoleptic) concerns related to drinking water quality. Water treatment may be required.

Note 2.11 for Sodium (total):
Standard is specific to protection of human health. Standard is derived with TRV protective of adults. Standard may not adequately protect other age groups.

Note 2.12 for Zinc (total):
Standard is specific to protection of human health. Standard is derived with TRV protective of adults. Standard may not adequately protect other age groups.

Note 2.13 for Aluminum (dissolved):
Standard is specific to protection of human health. Standard is derived with TRV protective of adults. Standard may not adequately protect other age groups.
Standard may not address aesthetic (organoleptic) concerns related to drinking water quality. Water treatment may be required.

Note 2.14 for Chromium (dissolved):
Analytical results for chromium (all species) in water may be used to demonstrate compliance with the standards. Where the standards cannot be met based on analytical results for chromium (all species), chromium speciation may be necessary.
Standard is 50 µg/L for chromium, hexavalent. Standard is 6000 µg/L for chromium, trivalent. The standard of 50 µg/L was used to identify exceedances for dissolved chromium in order to demonstrate compliance with the standards.

Note 2.15 for Cobalt (dissolved):
The standard in Schedule 3.2 is 1 µg/L. However the BC Ministry of Environment and Climate Change Strategy has set an interim background groundwater concentration estimate of 20 ug/L for Cobalt at sites in the Province. Therefore a standard of 20 ug/L has been used for this criteria set.

Note 2.16 for Copper (dissolved):
Standard is specific to protection of human health. Standard is derived with TRV protective of adults. Standard may not adequately protect other age groups.
Standard may not address aesthetic (organoleptic) concerns related to drinking water quality. Water treatment may be required.

Note 2.17 for Iron (dissolved):

Standard applies to a site used for an industrial or commercial purpose or activity set out in Schedule 2 as
(a) item A6, A7, A8 or A11
(b) item C1, C2, C3, C4 or C6,
(c) item D2, D3, D5, or D6
(d) item E4, or
(e) item H14.
Standard applies to a site used for an industrial or commercial purpose or activity set out in Schedule 2 as item H11 or H20, but only if the site was used for the purpose or activity in conjunction with or as a result of the site also being used for at least one of the purposes or activities set out above.
Standard is specific to protection of human health. Standard is derived with TRV protective of adults. Standard may not adequately protect other age groups. Standard may not address aesthetic (organoleptic) concerns related to drinking water quality. Water treatment may be required.

Note 2.18 for Manganese (dissolved):
Standard applies to a site used for an industrial or commercial purpose or activity set out in Schedule 2 as
(a) item B1
(b) item C1, C3 or C4
(c) item D2, D3, D5, or D6
(d) item E4, or
(e) item H3 or H14.
Standard applies to a site used for an industrial or commercial purpose or activity set out in Schedule 2 as item H11 or H20, but only if the site was used for the purpose or activity in conjunction with or as a result of the site also being used for at least one of the purposes or activities set out above.
Standard is specific to protection of human health. Standard is derived with TRV protective of adults. Standard may not adequately protect other age groups.
Standard may not address aesthetic (organoleptic) concerns related to drinking water quality. Water treatment may be required.

Note 2.19 for Sodium (dissolved):
Standard is specific to protection of human health. Standard is derived with TRV protective of adults. Standard may not adequately protect other age groups.

Note 2.20 for Zinc (dissolved):
Standard is specific to protection of human health. Standard is derived with TRV protective of adults. Standard may not adequately protect other age groups.

3. Notes for BC Approved Water Quality Guidelines for freshwater aquatic life (Long-term chronic) (BCAWQG AL (LT))

General Notes:
For some parameters, there are two water quality guidelines: the short-term acute guideline (i.e. maximum), and the long-term chronic guideline (i.e. average). The long-term chronic guideline was used in this criteria set for parameters that have both guideline values.

Note 3.1 for Ammonia (total, as N):
The maximum guideline for ammonia varies as a function of pH and temperature. See Table 3 in Overview Report Update September 2009.
The 30-day average guideline for ammonia varies as a function of pH and temperature. See Table 4 in Overview Report Update September 2009. / The lab pH and field temperature results were used for determining the maximum ammonia concentration for this report. If a lab pH result was not available then the field pH result was used.

Note 3.2 for Chloride ion:

To protect freshwater aquatic life from acute and lethal effects, the maximum concentration of chloride (mg/L as NaCl) at any time should not exceed 600 mg/L.
To protect freshwater aquatic life from chronic effects, the average (arithmetic mean computed from five weekly samples collected over a 30-day period) concentration of chloride (mg/L as NaCl) should not exceed 150 mg/L.

Note 3.3 for Fluoride:

Correction by BC MOE Sept. 2011: The criteria for Fluoride (total) in mg/L is 0.4 as a maximum where the water hardness (as CaCO3) is less than or equal to 10 mg/L. Otherwise use the equation:
LC50 fluoride = -51.73 + 92.57 log10 (Hardness) and multiply by 0.01.
Hardness is as CaCO3 in units mg/L.

Note 3.4 for Nitrate (as N):

The guideline maximum for nitrate (as N) is 32.8 mg/l.
The 30-day average guideline for nitrate (as N) is 3.0 mg /L. The 30-day average (chronic) concentration is based on 5 weekly samples collected within a 30-day period.
Where nitrate and nitrite are present, the total nitrate+nitrite nitrogen should not exceed these values.

Note 3.5 for Nitrate + Nitrite (as N) (calculated):

The guideline maximum for nitrate (as N) is 32.8 mg/l.
The 30-day average guideline for nitrate (as N) is 3.0 mg /L. The 30-day average (chronic) concentration is based on 5 weekly samples collected within a 30-day period.
Where nitrate and nitrite are present, the total nitrate+nitrite nitrogen should not exceed these values.

Note 3.6 for Nitrite (as N):

The guideline maximum for nitrite as N is:
0.06 mg/L if chloride less than 2 mg/L
0.12 mg/L if chloride is 2 to 4 mg/L
0.18 mg/L if chloride is 4 to 6 mg/L
0.24 mg/L if chloride is 6 to 8 mg/L
0.30 mg/L if chloride is 8 to 10 mg/L
0.60 mg/L if chloride is greater than 10 mg/L.
The guideline 30-day average for nitrite as N is:
0.02 mg/L if chloride less than 2 mg/L
0.04 mg/L if chloride is 2 to 4 mg/L
0.06 mg/L if chloride is 4 to 6 mg/L
0.08 mg/L if chloride is 6 to 8 mg/L
0.10 mg/L if chloride is 8 to 10 mg/L
0.20 mg/L if chloride is greater than 10 mg/L.

Note 3.7 for pH:

pH less than 6.5: No statistically significant decrease in pH from background.
pH from 6.5 to 9.0: Unrestricted change permitted within this range.
pH over 9.0: No statistically significant increase in pH from background.
See BC MOE Overview Report for additional details.

Note 3.8 for Sulfate:

The approved 30-day average (minimum of 5 evenly-spaced samples collected in 30 days) water quality guidelines to protect aquatic life in BC for sulphate are:
128 mg/L at hardness of 0 to 30 mg/L as CaCO3
218 mg/L at hardness of 31 to 75 mg/L as CaCO3
309 mg/L at hardness of 76 to 180mg/L as CaCO3
429 mg/L at hardness 181 to 250 mg/L as CaCO3
Need to determine guideline based on site water for hardness greater than 250 mg/L as CaCO3.
For screening purposes in this report, exceedance were flagged for sulphate greater than 429 mg/L at hardness greater than 250 mg/L as CaCO3.

Note 3.9 for Total suspended solids:
Maximum Induced Suspended Sediments - mg/L or % of background:
- 25 mg/L in 24 hours when background is less than or equal to 25;
- Mean of 5 mg/L in 30 days when background is less than or equal to 25;
- 25 mg/L when background is between 25 and 250;
- 10% when background is greater than or equal to 250.

Note 3.10 for E. coli (MPN):
The escherichia coli density in fresh and marine waters used for the growing and harvesting of shellfish for human consumption should not exceed a median MPN of 14/100 mL over 30 days, and at least 90% of the samples in a 30-day period should not exceed 43/100 mL.

Note 3.11 for Fecal coliforms (counts):
The guideline for fecal coliforms is as follows: “The fecal coliform density in fresh and marine waters used for the growing and harvesting of shellfish for human consumption should not exceed a median MPN of 14/100 mL over 30 days, and at least 90% of the samples in a 30-day period should not exceed 43/100 mL.”

Note 3.12 for Fecal coliforms (MPN):
The guideline for fecal coliforms is as follows: “The fecal coliform density in fresh and marine waters used for the growing and harvesting of shellfish for human consumption should not exceed a median MPN of 14/100 mL over 30 days, and at least 90% of the samples in a 30-day period should not exceed 43/100 mL.”

Note 3.13 for Cobalt (total):
The interim maximum concentration for total cobalt is 110 µg/L to protect aquatic life in the freshwater environment from acute effects of cobalt.
The interim 30-day average concentration for total cobalt (based on five weekly samples) is 4 µg/L to protect aquatic life from chronic effects of cobalt.

Note 3.14 for Lead (total):
The maximum guideline for total lead in water, at a water hardness less than or equal to 8 mg/L as CaCO3 is set at 3.0 µg/L. When water hardness exceeds 8.0 mg/L CaCO3 the maximum guideline for lead at any time is given by the following equation:
Maximum Criteria (µg/L) = exp (1.273 ln(hardness) - 1.460).
The 30-day average guideline for total lead in water, when water hardness exceeds 8 mg/L as CaCO3, is as follows:
30-Day Average (µg/L) is less than or equal to 3.31 + exp (1.273 ln (mean hardness) - 4.704).
For hardness less than or equal to 8.0 mg/L there is no 30-day average guideline; hence the maximum concentration of 3.0 µg/L is used.

Note 3.15 for Manganese (total):

The maximum concentration of total manganese in mg/L at any time should not exceed the value as determined by the following relationship:
0.01102 hardness + 0.54
where water hardness is reported as mg/L of CaCO3.
The 30-day mean concentration of total manganese in mg/L should be less than or equal to the value as determined by the following relationship:
0.0044 hardness + 0.605
where water hardness is reported as mg/L of CaCO3.

Note 3.16 for Mercury (total):
The average concentration of total mercury in water as measured over a 30-day period (based on five weekly samples) should not exceed 0.02 µg/L when the methyl mercury (MeHg) constitutes less than or equal to 0.5% of the total mercury concentration. When the proportion of MeHg is greater than 0.5%, the guideline should be adjusted as indicated in the Table 1 and Table 4 of the BC MOE Overview Report - First Update, February 2001.
There is no guideline maximum for total mercury in water, for freshwater aquatic life.

