# KITWANGA LANDFILL

## 2022 Annual Report


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

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

Regional District of
**Kitimat-Stikine**

## Executive Summary

The Kitwanga landfill began closure in 2016 and as of 2017, the Kitwanga facility has operated as a Transfer Station to consolidate waste for landfilling at the Hazelton Waste Management Facility.

During 2022, **3,208 cubic metres** of refuse was collected at the Kitwanga Transfer Station and landfilled at the Hazelton Waste Management Facility. Approximately **218.24 metric tonnes** of materials were collected at the Transfer Station for diversion. Diverted materials include **62.76 metric tonnes** of Packaging and Paper Products (PPP), **48.9 metric tonnes** of corrugated cardboard, **26.29 metric tonnes** of clean wood, **9.16 metric tonnes** of household electronics, **68.22 metric tonnes** of metal, **2.91 metric tonnes** of small appliances, and **500** tires.

There were no instances of wildlife breaching the facility fence observed during 2022 at the Kitwanga Landfill. There was minimal vector activity from birds, including raptor species (bald eagles), and corvid species (crows and ravens). The RDKS self reported two non-compliances for 2022, one for a water quality exceedance and the other for the facility fence. An ENV inspection resulted in one additional non-compliance being submitted for maintenance of works. There were three monitoring wells installed at the facility in 2022. The two surface water compliance points were sampled and monitored according to their OC prescriptions. The compiled data, interpretation, and recommendations by Sperling Hansen will be contained in the *Kitwanga Landfill 2022 Annual Environmental Effects Monitoring (EEM) Report*.

[This Page Left Intentionally Blank]

Regional District of
**Kitimat-Stikine**

# Contents

[This page left intentionally blank]

Regional District of
Kitimat-Stikine

# 1 Introduction

This annual report covers the period from January to December 2022 and has been prepared to fulfill the requirements of Kitwanga Landfill Operational Certificate (OC) MR-5767 (Appendix A). The Kitwanga OC was issued in 2012 and has not yet been updated to reflect the closure of the landfill. The OC authorizes the discharge of municipal solid and liquid wastes and outlines the criteria for environmental and human protection at the landfill.

The 2022 Annual Report meets the requirements in Section 10.5 of the Operational Certificate by providing the following information presented in Table 1.

**Table 1: Report Objectives**

| | |
|---|---|
| **Waste Tracking**<br>Quantity of Waste Received and Diverted<br>**Wildlife Observations**<br>**Operations and Maintenance**<br>Facility Maintenance<br>Non-Compliances<br>**Environmental Monitoring** |  |

Environmental monitoring was conducted in accordance with the OC. The results of the water quality monitoring program, which includes groundwater, surface water, and leachate monitoring, are discussed in the Environmental Effects Monitoring Report by Sperling Hansen Associates, and contained in Appendix B of this report.

# 2 Background

A The Kitwanga Landfill (Figure 1) began closure activities in 2016, and in 2017 began operating as a transfer station to consolidate waste for landfilling at the Hazelton Waste Management Facility (HWMF), and to accept materials for recycling. The Kitwanga Landfill continues in the process of closure, with one third currently closed with liner andthe remainder to be shaped and closed with clays sourced from the HWMF site over the next 3 years. The Kitwanga Landfill (the landfill) is located approximately 5 km north of the community of Kitwanga. Access is via the Stewart-Cassiar Highway.

The Kitwanga Transfer Station (the transfer station) opened in October of 2017 and is owned and operated by the Regional District of Kitimat-Stikine (RDKS). The transfer station is onthe site of the closed Landfill. The transfer station accepts and manages municipal solid waste generated from commercial and residential sources in the Kitwanga area, including the communities of Kitwanga, Cedarvale, Gitanyow, Gitwangak, and Gitsegukla in accordance with the Regional District of Kitimat-Stikine Solid Waste

Management Plan (1995). Material is no longer discharged in the Landfill; waste is consolidated and hauled to the HWMF for landfilling or recycling through various stewards.

Landfill operations are regulated by the Ministry of Environment's Operation Certificate MR-5767, most recently amended in November 2012, and conducted in accordance with the Transfer Station Construction and Landfill Closure Design for The Kitwanga Landfill (Sperling Hansen Associates, 2016).

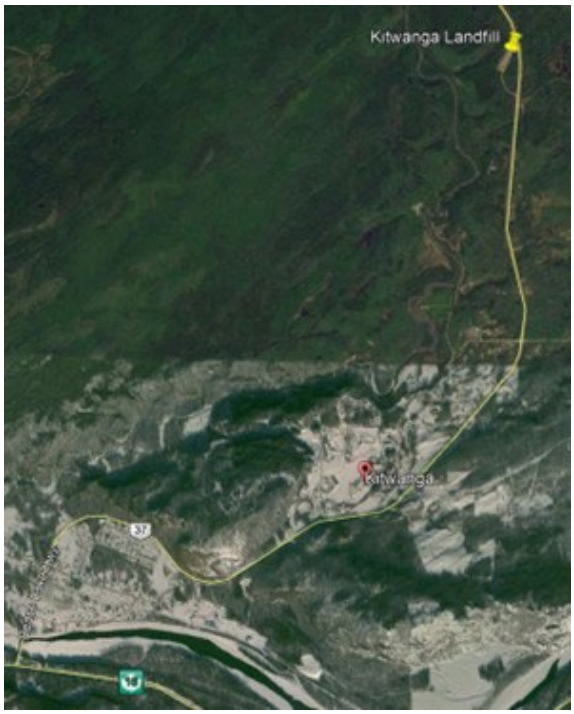



**Figure 1 Overview of Kitwanga Landfill.**

## 2.1 Landfill

The Kitwanga Landfill is a natural attenuation system. The landfill is no longer receiving waste. The RDKS is reviewing and updating the closure plan which is slated for completion in 2023. Full closure of the landfill is expected to in 2024, including final contours, engineered cover system, and a final vegetated cover layer.

# 3 Waste Disposal

The Kitwanga Transfer Station serves the Kitwanga area including the communities of: Kitwanga, Gitwangak, Gitanyow, Gitsegukla, and Cedarvale. The Landfill is in the process of closure and no waste was discharged at this location in 2022. Waste consolidated at the transfer station is landfilled at the Hazelton Waste Management Facility.

The total volumes of waste and diverted material collected at the Kitwanga Landfill from January through December 2022 are shown in Table 2.

**Table 2: Waste and Diversion Volumes for Kitwanga Landfill 2022**

| Waste Type | Cubic Metres | Metric Tonnes |
|---|---|---|
| **Landfilled Waste** | **3,208** | **363.8** |
| Refuse | 2,983 | 299.1 |
| C&D | 225 | 64.6 |
| Land Clearing Debris | 0.5 | 0.1 |
| **Diverted Waste** | | **218.2** |
| Cardboard | - | 48.9 |
| Clean Wood | - | 26.2 |
| Household Electronics | - | 9.2 |
| Metal | - | 68.2 |
| Printed Paper Packaging | - | 62.8 |
| Small Appliances | - | 2.9 |
| Tires | - | 500 |

## 3.1 Landfilled Wastes

### *Construction and Demolition*

C&D waste accepted at Kitwanga Transfer Station includes painted wood waste, treated wood waste, and demolition waste. In 2022, **225 cubic metres** of construction and demolition waste was collected at Kitwanga Transfer Station.