Note 3.17 for Molybdenum (total):
The maximum concentration for total molybdenum is 2 mg/L.
The 30-day average concentration for total molybdenum (based on at least five weekly samples in a period of 30 days) is less than or equal to 1 mg/L.

Note 3.18 for Phosphorus (total, by ICPMS/ICPOES):
Streams: None proposed for streams.
Lakes: It is not possible to specify a single phosphorous concentration to achieve protection of aquatic life in lakes. A range of total phosphorous concentrations (5-15 µg/L) is suggested as the criterion which can be used as the basis for site specific water quality objectives.

Note 3.19 for Phosphorus (total, APHA 4500-P):
Streams: None proposed for streams.
Lakes: It is not possible to specify a single phosphorous concentration to achieve protection of aquatic life in lakes. A range of total phosphorous concentrations (5-15 µg/L) is suggested as the criterion which can be used as the basis for site specific water quality objectives.

Note 3.20 for Selenium (total):
The 30-day average water quality guideline for protection of aquatic life is 2 µg/L determined as the mean concentration of 5 evenly spaced samples collected over 30 days, and measured as total selenium.
The 30-day average alert concentration for the protection of aquatic life in sensitive ecosystems is 1 µg/L determined as the mean concentration of 5 evenly spaced samples collected over 30 days, and measured as total selenium.

Note 3.21 for Silver (total):
The guideline maximum for total silver is:
0.1 µg/L maximum if hardness less than or equal to 100 mg/L
3.0 µg/L maximum if hardness greater than 100 mg/L.
The guideline 30-day average for total silver is:
0.05 µg/L as 30-day mean if hardness less than or equal to 100 mg/L
1.5 µg/L as 30-day mean if hardness greater than 100 mg/L.

Note 3.22 for Zinc (total):

The maximum concentration of total zinc (µg/L) at any time should not exceed 33 µg/L when water hardness is less than or equal to 90 mg/L as CaCO3.
When water hardness exceeds 90 mg/L CaCO3, the guideline maximum in µg/L for total zinc is the value determined by the following relationship:
33 + 0.75 * (hardness - 90)
where water hardness is reported as mg/L of CaCO3.
The 30-day average concentration of total zinc (µg/L) at any time should not exceed 7.5 µg/L when water hardness is less than or equal to 90 mg/L as CaCO3.
When water hardness exceeds 90 mg/L CaCO3, the guideline maximum in µg/L for total zinc is the value determined by the following relationship:
7.5 + 0.75 * (hardness - 90)
where water hardness is reported as mg/L of CaCO3.

Note 3.23 for Aluminum (dissolved):
The maximum concentration of dissolved aluminum at any time should not exceed:
1. 0.10 mg/L when the pH is greater than or equal to 6.5
2. The value (in mg/L) determined by the following relationship if pH less than 6.5
Dissolved Aluminum = e (1.209-2.426 (pH) + 0.286 $(pH)^2$)
The 30-day average concentration of dissolved aluminum (based on a minimum of 5 approximately weekly samples) should not exceed:
1. 0.05 mg/L when the median pH over 30 days is greater than or equal to 6.5
2. the value determined by the following relationship at median pH less than 6.5
Dissolved Aluminum = e (1.6-3.327 (median pH) + 0.402 (median $pH)^2$) / The lab pH results were used for determining the maximum aluminum (dissolved) concentration for this report. If a lab pH result was not available then the field pH result was used.

Note 3.24 for Arsenic (dissolved):
The recommended guideline is for total arsenic.

Note 3.25 for Boron (dissolved):
The recommended guideline is for total boron.

Note 3.26 for Cadmium (dissolved):
The guideline for cadmium is determined on a site-specific basis according to the local water hardness. The guideline for cadmium (dissolved) in µg/L is determined by the following equations for long term exposure:
1. If hardness (as CaCO3) is less than 3.4 mg/L then maximum is 0.0176 µg/L
2. If hardness (as CaCO3) is from 3.4 to 285 mg/L then maximum is based on equation:
e raised to the power of {0.736[ln(hardness)] - 4.943}
3. If hardness (as CaCO3) is greater than 285 mg/L then maximum is 0.457 µg/L.
When water hardness is greater than the upper bound (i.e., highest water hardness tested), a site-specific assessment may be required.

Note 3.27 for Cobalt (dissolved):
The interim maximum concentration for total cobalt is 110 µg/L to protect aquatic life in the freshwater environment from acute effects of cobalt.
The interim 30-day average concentration for total cobalt (based on five weekly samples) is 4 µg/L to protect aquatic life from chronic effects of cobalt.

Note 3.28 for Copper (dissolved):
The guideline is for dissolved copper and is dependent on the specific chemistry of the water body and can only be calculated using the British Columbia Biotic Ligand Model (BC BLM) software.

Note 3.29 for Lead (dissolved):

The maximum guideline for total lead in water, at a water hardness less than or equal to 8 mg/L as CaCO3 is set at 3.0 µg/L. When water hardness exceeds 8.0 mg/L CaCO3 the maximum guideline for lead at any time is given by the following equation:
Maximum Criteria (µg/L) = exp (1.273 ln(hardness) - 1.460).
The 30-day average guideline for total lead in water, when water hardness exceeds 8 mg/L as CaCO3, is as follows:
30-Day Average (µg/L) is less than or equal to 3.31 + exp (1.273 ln (mean hardness) - 4.704).
For hardness less than or equal to 8.0 mg/L there is no 30-day average guideline; hence the maximum concentration of 3.0 µg/L is used.

Note 3.30 for Manganese (dissolved):
The maximum concentration of total manganese in mg/L at any time should not exceed the value as determined by the following relationship:
0.01102 hardness + 0.54
where water hardness is reported as mg/L of CaCO3.
The 30-day mean concentration of total manganese in mg/L should be less than or equal to the value as determined by the following relationship:
0.0044 hardness + 0.605
where water hardness is reported as mg/L of CaCO3.

Note 3.31 for Mercury (dissolved):
The average concentration of total mercury in water as measured over a 30-day period (based on five weekly samples) should not exceed 0.02 µg/L when the methyl mercury (MeHg) constitutes less than or equal to 0.5% of the total mercury concentration. When the proportion of MeHg is greater than 0.5%, the guideline should be adjusted as indicated in the Table 1 and Table 4 of the BC MOE Overview Report - First Update, February 2001.
There is no guideline maximum for total mercury in water, for freshwater aquatic life.

Note 3.32 for Molybdenum (dissolved):
The maximum concentration for total molybdenum is 2 mg/L.
The 30-day average concentration for total molybdenum (based on at least five weekly samples in a period of 30 days) is less than or equal to 1 mg/L.

Note 3.33 for Phosphorus (dissolved, by ICPMS/ICPOES):
Streams: None proposed for streams.
Lakes: It is not possible to specify a single phosphorous concentration to achieve protection of aquatic life in lakes. A range of total phosphorous concentrations (5-15 µg/L) is suggested as the criterion which can be used as the basis for site specific water quality objectives.

Note 3.34 for Phosphorus (dissolved, APHA 4500-P):
Streams: None proposed for streams.
Lakes: It is not possible to specify a single phosphorous concentration to achieve protection of aquatic life in lakes. A range of total phosphorous concentrations (5-15 µg/L) is suggested as the criterion which can be used as the basis for site specific water quality objectives.

Note 3.35 for Selenium (dissolved):
The 30-day average water quality guideline for protection of aquatic life is 2 µg/L determined as the mean concentration of 5 evenly spaced samples collected over 30 days, and measured as total selenium.
The 30-day average alert concentration for the protection of aquatic life in sensitive ecosystems is 1 µg/L determined as the mean concentration of 5 evenly spaced samples collected over 30 days, and measured as total selenium.

Note 3.36 for Silver (dissolved):

The guideline maximum for total silver is:
0.1 µg/L maximum if hardness less than or equal to 100 mg/L
3.0 µg/L maximum if hardness greater than 100 mg/L.
The guideline 30-day average for total silver is:
0.05 µg/L as 30-day mean if hardness less than or equal to 100 mg/L
1.5 µg/L as 30-day mean if hardness greater than 100 mg/L.

Note 3.37 for Zinc (dissolved):
The Short-term Maximum concentration of total zinc (µg/L) at any time should not exceed 33 µg/L when water hardness is less than or equal to 90 mg/L as CaCO3.
When water hardness exceeds 90 mg/L CaCO3, the Short-term Maximum guideline in µg/L for total zinc is the value determined by the following relationship:
33 + 0.75 * (hardness - 90)
where water hardness is reported as mg/L of CaCO3.
Short-term maximum WQG formula applies to water hardness between 90 – 500 mg/L CaCO3.
The Long-term Average concentration of total zinc (µg/L) at any time should not exceed 7.5 µg/L when water hardness is less than or equal to 90 mg/L as CaCO3.
When water hardness exceeds 90 mg/L CaCO3, the Long-term Average guideline in µg/L for total zinc is the value determined by the following relationship:
7.5 + 0.75 * (hardness - 90)
where water hardness is reported as mg/L of CaCO3.
Long-term average WQG formula applies to water hardness between 90 – 330 mg/L CaCO3.

4. Notes for BC Approved Water Quality Guidelines for freshwater aquatic life (Short-term acute) (BCAWQG AL (ST))

General Notes:
For some parameters, there are two water quality guidelines: the short-term acute guideline (i.e. maximum), and the long-term chronic guideline (i.e. average). The short-term acute guideline was used in this criteria set for parameters that have both guideline values.

Note 4.1 for Ammonia (total, as N):
The maximum guideline for ammonia varies as a function of pH and temperature. See Table 3 in Overview Report Update September 2009.
The 30-day average guideline for ammonia varies as a function of pH and temperature. See Table 4 in Overview Report Update September 2009. / The lab pH and field temperature results were used for determining the maximum ammonia for this report. If a lab pH result was not available then the field pH result was used.

Note 4.2 for Chloride ion:
To protect freshwater aquatic life from acute and lethal effects, the maximum concentration of chloride (mg/L as NaCl) at any time should not exceed 600 mg/L.
To protect freshwater aquatic life from chronic effects, the average (arithmetic mean computed from five weekly samples collected over a 30-day period) concentration of chloride (mg/L as NaCl) should not exceed 150 mg/L.

Note 4.3 for Fluoride:
Correction by BC MOE Sept. 2011: The criteria for Fluoride (total) in mg/L is 0.4 as a maximum where the water hardness (as CaCO3) is less than or equal to 10 mg/L. Otherwise use the equation:
LC50 fluoride = -51.73 + 92.57 log10 (Hardness) and multiply by 0.01.
Hardness is as CaCO3 in units mg/L.