### *Land Clearing Waste*

Land clearing waste is defined as waste produced from the clearing of land for development, including trunks, stumps, tree branches 75 millimeters in diameter or greater, treetops, and whole trees. Land clearing debris does not include other organic materials, such as vegetative matter, tree branches under 75 millimeters, and compostable structural wood waste. Due to presence of rock and gravel within this land clearing debris, this material is often deposited in the landfill. In 2022, **0.5 cubic metres** of land clearing debris was received at Kitwanga Transfer Station.

### *Refuse*

Refuse includes general municipal solid waste (commercial and self hauled refuse, and small loads of C&D waste). In 2022 **2,983 cubic metres** of refuse was received at Kitwanga Transfer Station.

## 3.2 Diverted Wastes

Diverted metals, tires, and large appliances are collected and held at the transfer station for collection by the designated Stewardship or metal salvage company. Diverted materials include clean wood,

household electronics, metal, printed paper and packaging materials (PPP) and cardboard, small appliances and tires.

### *Clean Wood Waste*

Clean Wood means wood that is free of glue, laminate, paint, treatment, and may include small metal fasteners but does not include plywood or OSB. Clean wood is segregated is currently burned as outlined in Section 8 of the Operational Certificate. In 2022, **26.29 metric tonnes** of clean wood waste were received at the Transfer Station.

## 3.3 Extended Producer Responsibility Materials

Extended Producer Responsibility (EPR) materials consist of waste streams that are diverted and recycled through an approach that makes producers of products responsible for reducing environmental impacts and end of life management.

### *Household Electronics*

During 2022, **9.16 metric tonnes** of household electronics were collected at the Kitwanga Transfer Station for Stewardship recycling through the Encorp Electronics. The tonnage is also reported by Encorp Electronics.

### *Metals*

In 2022, a total of **68.22 metric tonnes** of metal, including scrap, propane tanks, and large appliances were collected at the Kitwanga Transfer Station for recycling. All ozone depleting substances were removedfrom applicable appliances prior to collection by the scrap metal recycler.

### *Printed Paper and Packaging (PPP) and Cardboard*

During 2022, **62.76 metric tonnes** of PPP and **48.90 metric tonnes** of corrugated cardboard was collected at the KitwangaTransfer Station for recycling. The tonnage of PPP and Cardboard was provided through the EPR Steward reports.

### *Small Appliances*

During 2022, **2.9 metric tonnes** of small appliances and power tools were collected at the Kitwanga Transfer Station for Stewardship recycling through Product Care's ElectroRecycle program. The tonnage reported is based on the ElectroRecycle invoices.

### *Tires*

In 2022, approximately **500** tires were collected at the Kitwanga Transfer Station for recycling through the Tire Stewardship of BC. This volume is an estimate based on a count of individual tires received at the facility.

## 3.4 Open Burning

No open burning took place at Kitwanga Landfill in 2022. Clean would received at the Kitwanga Transfer Station in 2022 was diverted to the Hazelton Waste Management Facility for burning.

# 4 Wildlife Occurrences and Observations

The Kitwanga landfill is located in a region with bears, wolves, coyotes, several species of birds of prey, and many other species of mammals that may attempt accessto the facility. An electric fence surrounds the facility, including the entrance gate, to prevent wildlife access. The fence is kept charged from spring until late fall.

Facility operators are required to conduct fence line inspections at a minimum weekly interval, testing for proper voltage, proper tension on fence stands, overall condition of the fence, and signs of wildlifeactivity. Inspection results are recorded on the Daily Operation Inspection Form.

There were no mammalian wildlife incidents or encounters observed during 2022 at the Kitwanga Landfill.

## 4.1 Bird and Vector Control

Birds, such as ravens and crows, are a nuisance at landfill sites, as they can scatter litter into the surrounding environment. As the landfill is undergoing closure and the transfer station is in an enclosed building, bird and vector activity is of minimal concern.

# 5 Operations and Maintenance

## 5.1 Complaints Received

No complaints were received regarding Kitwanga Transfer Station in 2022.

## 5.2 Annual Inspection of Cover System and Works

There was no inspection of cover system and works for the Kitwanga Landfill during 2022.

## 5.3 OC Amendments and Authorisations

The Kitwanga Landfill did not receive any updates or auhorizations to the OC in 2022. The OC requires the RDKS to follow the DOCP design, construction, operation, inspections, maintenance, monitoring, and closure of the facility, and to report on DOCP implementation.

## 5.4 Non-Compliance Reports

The RDKS was inspected by ENV in May 2022. The RDKS received an advisory letter for the inspection for non-compliances with the authorization related to open burning, a leachate breakout in the northwest corner of the landfill, inadequate area of final cover, and non-compliance reporting. The advisory letter is included in Appendix C.

As a corrective action, the RDKS began diverting clean wood from the Kitwanga Transfer Station to the Hazelton Waste Management Facility for burning.

The RDKS submitted two non-compliance reports in 2022. A summary of the non-compliances for the Kitwanga facility during the year of 2022 are presented in Table 3.

**Table 3 Summary of Non-Compliances for the Kitwanga Landfill in 2022.**

| Operational Certificate Non-Compliance Section | Description of Non-Compliance |
|---|---|
| **August 9, 2022**<br>4.17.3 Wire Tension<br>4.17.6 Period of Operation<br>4.17.8 Gate(s) | RDKS Staff dropped the fence lines on August 11, 2022, prior to drilling boreholes and restored position, tension, and energy on August 12, 2022. |
| **September 8, 2022**<br>Section 4.15 Water Quality and Protection | Dissolved Aluminum concentrations at the Upstream monitoring location exceeded the BCWQG-AW during the spring sampling event. |
| **April 3, 2023**<br>Section 4.16 Maintenance of Works and Emergency Procedures | The presence of two leachate breakouts was identified by ENV during a facility inspection and document review. ENV had not received a non-compliance for either breakout. A non-compliance submitted in response to inspection findings. |

## 5.5 Landfill Gas Collection

The Kitwanga Landfill contains a passive gas venting system consisting of a geomembrane cover system that lines a large portion of the landfill facility that is accessed by staff and the public. The Transfer Station building is equipped with a carbon monoxide and methane detector. The Kitwanga Landfill is not a regulated landfill site under the Landfill Gas Management Regulation (LGMR). The Kitwanga Landfill Closure Plan by Sperling Hansen Associates has indicated that there are no notable concerns of landfill gas migration to date. A landfill gas management system is not recommended for the landfill.

## 5.6 Fence Maintenance

The RDKS dropped sections of the fence to facilitate a monitoring well installation. The fence was re-tensioned and re-energized after the installation of the monitoring well. A non-compliance report was submitted for this event in August 2022.

## 5.7 Operational and Maintenance Expenditures

Operation and maintenance of the Rosswood landfill totaled $94,095 in 2022. Operations of the facility was $57,293.37 of this total, with the remaining going to maintenance activities, including closure plan updates, installation of monitoring wells, and environmental sampling.

# 6 Construction

No closure or construction activities took place at Kitwanga Landfill and Kitwanga Transfer Station in 2022.

# 7 Projected Operational Plan

The projected operational plan outlines the key strategies for the efficient and sustainable operations of the Kitwanga Landfill and the Kitwanga Transfer Station (KTs) for the next 12 months. As a responsible waste management organization, the RDKS recognizes the significance of managing waste effectively to protect the environment, promote public health, and ensure compliance with relevant regulations. By implementing this operational plan, RDKS aims to achieve the objectives of meeting the environmental and regulatory requirements, maximizing resource recovery, and maintaining a safe and environmentally responsible operation.

This plan will outline the various projects and improvements intended to be executed in the next 12 months, the processes involved, timeline and expected outcome. It will also outline the various strategies mapped out to reduce contamination and encourage diversion.

By adhering to this operational plan and working collaboratively with our stakeholders, we are confident that we will achieve our goals of efficient waste management, reduced environmental footprint, and a cleaner and healthier community. We are committed to regular evaluation, monitoring, and adaptation of our operations to remain at the forefront of waste management practices and technology.

A list of tasks sated for completion in 2023 is included in Table 4. Tasks are subject to budget approval and may change or be deferred subject to competing priorities following a risk-based approach.

**Table 4: Projected Operational Tasks for 2023**

| 2023 Plan | Description | Strategies | Expected Completion Date | Outcome |
|---|---|---|---|---|
| Amend the Closure Plan and Submit for Director Approval | Update the closure plan to address environmental concerns at the site from two leachate breakouts. | Work with QP to re-evaluate the proposed cover system and update the Environmental Effects Monitoring Program. | Sep-23 | Prepare for closure construction following Approved Closure Plan |
| Expand the RecycleBC drop off program | The RecycleBC Drop off program aims to promote recycling within communities and First Nations by establishing convenient recycling depots. | Develop plans to expand the program and have it run more effectively. Strategize to have at least two communities join the program. Develop effective outreach programs | Sep-23 | Expanded reach of recycling facilities to underserved communities |

# 8 Environmental Monitoring

Environmental monitoring for the Kitwanga Landfill was conducted by the Regional District of Kitimat-Stikine Environmental Technician, following the British Columbia Field Sampling Manual for Continuous Monitoring and the Collection of Air, Air-Emission, Water, Wastewater, Soil, Sediment, and Biological Samples (BC MOECCS 2013). All in-situ and laboratory data for surface water results has been analyzed and reviewed by Sperling Hansen. The compiled data, interpretation, and recommendations can be found in Appendix B.

## *Surface Water*

Two surface water sites were monitored at the Kitwanga Landfill; an Upstream and a Downstream point along an unnamed tributary to the Kitwanga River. The watercourse is downgradient from the landfill and runs parallel along the facility's western fence line. The two sites were sampled and monitored, once in April and once September. In-Situ parameters were monitored using a YSI. Lab parameters were collected in sample bottles and shipped to ALS for analysis.

In response to a non-compliance identified in the water quality results, an additional upstream monitoring location was added to the sampling and monitoring regime for the fall visit. The current location of the Upstream site is in close proximity to the landfill footprint. This additional Upstream site was chosen to aid in discerning if the Upstream exceedances to aluminum were from landfill influence or background conditions.

### *Groundwater*

Three groundwater monitoring wells installed at the facility in 2022. A senior hydrogeologist from Waterline Resources Inc. was retained to oversee the drilling and produce a report, contained in Appendix D. The wells were installed with a tracked sonic drill rig on August 11th and 12th, 2022. The wells are arranged in a triangle position, with one being located North of the Landfill footprint, one to the West side of the site, just before the land drops to the Unnamed Creek, down gradient of the facility. The third well was installed in the Southeast corner of the facility, down gradient of staining. The

The new wells were sampled by hand using Waterra tubing and a D-25 foot valve. In-Situ parameters are monitored using a YSI. Lab parameters were collected in sample bottles and shipped to ALS for analysis.

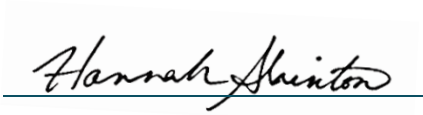
## 9 Summary

During 2022, **3,208 cubic metres** of refuse was collected at the Kitwanga Transfer Station and landfilled at the Hazelton Waste Management Facility. Approximately **218.24 metric tonnes** of materials were collected at the Transfer Station and diverted from landfill. Diverted materials include **62.76 metric tonnes** of PPP and **48.9 metric tonnes** of corrugated cardboard, **26.289 tonnes** of clean wood, **9.16 metric tonnes** of household electronics, **68.22 metric tonnes** of metal, **2.91 metric tonnes** of small appliances, and **500** tires.

There were no instances of mammalian wildlife breaching the facility fence observed during 2022 at the Kitwanga Landfill. There was minimal vector activity from birds, including raptor species (bald eagles), and corvid species (crows and ravens). The RDKS submitted two non-compliance reports in 2022, one for a water quality exceedance and the other for the facility fence. Three monitoring wells installed at the facility in 2022. Updates to the Closure Plan, and expansion of the RecycleBC program at the Transfer Station are planned for 2023.

Regional District of
**Kitimat-Stikine**

**Compiled by:**



**Hannah Shinton, B.Sc, A.Tag**
Environmental Technologist
Regional District of Kitimat-Stikine
hshinton@rdks.bc.ca

**Technical Review by:**

**Nicole Lavoie, B.Tech, A.Ag**
Environmental Services Coordinator
Regional District of Kitimat-Stikine
nlavoie@rdks.bc.ca

**Document Reviewed by:**

**Stephanie Ajah, MSc.**
Solid Waste Manager
Regional District of Kitimat-Stikine
sajah@rdks.bc.ca

**Document Certified by:**

**Robert Wickie, P.Eng**
Director of Works and Services
Regional District of Kitimat-Stikine
rwickie@rdks.bc.ca

# Appendix A Operational Certificate

BRITISH COLUMBIA
The Best Place on Earth

File: MR-5767

Date: November 8, 2012

**REGISTERED MAIL**

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

Dear Operational Certificate Holder:

Enclosed is Operational Certificate MR-5767 issued under the provisions of the *Environmental Management Act*. Your attention is respectfully directed to the terms and conditions outlined in the operational certificate.

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

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

Administration of this operational certificate will be carried out by staff from the Skeena Region. Plans, data and reports pertinent to the operational certificate are to be submitted to the Director, Environmental Protection, at Ministry of Environment, Regional Operations, Skeena Region, 3726 Alfred Avenue, Box 5000, Smithers, BC, V0J 2N0.