Note 4.4 for Nitrate (as N):

The guideline maximum for nitrate (as N) is 32.8 mg/l.
The 30-day average guideline for nitrate (as N) is 3.0 mg /L. The 30-day average (chronic) concentration is based on 5 weekly samples collected within a 30-day period.
Where nitrate and nitrite are present, the total nitrate+nitrite nitrogen should not exceed these values.

Note 4.5 for Nitrate + Nitrite (as N) (calculated):

The guideline maximum for nitrate (as N) is 32.8 mg/l.
The 30-day average guideline for nitrate (as N) is 3.0 mg /L. The 30-day average (chronic) concentration is based on 5 weekly samples collected within a 30-day period.
Where nitrate and nitrite are present, the total nitrate+nitrite nitrogen should not exceed these values.

Note 4.6 for Nitrite (as N):

The guideline maximum for nitrite as N is:
0.06 mg/L if chloride less than 2 mg/L
0.12 mg/L if chloride is 2 to 4 mg/L
0.18 mg/L if chloride is 4 to 6 mg/L
0.24 mg/L if chloride is 6 to 8 mg/L
0.30 mg/L if chloride is 8 to 10 mg/L
0.60 mg/L if chloride is greater than 10 mg/L.
The guideline 30-day average for nitrite as N is:
0.02 mg/L if chloride less than 2 mg/L
0.04 mg/L if chloride is 2 to 4 mg/L
0.06 mg/L if chloride is 4 to 6 mg/L
0.08 mg/L if chloride is 6 to 8 mg/L
0.10 mg/L if chloride is 8 to 10 mg/L
0.20 mg/L if chloride is greater than 10 mg/L.

Note 4.7 for pH:

pH less than 6.5: No statistically significant decrease in pH from background.
pH from 6.5 to 9.0: Unrestricted change permitted within this range.
pH over 9.0: No statistically significant increase in pH from background.
See BC MOE Overview Report for additional details.

Note 4.8 for Sulfate:

The approved 30-day average (minimum of 5 evenly-spaced samples collected in 30 days) water quality guidelines to protect aquatic life in BC for sulphate are:
128 mg/L at hardness of 0 to 30 mg/L as CaCO3
218 mg/L at hardness of 31 to 75 mg/L as CaCO3
309 mg/L at hardness of 76 to 180mg/L as CaCO3
429 mg/L at hardness 181 to 250 mg/L as CaCO3
Need to determine guideline based on site water for hardness greater than 250 mg/L as CaCO3.
For screening purposes in this report, exceedance were flagged for sulphate greater than 429 mg/L at hardness greater than 250 mg/L as CaCO3.

Note 4.9 for Total suspended solids:

Maximum Induced Suspended Sediments - mg/L or % of background:
- 25 mg/L in 24 hours when background is less than or equal to 25;
- Mean of 5 mg/L in 30 days when background is less than or equal to 25;
- 25 mg/L when background is between 25 and 250;
- 10% when background is greater than or equal to 250.

Note 4.10 for E. coli (MPN):

The escherichia coli density in fresh and marine waters used for the growing and harvesting of shellfish for human consumption should not exceed a median MPN of 14/100 mL over 30 days, and at least 90% of the samples in a 30-day period should not exceed 43/100 mL.

Note 4.11 for Fecal coliforms (counts):

The guideline for fecal coliforms is as follows: “The fecal coliform density in fresh and marine waters used for the growing and harvesting of shellfish for human consumption should not exceed a median MPN of 14/100 mL over 30 days, and at least 90% of the samples in a 30-day period should not exceed 43/100 mL.”

Note 4.12 for Fecal coliforms (MPN):

The guideline for fecal coliforms is as follows: “The fecal coliform density in fresh and marine waters used for the growing and harvesting of shellfish for human consumption should not exceed a median MPN of 14/100 mL over 30 days, and at least 90% of the samples in a 30-day period should not exceed 43/100 mL.”

Note 4.13 for Cobalt (total):

The interim maximum concentration for total cobalt is 110 µg/L to protect aquatic life in the freshwater environment from acute effects of cobalt.

The interim 30-day average concentration for total cobalt (based on five weekly samples) is 4 µg/L to protect aquatic life from chronic effects of cobalt.

Note 4.14 for Lead (total):

The maximum guideline for total lead in water, at a water hardness less than or equal to 8 mg/L as CaCO3 is set at 3.0 µg/L. When water hardness exceeds 8.0 mg/L CaCO3 the maximum guideline for lead at any time is given by the following equation:

Maximum Criteria (µg/L) = exp (1.273 ln(hardness) - 1.460).

The 30-day average guideline for total lead in water, when water hardness exceeds 8 mg/L as CaCO3, is as follows:

30-Day Average (µg/L) is less than or equal to 3.31 + exp (1.273 ln (mean hardness) - 4.704).

For hardness less than or equal to 8.0 mg/L there is no 30-day average guideline; hence the maximum concentration of 3.0 µg/L is used.

Note 4.15 for Manganese (total):

The maximum concentration of total manganese in mg/L at any time should not exceed the value as determined by the following relationship:

0.01102 hardness + 0.54

where water hardness is reported as mg/L of CaCO3.

The 30-day mean concentration of total manganese in mg/L should be less than or equal to the value as determined by the following relationship:

0.0044 hardness + 0.605

where water hardness is reported as mg/L of CaCO3.

Note 4.16 for Mercury (total):

The average concentration of total mercury in water as measured over a 30-day period (based on five weekly samples) should not exceed 0.02 µg/L when the methyl mercury (MeHg) constitutes less than or equal to 0.5% of the total mercury concentration. When the proportion of MeHg is greater than 0.5%, the guideline should be adjusted as indicated in the Table 1 and Table 4 of the BC MOE Overview Report - First Update, February 2001.

There is no guideline maximum for total mercury in water, for freshwater aquatic life.

Note 4.17 for Molybdenum (total):

The maximum concentration for total molybdenum is 2 mg/L.

The 30-day average concentration for total molybdenum (based on at least five weekly samples in a period of 30 days) is less than or equal to 1 mg/L.

Note 4.18 for Phosphorus (total, by ICPMS/ICPOES):

Streams: None proposed for streams.
Lakes: It is not possible to specify a single phosphorous concentration to achieve protection of aquatic life in lakes. A range of total phosphorous concentrations (5-15 µg/L) is suggested as the criterion which can be used as the basis for site specific water quality objectives.

Note 4.19 for Phosphorus (total, APHA 4500-P):
Streams: None proposed for streams.
Lakes: It is not possible to specify a single phosphorous concentration to achieve protection of aquatic life in lakes. A range of total phosphorous concentrations (5-15 µg/L) is suggested as the criterion which can be used as the basis for site specific water quality objectives.

Note 4.20 for Selenium (total):
The 30-day average water quality guideline for protection of aquatic life is 2 µg/L determined as the mean concentration of 5 evenly spaced samples collected over 30 days, and measured as total selenium.
The 30-day average alert concentration for the protection of aquatic life in sensitive ecosystems is 1 µg/L determined as the mean concentration of 5 evenly spaced samples collected over 30 days, and measured as total selenium.

Note 4.21 for Silver (total):
The guideline maximum for total silver is:
0.1 µg/L maximum if hardness less than or equal to 100 mg/L
3.0 µg/L maximum if hardness greater than 100 mg/L.
The guideline 30-day average for total silver is:
0.05 µg/L as 30-day mean if hardness less than or equal to 100 mg/L
1.5 µg/L as 30-day mean if hardness greater than 100 mg/L.

Note 4.22 for Zinc (total):
The maximum concentration of total zinc (µg/L) at any time should not exceed 33 µg/L when water hardness is less than or equal to 90 mg/L as CaCO3.
When water hardness exceeds 90 mg/L CaCO3, the guideline maximum in µg/L for total zinc is the value determined by the following relationship:
33 + 0.75 * (hardness - 90)
where water hardness is reported as mg/L of CaCO3.
The 30-day average concentration of total zinc (µg/L) at any time should not exceed 7.5 µg/L when water hardness is less than or equal to 90 mg/L as CaCO3.
When water hardness exceeds 90 mg/L CaCO3, the guideline maximum in µg/L for total zinc is the value determined by the following relationship:
7.5 + 0.75 * (hardness - 90)
where water hardness is reported as mg/L of CaCO3.

Note 4.23 for Aluminum (dissolved):
The maximum concentration of dissolved aluminum at any time should not exceed:
1. 0.10 mg/L when the pH is greater than or equal to 6.5
2. The value (in mg/L) determined by the following relationship if pH less than 6.5
Dissolved Aluminum = e (1.209-2.426 (pH) + 0.286 $(pH)^2$)
The 30-day average concentration of dissolved aluminum (based on a minimum of 5 approximately weekly samples) should not exceed:
1. 0.05 mg/L when the median pH over 30 days is greater than or equal to 6.5
2. the value determined by the following relationship at median pH less than 6.5
Dissolved Aluminum = e (1.6-3.327 (median pH) + 0.402 (median $pH)^2$)

Note 4.24 for Arsenic (dissolved):
The recommended guideline is for total arsenic.

Note 4.25 for Boron (dissolved):
The recommended guideline is for total boron.
Note 4.26 for Cadmium (dissolved):
The guideline for cadmium is determined on a site-specific basis according to the local water hardness. The guideline for cadmium (dissolved) in µg/L is determined by the following equations for short term exposure:
1. If hardness (as CaCO3) is less than 7 mg/L then maximum is 0.0380 µg/L
2. If hardness (as CaCO3) is from 7 to 45 mg/L then maximum is based on equation:
e to the power of {1.03[ln(hardness)] - 5.274}
3. If hardness (as CaCO3) is greater than 455 mg/L then maximum is 2.8 µg/L.
When water hardness is greater than the upper bound (i.e., highest water hardness tested), a site-specific assessment may be required.
Note 4.27 for Cobalt (dissolved):
The interim maximum concentration for total cobalt is 110 µg/L to protect aquatic life in the freshwater environment from acute effects of cobalt.
The interim 30-day average concentration for total cobalt (based on five weekly samples) is 4 µg/L to protect aquatic life from chronic effects of cobalt.
Note 4.28 for Copper (dissolved):
The guideline is for dissolved copper and is dependent on the specific chemistry of the water body and can only be calculated using the British Columbia Biotic Ligand Model (BC BLM) software. (Update August 2019)
Note 4.29 for Lead (dissolved):
The maximum guideline for total lead in water, at a water hardness less than or equal to 8 mg/L as CaCO3 is set at 3.0 µg/L. When water hardness exceeds 8.0 mg/L CaCO3 the maximum guideline for lead at any time is given by the following equation:
Maximum Criteria (µg/L) = exp (1.273 ln(hardness) - 1.460).
The 30-day average guideline for total lead in water, when water hardness exceeds 8 mg/L as CaCO3, is as follows:
30-Day Average (µg/L) is less than or equal to 3.31 + exp (1.273 ln (mean hardness) - 4.704).
For hardness less than or equal to 8.0 mg/L there is no 30-day average guideline; hence the maximum concentration of 3.0 µg/L is used.
Note 4.30 for Manganese (dissolved):
The maximum concentration of total manganese in mg/L at any time should not exceed the value as determined by the following relationship:
0.01102 hardness + 0.54
where water hardness is reported as mg/L of CaCO3.
The 30-day mean concentration of total manganese in mg/L should be less than or equal to the value as determined by the following relationship:
0.0044 hardness + 0.605
where water hardness is reported as mg/L of CaCO3.
Note 4.31 for Mercury (dissolved):
The average concentration of total mercury in water as measured over a 30-day period (based on five weekly samples) should not exceed 0.02 µg/L when the methyl mercury (MeHg) constitutes less than or equal to 0.5% of the total mercury concentration. When the proportion of MeHg is greater than 0.5%, the guideline should be adjusted as indicated in the Table 1 and Table 4 of the BC MOE Overview Report - First Update, February 2001.
There is no guideline maximum for total mercury in water, for freshwater aquatic life.
Note 4.32 for Molybdenum (dissolved):

The maximum concentration for total molybdenum is 2 mg/L.
The 30-day average concentration for total molybdenum (based on at least five weekly samples in a period of 30 days) is less than or equal to 1 mg/L.