Yours truly,

M. Love

Mark Love, P. Ag.
for Director, *Environmental Management Act*
Skeena Region

Enclosure

**Ministry of Environment**
Regional Operations
Skeena Region
Mailing/Location Address
3726 Alfred Avenue
Box 5000
Smithers, BC, V0J 2N0
Telephone: (250) 847-7260
Facsimile: (250) 847-7591
http://www.gov.bc.ca/env

**MINISTRY OF ENVIRONMENT**

# OPERATIONAL CERTIFICATE
# MR-5767

for the

# KITWANGA LANDFILL

*Under the Provisions of the Environmental Management Act*
*and in accordance with the approved*
*Regional District of Kitimat-Stikine Solid Waste Management Plan, the*

## Regional District of Kitimat-Stikine

**Suite 300-4545 Lazelle Avenue**

**Terrace, British Columbia**

**V8G 4E1**

is authorized to store, handle, treat and discharge municipal solid waste from Kitwanga and surrounding area at the Kitwanga landfill, subject to the conditions listed below. Contravention of any of these conditions is a violation of the *Environmental Management Act* and may result in prosecution.

## 1. LOCATION OF LANDFILL PROPERTY

The location of the property where discharges are authorized to occur is District Lot 1335 Cassiar Land District.

M. Love

Mark Love, P.Ag.
For Director, Environmental Management Act

## 2. AUTHORIZED DISCHARGES

### 2.1 Discharge of Municipal Solid Waste

This section applies to the discharge of municipal solid waste to ground at the landfill located approximately as shown on the attached site plan. The site reference number for this discharge is E209210. Refer to Section 5 for the operational requirements associated with this discharge.

2.1.1 Subject to Sections 4.2, 4.3 and 4.4, the characteristics of the discharge shall be typical of municipal solid waste.

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

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

### 2.2 Storage and Handling of Wastes for Salvage and Recycling

This section applies to the storage and handling of municipal solid wastes for salvage and recycling. Refer to Section 7 for the operational requirements associated with this discharge.

2.2.1 Subject to Section 4.2, the characteristics of the discharge shall be typical of recyclable municipal solid waste.

2.2.2 The quantity of recyclable wastes stored or handled is indeterminate.

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

### 2.3 Discharge of Air Contaminants from Open Burning

This section applies to the discharge of air contaminants to the atmosphere from the regulated open burning of wood and selected combustibles from a burn pile located approximately as shown on the attached site plan. The site reference number for this discharge is E219223. Refer to Section 8 for the operational requirements associated with this discharge.

2.3.1 The characteristics of the discharge shall be typical of those resulting from the regulated open burning of selected combustibles as per Section 8.3.

2.3.2 The maximum authorized rate of discharge is indeterminate.

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

## 3 LANDFILL DESIGN

### 3.1 Design by Qualified Professional(s)

The landfill and associated works [including but not limited to the size(s) and location(s) of disposal area(s), maximum allowable slopes of disposal area(s), leachate management system, progressive and final closure details, etc.] shall be designed by qualified professionals [such as engineer(s) and/or geoscientist(s)] registered in the Province of British Columbia who have expertise in the field of landfill design. These details shall be incorporated into a "Design, Operations and Closure Plan" (DOCP) and made available to the Director upon request. Where a design feature prepared by a qualified professional is in conflict with any requirement of this operational certificate, it shall be brought to the attention of the Director who shall determine a resolution to the conflict.

### 3.2 Construction

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

### 3.3 Engineered Footprint

The landfill design shall include preparation of an engineered final design footprint delineating the maximum extent of solid waste disposal allowable at the facility horizontally (in plan view). The engineered final design footprint shall be clearly shown on a scaled plan of the site and the plan made available in PDF format (see Section 3.6). These details shall be documented in the DOCP.

### 3.4 Engineered Excavation and Final Grade Contours

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

aid in depicting the landfill profile) and the drawings shall be made available in PDF format (see Section 3.6). These details shall be documented in the DOCP.

### 3.5 Legal Survey

The landfill property shall be legally surveyed on or before June 30, 2016, or a minimum of 6 months prior to closure, whichever is sooner.

### 3.6 Scaled Drawings

A scaled site plan accurately showing the legal survey (when completed), the engineered final design footprint, and final design contours, shall be included in the DOCP and made available in PDF format upon request by the Director. Additional scaled drawings showing excavation contours (if relevant) and typical cross sectional views of the site shall also be included in the DOCP.

## 4. GENERAL REQUIREMENTS

### 4.1 Site Identification

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

### 4.2 Prohibited Wastes

No wastes as defined by the *Hazardous Waste Regulation* shall be received, stored, treated or disposed of at this site except as authorized by the Director. Lead-acid batteries shall not be landfilled but may be salvaged/recycled provided they are stored, handled and shipped in compliance with the *Hazardous Waste Regulation* and with Section 8 of this operational certificate. Tires equal to or less than 22" in rim size and autohulks shall not be landfilled.

### 4.3 Waste Asbestos

Notwithstanding Section 4.2 of this operational certificate, the disposal of waste asbestos under Section 2.1 of this operational certificate and in compliance with the requirements of Section 40 of the *Hazardous Waste Regulation* is hereby authorized.

## 4.4 Contaminated Soil

Soil that contains contaminants in concentrations less than "Hazardous Waste" as defined by the *Hazardous Waste Regulation* may be disposed at the landfill site. Disposal includes monofilling, co-disposal with other wastes, use as a refuse cell berm material and use as a refuse cell cover material. Disposal must occur within a disposal area as authorized by Section 5 of this operational certificate. Disposal does not include use as final cover material.

## 4.5 Waste Measurement

The quantity of waste material landfilled at the site shall be measured or estimated by means suitable to the Director. The results shall be submitted in accordance with Section 10.5, once per year on or before June 30 for the previous year, expressed in tonnes/yr and/or $m^3$/yr.

## 4.6 Ozone Depleting Substances

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

## 4.7 Fire Prevention

The operational certificate holder shall make all reasonable efforts to prevent unauthorized fires from occurring at the landfill site. As a minimum, a fire break clear of all combustible materials at least 15 metres wide shall surround all disposal, treatment and individual storage areas which have received or are receiving combustible materials. Disposal areas that have had 30 cm of compacted mineral soil cell cover or final cover applied are exempt. Water supply and pumping capabilities and/or soil and earth moving equipment shall be maintained at a sufficient level to extinguish fires. In addition, reasonable efforts shall include, but are not necessarily limited to, the preparation of a Fire Prevention and Response Plan.

## 4.8 Extinguishment of Fires

In the event of an unauthorized fire (including any smouldering fire), the operational certificate holder shall immediately make all reasonable efforts to extinguish the fire. The operational certificate holder shall also immediately notify the Provincial Emergency Program (phone: 1-800-663-3456) and any local fire authority of an unauthorized fire.

### 4.9 Buffer Zone

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

### 4.10 Litter Control

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

### 4.11 Water Table Restriction

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

### 4.12 Surface Water Management

The distance between a natural body of surface water and any stored or buried materials shall be a minimum of 25 metres.

### 4.13 Inert Materials

Specific inert materials may be exempted from the requirements of Section 4.11 by the Director. The permission of the Director must be obtained in writing prior to any disposal or handling of inert materials on an exemption basis.