Note 4.33 for Phosphorus (dissolved, by ICPMS/ICPOES):
Streams: None proposed for streams.
Lakes: It is not possible to specify a single phosphorous concentration to achieve protection of aquatic life in lakes. A range of total phosphorous concentrations (5-15 µg/L) is suggested as the criterion which can be used as the basis for site specific water quality objectives.

Note 4.34 for Phosphorus (dissolved, APHA 4500-P):
Streams: None proposed for streams.
Lakes: It is not possible to specify a single phosphorous concentration to achieve protection of aquatic life in lakes. A range of total phosphorous concentrations (5-15 µg/L) is suggested as the criterion which can be used as the basis for site specific water quality objectives.

Note 4.35 for Selenium (dissolved):
The 30-day average water quality guideline for protection of aquatic life is 2 µg/L determined as the mean concentration of 5 evenly spaced samples collected over 30 days, and measured as total selenium.
The 30-day average alert concentration for the protection of aquatic life in sensitive ecosystems is 1 µg/L determined as the mean concentration of 5 evenly spaced samples collected over 30 days, and measured as total selenium.

Note 4.36 for Silver (dissolved):
The guideline maximum for total silver is:
0.1 µg/L maximum if hardness less than or equal to 100 mg/L
3.0 µg/L maximum if hardness greater than 100 mg/L.
The guideline 30-day average for total silver is:
0.05 µg/L as 30-day mean if hardness less than or equal to 100 mg/L
1.5 µg/L as 30-day mean if hardness greater than 100 mg/L.

Note 4.37 for Zinc (dissolved):
The Short-term Maximum concentration of total zinc (µg/L) at any time should not exceed 33 µg/L when water hardness is less than or equal to 90 mg/L as CaCO3.
When water hardness exceeds 90 mg/L CaCO3, the Short-term Maximum guideline in µg/L for total zinc is the value determined by the following relationship:
33 + 0.75 * (hardness - 90)
where water hardness is reported as mg/L of CaCO3.
Short-term maximum WQG formula applies to water hardness between 90 – 500 mg/L CaCO3.
The Long-term Average concentration of total zinc (µg/L) at any time should not exceed 7.5 µg/L when water hardness is less than or equal to 90 mg/L as CaCO3.
When water hardness exceeds 90 mg/L CaCO3, the Long-term Average guideline in µg/L for total zinc is the value determined by the following relationship:
7.5 + 0.75 * (hardness - 90)
where water hardness is reported as mg/L of CaCO3.
Long-term average WQG formula applies to water hardness between 90 – 330 mg/L CaCO3.

5. Notes for BC Working Water Quality Guidelines for Freshwater Aquatic Life (2020) (BCWWQG AL)
General Notes:
Reference: B.C. Working Water Quality Guidelines: Aquatic Life, Wildlife & Agriculture (2020). WWQG values are long-term (i.e. average) concentrations unless identified as a short-term maximum in the “Notes” for a specific analyte. Long-term WWQGs represent average substance concentrations calculated from 5 samples in 30 days. WWQG are given for total substance concentrations unless otherwise noted.

Note 5.1 for Alkalinity (total, as CaCO3):
The guideline for alkalinity (total as CaCO3) is as follows:
- Less than 10 mg/L, highly sensitive to acid inputs
- 10 to 20 mg/L, moderately sensitive to acid inputs
- Greater than 20 mg/L, low sensitivity to acid inputs.

Sensitivity to acid inputs can be determined by the concentration of dissolved calcium: < 4 mg/L is highly sensitive to acid inputs; 4 to 8 mg/L is moderately sensitive; and > 8 mg/L is low sensitivity.

Note 5.2 for Antimony (total):
The guideline is for antimony (III).

Note 5.3 for Chromium (total):
The guideline for Cr(VI) is 1 µg/L (total). The guideline for Cr(III) is 8.9 µg/L (total). The guideline of 1 µg/L for Cr(VI) was used, in this report, to identify exceedances for dissolved chromium, and total chromium as a means for determining the potential for exceeding the Cr(VI) and/or Cr(III) guidelines.

Note 5.4 for Nickel (total):
The guideline for nickel in µg/L is determined as follows:
When the water hardness is 0 to ≤ 60 mg/L, the maximum is 25 µg/L
At hardness > 60 to ≤ 180 mg/L the maximum is calculated using the equation:
e raised to the power of {0.76[ln(hardness)] + 1.06}
At hardness >180 mg/L, the maximum is 150 µg/L
Where water hardness is reported as mg/L CaCO3.
If the water hardness is unknown, the maximum is 25 µg/L.

Note 5.5 for Thallium (total):
30-day average, site-specific objective for the lower Columbia River, BC

Note 5.6 for Antimony (dissolved):
The guideline is for antimony (III).

Note 5.7 for Calcium (dissolved):
The guideline for dissolved calcium in mg/L is as follows:
- Less than 4, highly sensitive to acid inputs
- 4 to 8, moderately sensitive
- Greater than 8, low sensitivity.

Note 5.8 for Chromium (dissolved):
The guideline for Cr(VI) is 1 µg/L (total). The guideline for Cr(III) is 8.9 µg/L (total). The guideline of 1 µg/L for Cr(VI) was used, in this report, to identify exceedances for dissolved chromium, and total chromium as a means for determining the potential for exceeding the Cr(VI) and/or Cr(III) guidelines.

Note 5.9 for Nickel (dissolved):
The guideline for nickel in µg/L is determined as follows:
When the water hardness is 0 to ≤ 60 mg/L, the maximum is 25 µg/L
At hardness > 60 to ≤ 180 mg/L the maximum is calculated using the equation:
e raised to the power of {0.76[ln(hardness)] + 1.06}
At hardness >180 mg/L, the maximum is 150 µg/L
Where water hardness is reported as mg/L CaCO3.
If the water hardness is unknown, the maximum is 25 µg/L.

Note 5.10 for Thallium (dissolved):
30-day average, site-specific objective for the lower Columbia River, BC

6. Notes for BC Recreational Water Quality Guidelines (2019) (BC RWQG)

General Notes:

The guidelines are for primary contact recreational uses. Primary contact is defined as activities, such as swimming (this includes bathing/wading for the purposes of this document), windsurfing and waterskiing, as well as secondary contact activities, such as canoeing or fishing, in natural waters through intentional or incidental immersion.

Note 6.1 for E. coli (MPN):
The geometric mean guideline is ≤ 200 E. coli /100 mL and is a geometric mean of a minimum of 5 samples in 30 days. The single sample maximum concentration guideline is ≤ 400 E. coli /100 mL. / The most stringent guideline was used in this report.

Note 6.2 for Phosphorus (total, by ICPMS/ICPOES):
The guideline for lakes is 0.01 mg/L.

Note 6.3 for Phosphorus (total, APHA 4500-P):
The guideline for lakes is 0.01 mg/L.

Note 6.4 for Phosphorus (dissolved, by ICPMS/ICPOES):
The guideline for lakes is 0.01 mg/L.

Note 6.5 for Phosphorus (dissolved, APHA 4500-P):
The guideline for lakes is 0.01 mg/L.

7. Notes for BC Source Drinking Water Quality Guidelines - Maximum Acceptable Concentrations (2020 and updates) (BC SDWQG MAC)

General Notes:
The source drinking water quality guidelines apply to the ambient water before it is treated and distributed for domestic use. The guidelines apply to drinking water sources from surface water and groundwater.

Note 7.1 for E. coli (MPN):
The MAC is ≤ 10 E. coli /100 mL; 90th percentile (minimum of 5 samples).

Note 7.2 for Fecal coliforms (counts):
The MAC is ≤ 10 coliforms/100 mL; 90th percentile (minimum of 5 samples).

Note 7.3 for Fecal coliforms (MPN):
The MAC is ≤ 10 coliforms/100 mL; 90th percentile (minimum of 5 samples).

Note 7.4 for Copper (total):
Includes short-term and long-term exposure.

Note 7.5 for Copper (dissolved):
Includes short-term and long-term exposure.

8. Notes for BC Source Drinking Water Quality Guidelines - Aesthetic Objectives (2020 and updates) (BC SDWQG AO)

General Notes:
The source drinking water quality guidelines apply to the ambient water before it is treated and distributed for domestic use. The guidelines apply to drinking water sources from surface water and groundwater.

Note 8.1 for Phosphorus (total, by ICPMS/ICPOES):
The AO for lakes is 0.01 mg/L. For lakes with residence time > 6 months, measure total P during spring overturn. For lakes with residence time < 6 months, measure mean epilimnetic total P during the growing season (ENV 1985).

Note 8.2 for Phosphorus (total, APHA 4500-P):
The AO for lakes is 0.01 mg/L. For lakes with residence time > 6 months, measure total P during spring overturn. For lakes with residence time < 6 months, measure mean epilimnetic total P during the growing season (ENV 1985).

Note 8.3 for Phosphorus (dissolved, by ICPMS/ICPOES):
The AO for lakes is 0.01 mg/L. For lakes with residence time > 6 months, measure total P during spring overturn. For lakes with residence time < 6 months, measure mean epilimnetic total P during the growing season (ENV 1985).

Note 8.4 for Phosphorus (dissolved, APHA 4500-P):

The AO for lakes is 0.01 mg/L. For lakes with residence time > 6 months, measure total P during spring overturn. For lakes with residence time < 6 months, measure mean epilimnetic total P during the growing season (ENV 1985).

9. Notes for BC Approved Water Quality Guidelines for wildlife (BCAWQG WL)

General Notes:

The Water Quality Guidelines (Criteria) Reports by BC Ministry of Environment were used as references for the guidelines. (Internet address: http://www.env.gov.bc.ca/wat/wq/wq_guidelines.html). Overview Reports (BC MOE) were used as the references for the guidelines unless the note for specific analyte indicates that the Technical Appendix (BC MOE) was used.

Note 9.1 for Fluoride:

Total fluoride should not exceed 1.0 mg/L as a 30-day average or 1.5 mg/L as a maximum in fresh water used by wildlife.

Note 9.2 for Nitrate (as N):

The guideline maximum for Wildlife for nitrate as nitrogen is 100 mg/l. Where nitrate and nitrite are present, the total nitrate+nitrite nitrogen should not exceed this value.

Note 9.3 for Nitrate + Nitrite (as N) (calculated):

The guideline maximum for Wildlife for nitrate as nitrogen is 100 mg/l. Where nitrate and nitrite are present, the total nitrate+nitrite nitrogen should not exceed this value.

Note 9.4 for Total suspended solids:

Induced suspended sediments should not exceed 20 mg/L when background suspended sediments is less than or equal to 100 mg/L, nor should induced suspended sediments be more than 20 % of background when background is greater than 100 mg/L.

Note 9.5 for Mercury (total):

The average concentration of total mercury in water as measured over a 30-day period (based on five weekly samples) should not exceed 0.02 µg/L when the methyl mercury (MeHg) constitutes less than or equal to 0.5% of the total mercury concentration. When the proportion of MeHg is greater than 0.5%, the guideline should be adjusted as indicated in the Table 1 and Table 4 of the BC MOE Overview Report - First Update, February 2001.

Note 9.6 for Selenium (total):

The water column (aquatic life) guideline of 2 µg/L, and the dietary guideline of 4 µg/g in food items, are applicable to wildlife species. The 30-day average water quality guideline for protection of aquatic life is 2 µg/L determined as the mean concentration of 5 evenly spaced samples collected over 30 days, and measured as total selenium.

The chronic tissue guideline for the protection of wildlife, using birds as a surrogate, is 6 µg/g (dw) in bird egg tissue, calculated as the mean concentration of at least 8 eggs (from 8 individual nests) in a representative area, reported as dry weight.

Note 9.7 for Copper (dissolved):

The guideline maximum is for total copper.

Note 9.8 for Mercury (dissolved):

The average concentration of total mercury in water as measured over a 30-day period (based on five weekly samples) should not exceed 0.02 µg/L when the methyl mercury (MeHg) constitutes less than or equal to 0.5% of the total mercury concentration. When the proportion of MeHg is greater than 0.5%, the guideline should be adjusted as indicated in the Table 1 and Table 4 of the BC MOE Overview Report - First Update, February 2001.

Note 9.9 for Molybdenum (dissolved):

The guideline maximum is for total molybdenum.

Note 9.10 for Selenium (dissolved):

The water column (aquatic life) guideline of 2 µg/L, and the dietary guideline of 4 µg/g in food items, are applicable to wildlife species. The 30-day average water quality guideline for protection of aquatic life is 2 µg/L determined as the mean concentration of 5 evenly spaced samples collected over 30 days, and measured as total selenium.
The chronic tissue guideline for the protection of wildlife, using birds as a surrogate, is 6 µg/g (dw) in bird egg tissue, calculated as the mean concentration of at least 8 eggs (from 8 individual nests) in a representative area, reported as dry weight.

Legend for Reports for 2020-8732 CRD Spill Shallow Groundwater Quality Results

<	Less than reported detection limit
>	Greater than reported upper detection limit
>=	Greater than or equal to
A	Absent
BC RWQG	BC Recreational Water Quality Guidelines (2019)
BC SDWQG AO	BC Source Drinking Water Quality Guidelines - Aesthetic Objectives (2020 and updates)
BC SDWQG MAC	BC Source Drinking Water Quality Guidelines - Maximum Acceptable Concentrations (2020 and updates)
BCAWQG AL (LT)	BC Approved Water Quality Guidelines for freshwater aquatic life (Long-term chronic)
BCAWQG AL (ST)	BC Approved Water Quality Guidelines for freshwater aquatic life (Short-term acute)
BCAWQG WL	BC Approved Water Quality Guidelines for wildlife
BCWWQG AL	BC Working Water Quality Guidelines for Freshwater Aquatic Life (2020)
Calc	Calculated guideline or standard. The guideline or standard is dependent on the value of one or more other analytes, and is calculated from a formula or table.
CSR AW	BC CSR Generic Numerical Water Standards for Freshwater Aquatic Life
CSR DW	BC CSR Generic Numerical Water Standards for Drinking Water
L	Laboratory reading type (Lab result)
m asl	metres above sea level
N	Narrative type of guideline or standard, or Result Note.
ND	Non-detect. Result is less than lower detection limit.
NG	No Guideline
NR	No Result
NS	No Standard
NT	Not Tested
OG	Overgrown
P	Present
PR	Presumptive
TK	Test kit reading type (Field result)
TNTC	Too numerous to count
	Highlighted value has a lower detection limit that is greater than the guideline/standard maximum and/or the guideline/standard minimum, or has an upper detection limit that is less than the guideline/standard maximum and/or the guideline/standard minimum.
	The maximum guideline/standard value cannot be determined because a result for a dependent analyte is not available for the sample.
BC RWQG	Highlighted value exceeds BC RWQG

Residual Treatment Facility Spill

Water Quality Results

BC SDWQG AO	Highlighted value exceeds BC SDWQG AO
BC SDWQG MAC	Highlighted value exceeds BC SDWQG MAC
BCAWQG AL (LT)	Highlighted value exceeds BCAWQG AL (LT)
BCAWQG AL (ST)	Highlighted value exceeds BCAWQG AL (ST)
BCAWQG WL	Highlighted value exceeds BCAWQG WL
BCWWQG AL	Highlighted value exceeds BCWWQG AL
CSR AW	Highlighted value exceeds CSR AW
CSR DW	Highlighted value exceeds CSR DW
SL Criteria Override	Highlighted value exceeds sampling location criteria override

Residual Treatment Facility Spill

Soil Quality Results

Analyte	Unit	Guideline		Sampling Location	RTF-NAR-S2	RTF-NAR-S2	RTF-NAR-S2	RTF-P-SS4	RTF-P-SS4	RTF-P-SS4
				Date Sampled	20-Jan-21	27-Apr-21	13-May-21	18-Jan-21	27-Apr-21	13-May-21
				Lab Sample ID	1983598	2400728	2470754	1973937	2400722	2470677
				Sample Type						
		CSR PL	CSR IL							
Lab Results										
General										
Soluble ammonia (as N) (mass/mass)	µg/g	NG	NG		46	2		<1	3	
Ammonia, soluble ion content (as N)	mg/L	NG	NG							
Moisture	% wet	NG	NG							
Nitrate (as N)	µg/g	50000	400000		6	35		<1	7	
Nitrite (as N)	µg/g	3000	25000		<1	<1		<1	<1	
Total nitrogen	µg/g	NG	NG		52	38		1	10	
Total nitrogen (percent)	%	NG	NG		0.62					
pH (in 2:1 water:soil mixture)		NG	NG		6.36	6.54		7.17	7.48	
Microbiological										
E. coli (MPN)	MPN/g	NG	NG		9804		5160	10000		<10
Fecal coliforms (MPN)	MPN/g	NG	NG		43000		270	1600		2.6
Total coliforms (MPN)	MPN/g	NG	NG		>242000			612700		
Metals										
Aluminum	µg/g	40000	250000		26400	26500		32300	34300	
Antimony	µg/g	20 [1.1]	40 [2.1]		0.3	0.5		0.3	0.3	
Arsenic	µg/g	10 [1.2]	10 [2.2]		4.1	4.7		2.7	3.0	
Barium	µg/g	350 [1.3]	350 [2.3]		47.7	58.4		27.7	30.0	
Beryllium	µg/g	Calc [1.4]	Calc [2.4]		0.3	0.4		0.4	0.3	
Bismuth	µg/g	NG	NG		0.6	<0.5		<0.5	<0.5	
Boron	µg/g	15000	1000000		6.4	7.2		6.9	7.2	
Cadmium	µg/g	Calc [1.5]	Calc [2.5]		0.19	0.32		0.10	0.17	
Calcium	µg/g	NG	NG							
Chromium	µg/g	60 [1.6]	60 [2.6]		29	38		*69*	*78*	
Cobalt	µg/g	25 [1.7]	25 [2.7]		16.7	21.5		22.7	23.6	
Copper	µg/g	Calc [1.8]	Calc [2.8]		63.9	75.6		63.9	72.7	
Iron	µg/g	35000	150000		*35500*	*35700*		*38800*	*39900*	
Lead	µg/g	120 [1.9]	Calc [2.9]		5.6	10.3		3.4	4.4	
Lithium	µg/g	65	450		7.6	9.3		7.8	7.9	
Magnesium	µg/g	NG	NG							
Manganese	µg/g	2000 [1.10]	2000 [2.10]		1120	1410		649	631	
Mercury	µg/g	25 [1.11]	75 [2.11]		0.03	0.07		0.02	0.02	
Molybdenum	µg/g	3 [1.12]	15 [2.12]		1.1	1.2		0.7	1.2	
Nickel	µg/g	Calc [1.13]	Calc [2.13]		29.5	36.7		40.4	46.0	
Phosphorus	µg/g	NG	NG							
Potassium	µg/g	NG	NG							
Selenium	µg/g	1 [1.14]	1 [2.14]		0.8	*1.2*		0.7	0.3	
Silver	µg/g	20 [1.15]	40 [2.15]		<0.5	<0.5		<0.5	<0.5	

Residual Treatment Facility Spill

Soil Quality Results

Analyte	Unit	Guideline		Sampling Location	RTF-NAR-S2	RTF-NAR-S2	RTF-NAR-S2	RTF-P-SS4	RTF-P-SS4	RTF-P-SS4
				Date Sampled	20-Jan-21	27-Apr-21	13-May-21	18-Jan-21	27-Apr-21	13-May-21
				Lab Sample ID	1983598	2400728	2470754	1973937	2400722	2470677
				Sample Type						
		CSR PL	CSR IL							
Sodium	µg/g	NG	NG							
Strontium	µg/g	20000	150000		32	44		39	45	
Sulphur	µg/g	NG	NG							
Thallium	µg/g	9 [1.16]	25 [2.16]		<0.1	<0.1		<0.1	<0.1	
Tin	µg/g	50 [1.17]	300 [2.17]		0.7	1.0		0.4	0.5	
Titanium	µg/g	NG	NG							
Tungsten	µg/g	25	200		0.36	0.40		0.25	0.30	
Uranium	µg/g	15 [1.18]	30 [2.18]		0.5	0.9		0.4	0.4	
Vanadium	µg/g	100 [1.19]	100 [2.19]		70	89		97	*104*	
Zinc	µg/g	Calc [1.20]	Calc [2.20]		156	199		76	110	
Zirconium	µg/g	NG	NG		1.2	2.0		2.0	1.9	

Guideline Notes for Reports for 2020-8732 CRD Spill Soil Quality Results

1. Notes for BC Contaminated Sites Regulation, Soil Standards for Urban Park Land Use (CSR PL)

General Notes:

BC Contaminated Sites Regulation, Soil Standards for Urban Park Land Use; includes amendments up to B.C. Reg. 13/2019, January 24, 2019. Soil Standards from Schedule 3.1 for urban park land use have been applied. Schedule 3.1 includes three parts: Part 1 – Matrix numerical soil standards; Part 2 – Generic numerical soil standards to protect human health; and Part 3 – Generic numerical soil standards to protect environmental health.