### 4.14 Landfill Gas Lower Explosive Limit

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

### 4.15 Water Quality and Protection

The landfill shall be operated in a manner such that ground or surface water quality does not decrease beyond that specified by the Director, at the landfill property boundary or other specified location.

If exceedences of the specified criteria occur as a result of landfill operations, the Director may require that leachate management control measures or works be undertaken. Terms of reference for any leachate management study and/or design work shall be submitted to the Director for approval prior to conducting the work.

In addition to requirements specified by the director, groundwater must be managed in accordance with the Contaminated Sites Regulation.

M. Love

Mark Love, P.Ag.
For Director, Environmental Management Act

## 4.16 Maintenance of Works and Emergency Procedures

The operational certificate holder shall inspect the operation regularly and maintain it in good working order. The operational certificate holder shall immediately notify the Director of any circumstance which prevents continuing operation in the approved manner or results in non-compliance with the requirements of this operational certificate.

## 4.17 Electric Fencing

### 4.17.1 Design, Construction and Maintenance

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

### 4.17.2 Fence Type

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

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

### 4.17.3 Wire Tension

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

be corrected for temperature by use of the following formula for 12-½ gauge high tensile steel wire:

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

where: *Tension* is in lbs force

*Temperature* is in °C

4.17.4 Post Spacing

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

4.17.5 Grounding System

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

4.17.6 Period of Operation

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

4.17.7 Minimum Voltage

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

4.17.8 Gate(s)

Any access through electric fencing for vehicles, equipment and personnel shall consist of an electrified gate system that is closed during non-operating hours. The gate system shall be electrified to a minimum voltage of 6,000 volts at all times except when being opened or closed. Any gate that is open during operating hours shall be periodically checked by the attendant for bear activity during hours of operation. Gaps between the gate and the fence and

ground, and between gate panels (for a double-hung gate), shall not exceed 10 cm.

4.17.9 Fence Inspections

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

Signs of digging or other attempts by bears to penetrate electric fencing shall be recorded in a log book. Any penetrations through electric fencing by bears shall be immediately reported to the Conservation Officer Service at 1-877-952-7277 and to the Director at 250-847-7260.

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

### 4.18 Other Agency Requirements

This operational certificate does not relieve the operational certificate holder from complying with requirements of federal, provincial, regional district or municipal authorities.

## 5. OPERATIONAL REQUIREMENTS FOR THE DISPOSAL OF SOLID WASTE

### 5.1 Location

The operational certificate holder shall identify an area for disposal of solid waste (herein referred to as the solid waste disposal area) that is within the authorized municipal solid waste disposal footprint (see Section 2.1.3). Signs which identify the nature of the waste acceptable at the designated solid waste disposal area shall be erected and maintained. The lettering on the sign shall be such that it is clearly readable by the public upon approach.

### 5.2 Nature of Wastes

Wastes disposed at the active face of the solid waste disposal area may include any municipal solid waste except liquid wastes and hot ashes or as otherwise restricted by Section 4.2.

## 5.3 Bear-Proofing

The solid waste disposal area shall be maintained inside an electric fence. The electric fence shall comply with all requirements of Section 4.17.

## 5.4 Waste Compaction

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

## 5.5 Maximum Lift Height

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

## 5.6 Waste Cover

Cover shall be applied to waste in the solid waste disposal area as specified below. The operational certificate holder shall maintain a log book to record all dates of cover application.

### 5.6.1 Active Face Cover

Except as otherwise stated in Sub-section 5.6.2, the active face of the solid waste disposal area does not normally require cover. Based on information concerning environmental or public health concerns related to exposed waste at the active face, however, the Director may require that the active face be covered completely at a specified frequency with 0.15 m of soil (or functional equivalent) for a specified period.

### 5.6.2 Cell Cover

A uniform cover of 30 cm compacted soil shall be applied to all sides of the active waste cell in the solid waste disposal area such that no more than 200 $m^2$ of waste are exposed at the active face at any time and such that the volume of waste in the cell does not exceed 2000 $m^3$. Once the maximum volume of waste has been reached in a cell, the active face shall be covered with 30 cm of compacted soil and a new waste cell begun.

### 5.6.3 Final Cover

Completed portions of the solid waste disposal area shall progressively receive final cover during the active life of the landfill (see Section 11.5).



Mark Love, P.Ag.
For Director, Environmental Management Act

### 5.7 Dead Animal Disposal

Dead animals and animal parts shall be disposed of in the solid waste disposal area and covered as soon as practicable with a minimum of 60 centimetres of soil and/or waste material such that flies and scavenging animals are prevented from accessing the carrion. Disposal of Specified Risk Material from cattle shall only be done in accordance with Canadian Food Inspection Agency requirements and procedures.

## 6. OPERATIONAL REQUIREMENTS FOR COMPOSTING

### 6.1 Composting

Composting operations shall comply with the requirements of the *Organic Matter Recycling Regulation* and any other relevant legislation.

### 6.2 Bear-Proofing

If the composting operation is to receive any organic wastes that are potential attractants to bears, then composting shall be completely enclosed by an electric fence or contained in a bear-proof structure (building or composting vessel). The electric fence shall comply with all requirements of Section 4.17.

## 7. OPERATIONAL REQUIREMENTS FOR STORAGE OF SELECTED WASTES FOR SALVAGE AND RECYCLING

### 7.1 Location

The operational certificate holder may identify an area for the storage of selected wastes for salvage and recycling (herein referred to as the salvage/recycling area). Any salvage/recycling shall be restricted to the designated salvage/recycling area. This area shall be clearly identified at the landfill site. Signs which identify the nature of the materials acceptable at the designated salvage/recycling area shall be erected and maintained. The lettering on the sign shall be such that it is clearly readable by the public upon approach.

### 7.2 Nature of Wastes

Wastes to be salvaged/recycled may be any items with potential salvage or recycling value such as tires, lead-acid batteries, auto hulks, white goods, furniture, used lumber, used goods and the like, but shall not include any refuse consisting of or containing putrescibles, any liquid wastes, hot ashes or materials otherwise restricted by Section 4.2.

### 7.3 Compliance

Salvage/recycling shall comply with the requirements of the *Storage of Recyclable Material Regulation* and any other relevant legislation and any additional requirements contained in this operational certificate.

### 7.4 Contamination

Contamination of any of the designated salvage/recycling storage piles with putrescible wastes shall be cleaned up immediately.

## 8. OPERATIONAL REQUIREMENTS FOR REGULATED OPEN BURNING

### 8.1 Location

The operational certificate holder may identify an area for the use of open burning to dispose of selected combustibles (herein referred to as the open burning area). Any open burning of selected wastes shall be restricted to the designated open burning area. This area shall be clearly identified at the landfill site. Signs which identify the nature of the waste acceptable at the designated open burning area shall be erected and maintained. The lettering on the sign(s) shall be such that it is clearly readable by the public upon approach.

### 8.2 Quantity, Timing, and Duration of Discharge

The maximum authorized quantity of wood residue to be open burned during each event is that which has accumulated at the time of burn initiation. The pile(s) shall be constructed so as to ensure a rapid and complete burn. The quantity of air contaminants is indeterminate.

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

Should a condition arise which prevents the burn pile(s) from being burned within this period, the Director must be notified in accordance with Section 8.10 of this authorization.

### 8.3 Nature of Wastes

No wastes shall be burned which are unacceptable to the Director. Acceptable materials for burning may only include dry, unpainted, untreated demolition, construction and packing-related wood residue, clean stumps and brush, but must exclude nuisance-causing combustibles such as glue-containing wood, painted

and treated wood, sawdust, yard wastes, mulch, wood chips, rubber, plastics, tars, insulation, roofing material, asphalt shingles, etc.

## 8.4 Favourable Weather for Smoke Dispersion

Open burning shall not proceed unless weather conditions are such that emissions are dispersed away from populated areas.

The operational certificate holder must also obtain a burn registration number from the Ministry of Forests (1-888-797-1717) prior to ignition.

Open burning of wood residue must not be initiated or continued if the local air flow will cause the smoke to negatively impact a nearby population or cause pollution.

No burning shall occur during periods of fire hazard or when burning is prohibited by other agencies.

## 8.5 Fire Accelerant

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

## 8.6 Minimization of Smoke

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

## 8.7 Contingency Plan

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

i) Inadequate smoke dispersion in the surrounding environment;

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

iii) the Director requires that the open burn be extinguished for environmental protection reasons.

At a minimum, the plan must detail the actions to be taken to extinguish the open burn should any of the above conditions occur. The plan shall be made available to the Director upon request.

### 8.8 Extinguishment

All combustion shall be completely extinguished at the end of the authorized period as set out in Section 8.2 "Quantity, Timing and Duration of Discharge."

### 8.9 Fire Supervision and Suppression

An attendant shall be on-site to supervise the burn. Adequate fire suppression equipment shall be available for the entire duration of the event, and must be capable of extinguishing the fire if necessary. Local fire departments must be notified of the operational certificate holder's intent to burn, prior to ignition.

### 8.10 Maintenance of Works and Emergency Procedures

The operational certificate holder shall inspect the burn piles regularly and ensure that they are burning well. In the event of an emergency, or condition beyond the control of the operational certificate holder which prevents continuing operation of the approved method of open burning, the operational certificate holder shall notify the Director within two hours. If notification is necessary, it shall be accomplished by contacting the Environmental Protection program at (250) 847 – 7260.

The Director may require additional controls on the burning process and may require that the burn be extinguished at any time based on its impacts on the receiving environment.

### 8.11 Documentation

Following completion of each burn, notice shall be sent to the Director by fax (250-847-7591) or by e-mail to a Skeena Environmental Protection staff member advising of the following details: time of burn initiation, time of burn cessation, volume of wood residue burned, venting index values obtained for burning, and any extraordinary conditions encountered during the burn

## 9. MONITORING REQUIREMENTS

The operational certificate holder shall have a qualified professional evaluate whether an environmental effects monitoring program is needed. The assessment and recommended monitoring program, should one be required, shall be submitted for Director's approval on or before June 30, 2013. In addition to surface water sites, the qualified professional should consider the necessity of establishing ground water

M. Love

Mark Love, P.Ag.
For Director, Environmental Management Act

monitoring locations.

Until June 30, 2013, an interim monitoring program shall be implemented as follows:

| Sampling Locations[1] and EMS ID | Frequency[3] | Parameters[3] |
|---|---|---|
| Unnamed Creek U/S of Kitwanga Landfill E278450<br><br>Unnamed Creek D/S of Kitwanga Landfill E278449 | twice annually, in April and September | **Field Measurements:**<br>pH, dissolved oxygen, specific conductance, temperature<br>**Lab Analysis:**<br>BOD, total nitrogen, phosphorous, ammonia, pH, total and dissolved metals[2] |
| [1] Sampling locations are shown on the site plan<br>[2] Lab analysis for dissolved metals shall use a low level scan<br>[3] May be altered in future, depending on results | | |

## 10. REPORTING REQUIREMENTS

### 10.1 Reporting

All reports, drawings, data, studies and the like shall be submitted in hardcopy and electronic formats unless otherwise specified by the Director.

### 10.2 Log Book

As required by Sections 4.17.9 and 5.6 the operational certificate holder shall maintain a log book. The log book shall be made available for inspection by Ministry staff upon request.

### 10.3 Non-compliance Reporting

The operational certificate holder shall immediately notify the Director of any non-compliance with the requirements of this operational certificate and take appropriate remedial action. Written confirmation of all non-compliance events, including available test results, is required by facsimile or email to Environmental Protection staff within 24 hours of the original notification unless otherwise directed by the Director.

### 10.4 Non-compliance Follow-up

Upon request, the operational certificate holder shall submit to the Director a written report within 30 days of the non-compliance

M. Love

Mark Love, P.Ag.
For Director, Environmental Management Act

occurrence. The report shall include, but not necessarily be limited to, the following:

i) All relevant information and test results related to the non-compliance;

ii) an explanation of the most probably cause(s) of the non-compliance; and,

iii) remedial action planned and/or taken to prevent similar non-compliance(s) in the future.

### 10.5 Annual Report

The operational certificate holder shall submit a basic annual report to the Director on or before June 30 each year for the previous calendar year.

The report shall contain, at a minimum:

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

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

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

## 11. CLOSURE REQUIREMENTS

### 11.1 Notification of Closure

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

### 11.2 Closure Plan

A closure plan shall be submitted to the Director no later than 6 months in advance of scheduled closure. The closure plan shall, at a minimum, include the following:

i) Proposed end-use of the landfill property after closure;

ii) anticipated total waste volume, tonnage, and life remaining of the landfill;

iii) a topographic plan showing the final elevation contours of the landfill and surface water diversion and drainage controls;

iv) design of the final cover suited to the intended end-use of the site, including the thickness and permeability of barrier layers and drainage layers, and information on topsoil, vegetative cover and erosion prevention controls;

v) procedures for notifying the public about the closure and about alternative waste disposal facilities;

vi) rodent and nuisance wildlife control procedures;

vii) a comprehensive monitoring plan, if determined to be necessary by a qualified professional, including groundwater monitoring, surface water monitoring, landfill gas monitoring, leachate monitoring, final cover monitoring, and erosion and settlement monitoring, for a minimum post-closure period of 25 years;

viii) a plan and accompanying design for the collection, storage and treatment/use of landfill gas for a minimum 25 year post-closure period (if required);

ix) a plan for operation of any required pollution abatement engineering works such as leachate collection and treatment systems, for a minimum post-closure period of 25 years; and,

x) an estimated cost, updated annually, to carry out closure and post-closure activities for a minimum period of 25 years.

## 11.3 Closure Funding

The operational certificate holder shall ensure that sufficient funds will be available to provide for all closure and post-closure requirements as outlined in the closure plan required by Section 11.2, plus a reasonable contingency for any remediation which may be required.