The most stringent standards in Schedule 3.1 were used based on applicable site-specific factors.

The Schedule 3.1 – Part 1 standards that were used, along with the site-specific factor, are included in the notes for the relevant analytes. For generic numerical soil standards, the Schedule 3.1 – Part 2 generic numerical soil standards were used unless noted otherwise in the notes for the relevant analytes.

Note 1.1 for Antimony:

Schedule 3.1, Part 3, Standard to Protect Ecological Health.

Note 1.2 for Arsenic:

Schedule 3.1, Part 1. The most stringent standards are as follows:

Human Health Protection, Groundwater used for drinking water: 10 µg/g

Environmental Protection, Groundwater flow to surface water used by aquatic life: 10 µg/g

Environmental Protection, Groundwater used for irrigation: 10 µg/g

Note 1.3 for Barium:

Schedule 3.1, Part 1, Human Health Protection, Groundwater used for drinking water.

Note 1.4 for Beryllium:

Schedule 3.1, Part 1. The most stringent combination of standards is as follows:

The standard for Beryllium varies with the pH of the soil at a site, as follows.

Human Health Protection, Intake of contaminated soil: 150 µg/g

Human Health Protection, Groundwater used for drinking water:

1 µg/g if pH < 5.5

Environmental Protection, Groundwater flow to surface water used by freshwater aquatic life:

1 µg/g if pH < 6.5;

4 µg/g if 6.5 ≤ pH < 7.0;

30 µg/g if 7.0 ≤ pH < 7.5;

Environmental Protection, Toxicity to soil invertebrates and plants: 150 µg/g

Note 1.5 for Cadmium:

Schedule 3.1, Part 1. The most stringent combination of standards is as follows.
The standard for cadmium varies with the pH of the soil at a site, as follows.
Human Health Protection, Groundwater used for drinking water:
1 µg/g if pH < 7.0
Environmental Protection, Toxicity to soil invertebrates and plants: 30 µg/g
Environmental Protection, Groundwater flow to surface water used by freshwater aquatic life:
1 µg/g if pH < 7.0;
3 µg/g if pH 7.0 - < 7.5;
20 µg/g if pH 7.5 - < 8.0;
Standard varies with receiving water hardness (H). H = 150 to < 210 mg/L as CaCO3 is assumed. Consult a director for further advice.
Environmental Protection, Groundwater used for irrigation:
1 µg/g if pH < 7.0

Note 1.6 for Chromium:

Schedule 3.1, Part 1, Matrix 9 - Chromium provides standards for chromium, hexavalent; chromium, trivalent; and chromium (all species).
The most stringent standards for chromium, hexavalent are:
Human Health Protection, Groundwater used for drinking water: 60 µg/g
Environmental Protection, Groundwater flow to surface water used by aquatic life: 60 µg/g
Environmental Protection, Groundwater used for irrigation: 60 µg/g
The most stringent standards for chromium, trivalent are:
Environmental Protection, Toxicity to soil invertebrates and plants: 200 µg/g
The standard of 60 µg/g was used for chromium in this report to demonstrate compliance with the standards of this matrix.

Note 1.7 for Cobalt:

Schedule 3.1, Part 1. The most stringent standards are as follows:
Human Health Protection, Intake of contaminated soil: 25 µg/g
Human Health Protection, Groundwater used for drinking water: 25 µg/g
Environmental Protection, Groundwater flow to surface water used by aquatic life: 25 µg/g
Environmental Protection, Groundwater used for irrigation: 25 µg/g

Note 1.8 for Copper:

Schedule 3.1, Part 1. The most stringent combination of standards is as follows:
The standard for copper varies with the pH of the soil at a site, as follows.
Environmental protection, Toxicity to soil invertebrates and plants:
150 µg/g
Environmental Protection, Groundwater flow to surface water used by freshwater aquatic life:
75 µg/g if pH < 5.5;
100 µg/g if 5.5 ≤ pH < 6.0;
Standard varies with receiving water hardness (H). H ≥ 200 mg/L as CaCO3 is assumed. Consult a director for further advice.
Environmental Protection, Groundwater used for irrigation:
75 µg/g if pH < 5.5

Note 1.9 for Lead:

Schedule 3.1, Part 1. The most stringent combination of standards is as follows:
Human Health Protection, Intake of contaminated soil:
120 µg/g
Human Health Protection, Groundwater used for drinking water:
120 µg/g if pH < 5.5

Note 1.10 for Manganese:
Schedule 3.1, Part 1. The most stringent standards are as follows:
Human Health Protection, Groundwater used for drinking water: 2,000 µg/g.
Standard applies to a site used for an industrial or commercial purpose or activity set out in Schedule 2 as (a) item B1, or (b) item C1, C3 or C4, (c) item D2, D3, D5 or D6, (d) item E4, or (e) item H3 or H14.
Standard applies to a site used for an industrial or commercial purpose or activity set out in Schedule 2 as item H11 or H20 but only if the site was used for that purpose or activity in conjunction with or as a result of the site being used for at least one of the purposes or activities set out in the above note.
Environmental Protection, Toxicity to soil invertebrates and plants: 2,000 µg/g
Environmental Protection, Groundwater used for irrigation: 2,000 µg/g

Note 1.11 for Mercury:
Schedule 3.1, Part 1, Human Health Protection, Intake of contaminated soil

Note 1.12 for Molybdenum:
Schedule 3.1, Part 1, Environmental Protection, Groundwater used for irrigation

Note 1.13 for Nickel:
Schedule 3.1, Part 1. The most stringent combination of standards is as follows:
The standard for nickel varies with the pH of the soil at a site, as follows.
Human Health Protection, Groundwater used for drinking water:
70 µg/g if pH < 7.5;
Environmental Protection, Toxicity to soil invertebrates and plants:
150 µg/g
Environmental Protection, Groundwater used for irrigation:
70 µg/g if pH < 7.0

Note 1.14 for Selenium:
Schedule 3.1, Part 1. The most stringent standards are as follows:
Human Health Protection, Groundwater used for drinking water: 1 µg/g
Environmental Protection, Groundwater flow to surface water used by aquatic life: 1 µg/g
Environmental Protection, Groundwater used for irrigation: 1 µg/g

Note 1.15 for Silver:
Schedule 3.1, Part 3, Standard to Protect Ecological Health.

Note 1.16 for Thallium:
Schedule 3.1, Part 3, Standard to Protect Ecological Health.

Note 1.17 for Tin:
Schedule 3.1, Part 3, Standard to Protect Ecological Health.

Note 1.18 for Uranium:
Schedule 3.1, Part 1, EP, Groundwater used for irrigation.

Note 1.19 for Vanadium:
Schedule 3.1, Part 1, Human Health Protection, Groundwater used for drinking water.

Note 1.20 for Zinc:

Schedule 3.1, Part 1. The most stringent combination of standards is as follows:
The standard for zinc varies with the pH of the soil at a site, as follows.
Environmental Protection, Toxicity to soil invertebrates and plants:
450 µg/g
Environmental Protection, Groundwater flow to surface water used by freshwater aquatic life:
150 µg/g if pH < 6.0;
250 µg/g if 6.0 ≤ pH < 6.5;
350 µg/g if 6.5 ≤ pH < 7.0;
Standard varies with receiving water hardness (H). H = 200 to < 300 mg/L as CaCO3 is assumed. Consult director for further advice.
Environmental Protection, Groundwater used for irrigation: 150 µg/g if pH < 6.0

2. Notes for BC Contaminated Sites Regulation, Soil Standards for Industrial Land Use (CSR IL)

General Notes:

BC Contaminated Sites Regulation, Soil Standards for Industrial Land Use; includes amendments up to B.C. Reg. 13/2019, January 24, 2019. Soil Standards from Schedule 3.1 for industrial land use have been applied. Schedule 3.1 includes three parts: Part 1 – Matrix numerical soil standards; Part 2 – Generic numerical soil standards to protect human health; and Part 3 – Generic numerical soil standards to protect environmental health.
The most stringent standards in Schedule 3.1 were used based on applicable site-specific factors.
The Schedule 3.1 – Part 1 standards that were used, along with the site-specific factor, are included in the notes for the relevant analytes. For generic numerical soil standards, the Schedule 3.1 – Part 2 generic numerical soil standards were used unless noted otherwise in the notes for the relevant analytes.

Note 2.1 for Antimony:

Schedule 3.1, Part 3, Standard to Protect Ecological Health.

Note 2.2 for Arsenic:

Schedule 3.1, Part 1. The most stringent standards are as follows:
Human Health Protection, Groundwater used for drinking water: 10 µg/g
Environmental Protection, Groundwater flow to surface water used by aquatic life: 10 µg/g

Note 2.3 for Barium:

Schedule 3.1, Part 1, Human Health Protection, Groundwater used for drinking water.

Note 2.4 for Beryllium:

Schedule 3.1, Part 1. The most stringent combination of standards is as follows:
The standard for Beryllium varies with the pH of the soil at a site, as follows.
Human Health Protection, Groundwater used for drinking water:
1 µg/g if pH < 5.5
Environmental Protection, Groundwater flow to surface water used by freshwater aquatic life:
1 µg/g if pH < 6.5;
4 µg/g if 6.5 ≤ pH < 7.0;
30 µg/g if 7.0 ≤ pH < 7.5;
250 µg/g if 7.5 ≤ pH < 8.0;
Environmental protection, Toxicity to soil invertebrates and plants:
350 µg/g

Note 2.5 for Cadmium:

Schedule 3.1, Part 1. The most stringent combination of standards is as follows.
The standard for cadmium varies with the pH of the soil at a site, as follows.
Human Health Protection, Groundwater used for drinking water:
1 µg/g if pH < 7.0
Environmental Protection, Groundwater flow to surface water used by freshwater aquatic life:
1 µg/g if pH < 7.0;
3 µg/g if 7.0 ≤ pH < 7.5;
20 µg/g if 7.5 ≤ pH < 8.0;
50 µg/g if pH ≥ 8.0
Standard varies with receiving water hardness (H). H = 150 to < 210 mg/L as CaCO3 is assumed. Consult a director for further advice.

Note 2.6 for Chromium:

Schedule 3.1, Part 1, Matrix 9 - Chromium provides standards for chromium, hexavalent; chromium, trivalent; and chromium (all species).
The most stringent standards for chromium, hexavalent are:
Human Health Protection, Groundwater used for drinking water: 60 µg/g;
Environmental Protection, Groundwater flow to surface water used by aquatic life: 60 µg/g.
The most stringent standard for chromium, trivalent is:
Environmental Protection, Toxicity to soil invertebrates and plants: 250 µg/g
The standard of 60 µg/g was used for chromium in this report to demonstrate compliance with the standards of this matrix.

Note 2.7 for Cobalt:

Schedule 3.1, Part 1. The most stringent standards are as follows:
Human Health Protection, Groundwater used for drinking water: 25 µg/g
Environmental Protection, Groundwater flow to surface water used by aquatic life: 25 µg/g

Note 2.8 for Copper:

Schedule 3.1, Part 1. The most stringent combination of standards is as follows:
The standard for copper varies with the pH of the soil at a site, as follows.
Environmental Protection, Groundwater flow to surface water used by freshwater aquatic life:
75 µg/g if pH < 5.5;
100 µg/g if 5.5 ≤ pH < 6.0;
Standard varies with receiving water hardness (H). H ≥ 200 mg/L as CaCO3 is assumed. Consult a director for further advice.
Environmental protection, Toxicity to soil invertebrates and plants:
300 µg/g

Note 2.9 for Lead:

Schedule 3.1, Part 1. The most stringent combination of standards is as follows:
The standard for lead varies with the pH of the soil at a site, as follows.
Human Health Protection, Groundwater used for drinking water:
120 µg/g if pH < 5.5;
150 µg/g if 5.5 ≤ pH < 6.0;
800 µg/g if 6.0 ≤ pH < 6.5;
Environmental Protection, Toxicity to soil invertebrates and plants
1,000 µg/g

Note 2.10 for Manganese:

Schedule 3.1, Part 1. The most stringent standards are as follows:
Human Health Protection, Groundwater used for drinking water: 2,000 µg/g.
Standard applies to a site used for an industrial or commercial purpose or activity set out in Schedule 2 as (a) item B1, or (b) item C1, C3 or C4, (c) item D2, D3, D5 or D6, (d) item E4, or (e) item H3 or H14.
Standard applies to a site used for an industrial or commercial purpose or activity set out in Schedule 2 as item H11 or H20 but only if the site was used for that purpose or activity in conjunction with or as a result of the site being used for at least one of the purposes or activities set out in the above note.
Environmental Protection, Toxicity to soil invertebrates and plants: 2,000 µg/g

Note 2.11 for Mercury:
Schedule 3.1, Part 1, Environmental Protection, Toxicity to soil invertebrates and plants.

Note 2.12 for Molybdenum:
Schedule 3.1, Part 1, Human Health Protection, Groundwater used for drinking water.

Note 2.13 for Nickel:
Schedule 3.1, Part 1. The most stringent combination of standards is as follows:
The standard for nickel varies with the pH of the soil at a site, as follows.
Human Health Protection, Groundwater used for drinking water:
70 µg/g if pH < 7.5;
250 µg/g if 7.5 ≤ pH < 8.0;
Environmental Protection, Toxicity to soil invertebrates and plants:
250 µg/g

Note 2.14 for Selenium:
Schedule 3.1, Part 1. The most stringent standards are as follows:
Human Health Protection, Groundwater used for drinking water: 1 µg/g
Environmental Protection, Groundwater flow to surface water used by aquatic life: 1 µg/g

Note 2.15 for Silver:
Schedule 3.1, Part 3, Standard to Protect Ecological Health.

Note 2.16 for Thallium:
Schedule 3.1, Part 3, Standard to Protect Ecological Health.

Note 2.17 for Tin:
Schedule 3.1, Part 3, Standard to Protect Ecological Health.

Note 2.18 for Uranium:
Schedule 3.1, Part 1, Human Health Protection, Groundwater used for drinking water.

Note 2.19 for Vanadium:
Schedule 3.1, Part 1, Human Health Protection, Groundwater used for drinking water.

Note 2.20 for Zinc:
Schedule 3.1, Part 1. The most stringent combination of standards is as follows:
The standard for zinc varies with the pH of the soil at a site, as follows.
Environmental Protection, Groundwater flow to surface water used by freshwater aquatic life:
150 µg/g if pH < 6.0;
250 µg/g if 6.0 ≤ pH < 6.5;
350 µg/g if 6.5 ≤ pH < 7.0;
Standard varies with receiving water hardness (H). H = 200 to < 300 mg/L as CaCO3 is assumed. Consult director for further advice.
Environmental Protection, Toxicity to soil invertebrates and plants:
450 µg/g

Legend for Reports for 2020-8732 CRD Spill Soil Quality Results

<	Less than reported detection limit
>	Greater than reported upper detection limit
>=	Greater than or equal to
A	Absent
Calc	Calculated guideline or standard. The guideline or standard is dependent on the value of one or more other analytes, and is calculated from a formula or table.
CSR IL	BC Contaminated Sites Regulation, Soil Standards for Industrial Land Use
CSR PL	BC Contaminated Sites Regulation, Soil Standards for Urban Park Land Use
L	Laboratory reading type (Lab result)
m asl	metres above sea level
N	Narrative type of guideline or standard, or Result Note.
ND	Non-detect. Result is less than lower detection limit.
NG	No Guideline
NR	No Result
NS	No Standard
NT	Not Tested
OG	Overgrown
P	Present
PR	Presumptive
TK	Test kit reading type (Field result)
TNTC	Too numerous to count
	Highlighted value has a lower detection limit that is greater than the guideline/standard maximum and/or the guideline/standard minimum, or has an upper detection limit that is less than the guideline/standard maximum and/or the guideline/standard minimum.
	The maximum guideline/standard value cannot be determined because a result for a dependent analyte is not available for the sample.
CSR IL	Highlighted value exceeds CSR IL
CSR PL	Highlighted value exceeds CSR PL
SL Criteria Override	Highlighted value exceeds sampling location criteria override