## 11.4 Final Cover

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

cover shall consist of a layer of 1 metre of low permeability (<1 x $10^{-5}$ cm/s) compacted soil followed by a layer of topsoil suitable for establishment of vegetation. Higher permeability soil may be used if determined to be acceptable by a qualified professional and specified in the DOCP. The final cover shall be constructed with minimum and maximum slopes as specified by a qualified professional (see Section 3.4) to promote runoff and minimize erosion, with appropriate runon/runoff drainage controls, erosion controls, and gas venting controls. The site shall be seeded with a grass/legume mixture suited to the local climate.

### 11.5 Progressive Application of Final Cover

Completed portions of the landfill shall progressively receive final cover during the active life of the landfill. The maximum area of disposed refuse that has not yet received final cover shall not exceed 25% of the total final footprint area. Final cover is to be applied according to the specifications identified in Section 11.4.

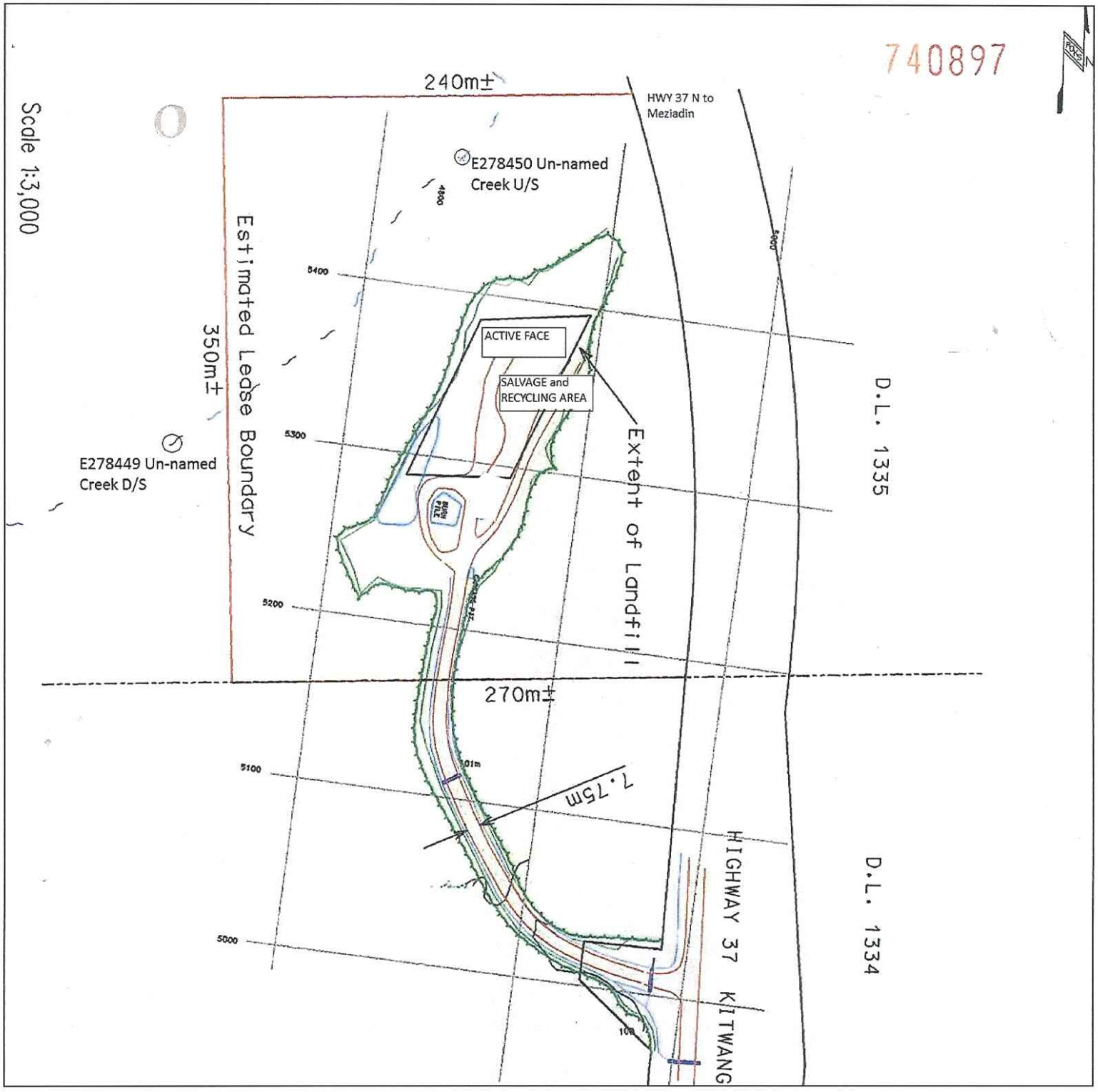
## 12. ENVIRONMENTAL IMPACT

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

M. Love

Mark Love, P.Ag.
For Director, Environmental Management Act

# SITE PLAN




Date Issued: November 8, 2012
Date Amended:
(most recent)

H. Love

Mark Love, P.Ag
for Director, *Environmental Management Act*
Skeena Region
Permit Number: MR-5767

# Appendix B Environmental Effects Monitoring Program Report

SPERLING HANSEN ASSOCIATES

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

Regional District of Kitimat-Stikine

# Kitwanga Landfill 2022 Environmental Effects Monitoring Program Annual Report

June, 2023


Prepared by:
Sperling Hansen Associates
1332 McGill Road
Kamloops BC
Phone: 1-778-471-7088
Email :sperling@sperlinghansen.com

Prepared for:
Regional District of Kitimat-Stikine
Contact: Nicole Lavoie, Envr. Services Coordinator
4545 Lazelle Avenue – Suite 300
Terrace BC V8G 4E1
Email: nlavoie@rdks.bc.ca

This Page is Intentionally Blank.

## Executive Summary

In 2023, Sperling Hansen Associates (SHA) was retained by the Regional District of Kitimat-Stikine (RDKS) to analyze and report on environmental monitoring results for the Kitwanga Landfill (the Landfill), as per the site's Operational Certificate (OC) MR-5767. As specified in Section 10.5 iii) of the OC, this report contains results of monitoring and sampling events, trend analysis, and evaluation of any identified impacts of discharges on the receiving environment.

The Landfill is located just over 8km of the community of Kitwanga within the RDKS, and served as the main waste disposal facility for the area between 1970 and 2016. The Landfill was closed in 2016 in accordance with the Kitwanga Landfill Closure Plan, which is in the process of being finalized with the Ministry of Environment and Climate Change Strategy (ENV). Upon finalization, an amendment to the OC will be requested to manage the closed landfill site.

The site is approximately 9 hectares (ha) in size and of this, roughly 2 ha is cleared and contains the Landfill footprint. An Unnamed Tributary to the Kitwanga River flows west of the site below an escarpment. Drainage from the site is assumed to flow to the west and southwest along the existing topography. As part of the Environmental Effects Monitoring Program (EEMP), this tributary is monitored and sampled twice annually in April and September for field and lab parameters. Groundwater has not been historically sampled at this site, and no groundwater monitoring infrastructure was in place until August 2022 when the RDKS installed three groundwater wells. These wells are not yet incorporated into the EEMP, however once a formal review of the current EEMP is completed in 2023, these wells will be used to assess potential impacts on groundwater.