Residual Treatment Facility Spill
Sediment Quality Results

Analyte	Unit	Guideline	Sampling Location	RTF-W-SED10	RTF-W-SED10	RTF-W-SED10	RTF-W-SED11	RTF-W-SED11	RTF-W-SED11	RTF-W-SED12	RTF-W-SED12	RTF-W-SED13	RTF-W-SED13	RTF-W-SED14	RTF-W-SED14	RTF-W-SED15	RTF-W-SED15	RTF-W-SED16	RTF-W-SED16	RTF-W-SED17	RTF-W-SED17	RTF-W-SED7	RTF-W-SED7	RTF-W-SED7	RTF-W-SED7	RTF-W-SED8	RTF-W-SED8	RTF-W-SED8	RTF-W-SED8	RTF-W-SED8	RTF-W-SED9	RTF-W-SED9	RTF-W-SED9
			Date Sampled	20-Jan-21	27-Apr-21	13-May-21	20-Jan-21	27-Apr-21	13-May-21	19-Jan-21	26-Apr-21	19-Jan-21	26-Apr-21	19-Jan-21	26-Apr-21	19-Jan-21	26-Apr-21	19-Jan-21	26-Apr-21	19-Jan-21	26-Apr-21	20-Jan-21	20-Jan-21	27-Apr-21	13-May-21	20-Jan-21	27-Apr-21	27-Apr-21	13-May-21	13-May-21	20-Jan-21	27-Apr-21	13-May-21
			Lab Sample ID	1983596	2400733	2470759	1983597	2400734	2470760	1977905	2395386	1977909	2395384	1977910	2395383	1977911	2395382	1977912	2395381	1977913	2395376	1983571	1983599	2400730	2470756	1983594	2400729	2400731	2470755	2470757	1983595	2400732	2470758
			Sample Type																														
Analyte	**Unit**	**CSR SedSSS(F)**																															
Lab Results																																	
General																																	
Soluble ammonia (as N) (massl/mass)	µg/g	NG		78	5		3	3		4	2	1	2	2	2	4	6	4	1	2	1	2	2	2		1	3	5			2	<1	
Nitrate (as N)	µg/g	NG		4	16		3	<1		2	2	1	1	1	2	3	5	5	8	2	6	<1	<1	<1		<1	51	50			3	3	
Nitrite (as N)	µg/g	NG		<1	<1		<1	<1		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1		<1	<1	<1			<1	<1	
Total nitrogen	µg/g	NG		82	21		5	4		6	3	3	3	4	3	7	11	9	10	5	8	3	2	3		1	54	55			5	3	
Total nitrogen (percent)	%	NG		0.74			0.65			0.98		1.13		1.13			1.35		0.97		0.87	0.70	0.55			0.30					0.52		
pH (in 2:1 water:soil mixture)		NG		6.94	6.19		6.36	6.37		6.53	6.42	6.71	6.38	6.69	6.28	6.33	6.21	6.51	6.38	6.82	6.60	6.87	6.66	6.85		7.08	6.42	6.65			7.16	7.53	
Microbiological																																	
E. coli (MPN)	MPN/g	NG		22818		<10	388		202	<100	<10	<10	<10	42	20	<100	10	<10	<10	<10	<100	<10	52		100	21			51.6	10	84		10
Fecal coliforms (MPN)	MPN/g	NG		28000		17	700		350	<2	11	<2	24	92	0.8	54	11	3	<0.2	14	<0.2	<2	160		4	35			38	22	220		280
Total coliforms (MPN)	MPN/g	NG		>242000			54925			100		109		313		<100		327		441		1956	2382			657					5172		
Metals																																	
Aluminum	µg/g	NG		19300	16100		22500	7650		21500	4530	23800	4400	21400	10400	19300	8280	17900	16600	41800	30400	22300	22700	21300		29500	28400	31600			29700	23700	
Antimony	µg/g	NG		0.4	0.5		0.3	0.5		0.8	0.9	0.5	0.8	0.3	0.9	0.5	0.9	0.5	0.8	0.8	0.8	0.5	0.4	0.6		0.4	0.8	0.7			0.5	0.4	
Arsenic	µg/g	11.0		5.6	2.7		2.2	1.3		2.4	1.2	3.4	1.1	1.4	1.6	2.5	1.6	1.4	1.7	9.5	8.6	8.5	6.4	8.1		8.1	9.8	10.4			8.4	6.4	
Barium	µg/g	NG		65.8	38.4		44.5	20.0		30.9	12.1	24.9	16.8	49.2	50.6	68.2	42.5	69.1	113	146	87.6	54.8	53.1	61.6		96.5	115	125			88.7	71.2	
Beryllium	µg/g	NG		0.3	0.4		0.7	0.3		1.0	0.2	0.9	<0.1	0.3	0.3	0.3	0.2	0.3	0.4	1.2	1.4	0.3	0.3	0.4		0.5	0.5	0.6			0.5	0.4	
Bismuth	µg/g	NG		1.2	<0.5		<0.5	<0.5		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		<0.5	0.5	0.6			<0.5	<0.5	
Boron	µg/g	NG		7.7	11.3		5.6	11.2		9.7	12.7	6.6	15.9	6.2	16.6	9.7	18.9	10.6	15.6	9.0	14.3	11.4	6.5	8.6		6.4	8.9	12.3			9.1	7.6	
Cadmium	µg/g	2.2		0.30	0.43		0.37	0.43		0.81	0.57	0.88	0.65	0.52	0.54	0.66	0.49	0.44	0.75	1.18	1.15	0.39	0.33	0.47		0.32	0.53	0.56			0.39	0.36	
Chromium	µg/g	56.0		20	17		21	10		22	8	29	7	24	11	16	11	18	20	40	37	26	26	30		30	34	40			29	25	
Cobalt	µg/g	NG		12.9	7.3		7.6	3.3		6.0	2.2	6.6	3.7	6.4	3.3	5.4	4.0	5.1	6.0	40.5	31.8	16.5	16.5	18.7		21.8	26.7	30.6			21.0	16.7	
Copper	µg/g	120.0		73.5	70.3		80.6	57.5		**179**	41.2	**160**	26.9	37.4	60.5	41.2	38.1	34.2	51.8	79.2	92.8	38.3	39.0	47.6		36.9	76.4	86.9			52.0	47.3	
Iron	µg/g	NG		25000	13900		17400	6280		13800	4280	17000	4970	15500	5270	10200	5860	7870	6340	34900	27700	35300	31700	29400		37700	34600	38600			36200	27300	
Lead	µg/g	57.0		9.4	14.1		10.2	14.0		15.9	26.4	12.6	17.3	12.3	19.4	25.9	28.6	14.6	27.7	23.6	37.3	6.7	7.4	8.6		9.4	16.0	17.8			13.0	10.7	
Lithium	µg/g	NG		7.6	5.5		7.3	2.4		8.0	1.5	12.8	1.3	8.8	4.5	6.6	3.5	10.7	10.9	16.5	11.1	8.0	7.9	9.3		15.2	13.4	15.4			13.2	10.6	
Manganese	µg/g	NG		2880	395		258	150		392	67	214	83	132	147	188	235	131	160	5630	1490	1140	1110	1670		2240	5490	6000			3480	3320	
Mercury	µg/g	0.3		0.11	0.08		0.06	0.09		0.11	0.08	0.07	0.11	0.05	0.14	0.12	0.16	0.09	0.13	0.14	0.17	0.06	0.06	0.08		0.05	0.11	0.13			0.07	0.07	
Molybdenum	µg/g	NG		1.5	1.5		0.8	1.8		1.4	1.7	0.8	4.3	0.9	3.6	1.5	4.3	1.2	1.6	7.3	2.0	0.9	0.9	1.1		0.8	2.2	2.6			1.5	1.3	
Nickel	µg/g	NG		20.4	15.4		20.8	8.5		20.6	7.0	20.4	6.7	14.5	9.7	14.1	9.1	14.1	15.1	35.2	32.9	24.7	24.6	26.7		32.6	37.6	43.6			31.5	23.7	
Selenium	µg/g	1.5		1.7			1.5	3.4		4.0	4.4	3.0	2.0	1.4	3.4	1.5	2.6	1.5	2.0	2.1	2.2	1.9	1.9	1.9		1.1	1.6	1.9			1.5	1.2	
Silver	µg/g	NG		<0.5	<0.5		<0.5	<0.5		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		<0.5	<0.5	<0.5			<0.5	<0.5	
Strontium	µg/g	NG		43	63		46	62		105	75	84	79	73	100	86	104	76	97	71	83	37	33	43		40	60	68			59	48	
Thallium	µg/g	NG		<0.1	<0.1		<0.1	<0.1		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.3	0.2	<0.1	<0.1	<0.1		<0.1	0.1	0.1			<0.1	<0.1	
Tin	µg/g	NG		1.1	0.6		0.4	0.4		0.7	0.3	0.6	0.5	0.6	0.5	0.9	0.6	0.6	0.8	0.8	1.1	0.4	0.4	0.5		0.5	1.0	1.1			0.5	0.7	
Tungsten	µg/g	NG		0.17	0.17		0.10	0.11		0.14	0.10	0.17	0.10	0.11	0.11	0.11	0.13	0.10	0.11	0.18	0.21	0.18	0.16	0.20		0.19	0.23	0.30			0.17	0.18	
Uranium	µg/g	NG		0.8	3.4		2.6	23.2		20.2	17.7	9.8	3.0	2.6	21.2	1.8	3.8	2.4	3.0	4.4	5.3	0.9	0.9	1.1		0.6	1.2	1.3			0.9	0.8	
Vanadium	µg/g	NG		45	40		38	36		58	31	50	32	43	72	35	38	32	38	98	90	63	59	70		76	78	91			75	83	
Zinc	µg/g	200.0		169	72		63	37		49	25	59	80	99	54	114	78	154	**207**	**215**	200	**224**	**219**	**226**		**261**	**316**	**365**			**250**	169	
Zirconium	µg/g	NG		0.5	2.3		1.9	1.5		3.6	1.0	3.4	1.2	2.9	2.7	2.6	2.2	2.6	4.1	4.7	6.5	1.7	1.4	1.8		2.5	1.9	1.5			1.6	1.2	

Guideline Notes for Reports for 2020-8732 CRD Spill Sediment Quality Results

Notes for BC Contaminated Sites Regulation, Freshwater Sediment Standard for Sensitive Use (2017 and updates) (CSR SedSSS(F))

General Notes:

Sediment standards from BC CSR Schedule 3.4 - Generic Numerical Sediment Standards, Freshwater Sediment Standard for Sensitive Use have been applied.

Standards are specific to the protection of freshwater life. It is the responsibility of the responsible person for the site to ensure that use of the standards of this schedule does not constitute a significant risk or hazard to human health.

Sensitive sediment use means the use of a site containing sediment as habitat for sensitive components of freshwater, marine or estuarine aquatic ecosystems. Consult a director for further advice.

Legend for Reports for 2020-8732 CRD Spill Soil Quality Results

<	Less than reported detection limit
>	Greater than reported upper detection limit
>=	Greater than or equal to
A	Absent
Calc	Calculated guideline or standard. The guideline or standard is dependent on the value of one or more other analytes, and is calculated from a formula or table.
CSR SedSSS(F)	BC Contaminated Sites Regulation, Freshwater Sediment Standard for Sensitive Use (2017 and updates)
L	Laboratory reading type (Lab result)
m asl	metres above sea level
N	Narrative type of guideline or standard, or Result Note.
ND	Non-detect. Result is less than lower detection limit.
NG	No Guideline
NR	No Result
NS	No Standard
NT	Not Tested
OG	Overgrown
P	Present
PR	Presumptive
TK	Test kit reading type (Field result)
TNTC	Too numerous to count
	Highlighted value has a lower detection limit that is greater than the guideline/standard maximum and/or the guideline/standard minimum, or has an upper detection limit that is less than the guideline/standard maximum and/or the guideline/standard minimum.
	The maximum guideline/standard value cannot be determined because a result for a dependent analyte is not available for the sample.
CSR SedSSS(F)	Highlighted value exceeds CSR SedSSS(F)
SL Criteria Override	Highlighted value exceeds sampling location criteria override

APPENDIX B - DETAILED AMPHIBIAN SURVEY RESULTS

Monitoring Event	Date	Time	Weather	Wetland #	VES notes (Adult)	VES notes (Egg mass)	Auditory index	# of individuals heard	Comments
1	2021-03-18	17:30-20:00	9°C, 0 mm/24 hours, no wind.	0	0		0	0	
				1	0		0	0	
				2	0		0	0	
During GW sampling	2021-03-24	14:45	8.1°C, 8.4 mm/24 hours, raining, no wind.	1	N/A		1	1 PSRE individual	
2	2021-03-25	17:30 - 19:45	9.1°C, 1 mm rain/24 hours, no wind.	0	0		0	0	
				1	0		1	1 to 2 PSRE individuals	
				2	0		0	0	
3	2021-04-08	19:15 - 20:45	7°C, 3.75 mm rain/24 hours, no wind.	0	0		0	0	
				1	0		0	0	
				2	0		0	0	
During SED Sampling	2021-04-26	12:20	10°C, 14 mm rain/24 hours, no wind.	1	N/A		1	1 PSRE individual	Wetland goes east to west, heard from center of wetland.
During SED Sampling	2021-04-27	10:40	10°C, 1 mm rain/24 hours, no wind.	1	N/A		1	2 PSRE individuals	Heard from west end of wetland near station #3.
4	2021-04-29	18:30-20:50	13°C, 0 mm rain/24 hours, no wind.	0	0		0	0	
				1	1 PSRE		2	3 to 4 PSRE individuals	Auditory - heard from center of wetland on N and S sides. Visual - 1 adult on mud in middle area of wetland on S side.
				2	0		0	0	
5	2021-05-13	19:00-21:35	14°C, clear/sunny, 0mm/24 hours, no wind.	0	0		0	0	
				1	2 RAAU & 1 PSRE	1 RAAU	0	0	
				2	0		0	0	

Notes:
VES - visual encounter survey
PSRE - Northern Pacific Tree frog
RAAU - Northern Red-Legged Frog

Wetland 0 - small wetland south of Willis Point Road; Amphibian Survey Station 1
Wetland 1 - large wetland north of Willis Point Road; Amphibian Survey Stations 2 and 3
Wetland 2 - wetland between wetland 1 and Durance Lake; Amphibian Survey Stations 4 and 5

Auditory Index

0	no individuals
1	individuals can be counted (no overlapping calls)
2	calls of individuals are distinguishable, but some calls overlap
3	full chorus or continuous calls where individuals can not be distinguished