Three locations were tested, including two upstream locations (Upstream – E278450, Further Upstream – SW2201) and one location downstream (Downstream – E278449). Upstream is assumed to represent background water quality, however Further Upstream was sampled in 2022 to compare the upstream locations and determine whether Upstream may be within the plume of the Landfill. Results of 2022 monitoring and sampling events were compared with four water quality criteria, including those for the protection of aquatic life, and drinking water. There were two exceedances found of dissolved aluminum, at both Downstream and Upstream. Further Upstream exhibited exceedances of dissolved iron and manganese, and total manganese and total mercury were also observed in elevated concentrations at Further Upstream and Upstream respectively. These exceedances and applicable criteria limits are detailed in Table 4-3.

Field sampling and Quality Assurance/Quality Control (QA/QC) procedures were found to comply with the *BC Field Sampling Manual*. Trend analysis indicates that Upstream and Downstream locations exhibit similar temporal patterns. Further monitoring is required to determine the extent of the Landfill's influence in the upstream area.

## Statement of Limitations

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

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

The report is intended solely for the use of the RDKS for the management of the Kitwanga Landfill located north of Kitwanga, BC. Any use which a third party makes of this report, or any reliance on, or decisions to be made based on it, are the responsibilities of such third parties. SHA does not accept any responsibility for other uses of the material contained herein nor for damages, if any, suffered by any third party as a result of decisions made or actions based on this report. Copying of this intellectual property for other purposes is not permitted.

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

## Acronyms and Definitions

| | |
|---|---|
| Environmental Effects Monitoring Program | EEMP |
| Hectare | ha |
| Hazelton Waste Management Facility | HWMF |
| Kilometre | km |
| Kitwanga Landfill | KL |
| Ministry of Environment and Climate Change Strategy | ENV |
| License of Occupation | LoO |
| Metre | m |
| Non-compliance Report | NCR |
| Operational Certificate | OC |
| Quality Assurance Quality Control | QAQC |
| Regional District of Kitimat-Stikine | RDKS |
| Relative Percent Difference | RPD |

**Contents**

# 1 Introduction

In 2023, Sperling Hansen Associates (SHA) was retained by the Regional District of Kitimat-Stikine (RDKS) to analyze and report on environmental monitoring results for the Kitwanga Landfill (the Landfill), as per the site's Operational Certificate (OC) MR-5767. This report details the results and trends of the Environmental Effects Monitoring Program (EEMP) and assesses the potential impacts of the Landfill on the receiving environment during the reporting period of January 1, 2022 – December 31st, 2022.

Appendix A attached presents the Landfill Site Map as Figure 1.

# 2 Background

The RDKS has operated the Kitwanga Landfill since the 1970s until 2016, at which time the Landfill was closed and converted to a transfer station. The closed Landfill (Figure 1) is managed under OC MR-5767, attached in Appendix B. The OC currently reflects an operational landfill, including an authorisation to accept waste and a requirement for electric fencing. The Kitwanga Landfill is in the final stages of closure, operating as a transfer station and hauling waste to Hazelton Waste Management Facility (HWMF). The Kitwanga Landfill Closure Plan was submitted to the Ministry of Environment and Climate Change Strategy (ENV) in 2022. An amendment to the OC to reflect a closed landfill will be requested in 2023, following the finalisation of the Kitwanga Landfill Closure Plan with ENV.

## 2.1 Site Description

The Kitwanga Landfill (the site) is approximately 8.2 km north of Kitwanga in the Kitwanga River watershed. The site is located on a licence of occupation (crown lands file no. 6400619, the tenure) within District Lot 1335, occupying the southern area along the west side of the Stewart-Cassiar Highway (Hwy 37). The tenure is approximately 9.3 ha in size. A transmission line right-of-way (ROW) runs from Hwy 37 along the south-east side of the landfill and provides power to the transfer station Quonset hut. Within the tenure, 1.8 ha is cleared and includes the landfill footprint, and transfer station infrastructure. The Landfill is situated along the top of an escarpment to the west that slopes steeply downwards towards an Unnamed Tributary to the Kitwanga River. The eastern remaining portions of the tenure include several wet and saturated forested areas with variable topography.

Regional geology includes primarily till deposits with sand and gravel sediments. Boreholes logs completed in 2022 indicate the site is underlain by silt, sand, and gravels. Water drains westward, toward Unnamed Creek. There are no identified aquifers beneath, adject to, or downgradient of the Landfill.

There were two active leachate breakouts at the site during 2022, identified on Figure 1. These areas were monitored for specific conductance and pH during site visits. To address these breakouts, the RDKS will undertake an amendment to the current site Closure Plan. The Closure

Plan was submitted to ENV in 2022, and this amendment will detail mitigation measures to be implemented during the application of final cover.

## 2.2 Recent Studies and Investigations

### 2.2.1 Facility Inspections by ENV

ENV inspected the Kitwanga Landfill for compliance with the OC on May 25, 2022. Compliance was assessed for the two-year period preceding the visit. The site received a NCR Letter on January 6, 2023. The site was found to be out of compliance with respect to the following areas of the authorization during 2022:

- Open burning did not meet the criteria of the authorization
- Application of closure material is outstanding
- A leachate breakout was not reported as a non-compliance

The leachate breakout observed during the inspection is located at the North end of the landfill and was first identified in 2016 by RDKS field staff. A second leachate breakout in the southeast area of the site exists, with the first record of observation in 2018 by RDKS field staff. This second leachate breakout was not observed by ENV during their inspection. A non-compliance report for this second breakout was submitted in January 2023.

The OC requires that surface water be assessed at the tenure boundary to assess compliance. Because sample sites of the EEMP are not located on the tenure boundary, compliance with this section was not determined for 2022.

The Kitwanga OC requires that an environmental review of the interim EEMP be completed prior to June 30, 2013. Because this date preceded the inspection period, the interim EEMP was not assessed for compliance. Compliance with this section of the OC is outstanding, and a formal review of the EEMP program will be completed in 2023.

Components of the inspection report not related to the interim EEMP are discussed in further detail in the RDKS 2022 Operational Annual Report for Kitwanga Landfill.

### 2.2.2 Field Studies

In 2022 a hydro-geotechnical program was undertaken to install three groundwater monitoring wells, and to provide an environmental review of the interim groundwater monitoring requirements outlined in the OC. A senior hydrogeologist from Waterline Resources Inc. installed three monitoring wells within the landfill tenure on August 11$^{th}$ and 12$^{th}$ of 2022. The locations of these wells are shown on Figure 1. Reporting deliverables for the groundwater well installation and environmental review were not received in 2022 and will be covered in the Kitwanga Landfill 2023 EEMP annual report.

A small parcel of cleared land at the entrance of the Tea Lakes Forest Service Road has been considered suitable for the installation of a background monitoring well as part of the hydro-geotechnical program. The parcel is dominated by grass and small shrubs, and was cleared of

trees by another party. An application for License of Occupation (LoO) was submitted in 2022 to obtain tenure over this parcel, however the RDKS was not successful in receiving the tenure prior to the drilling component of the program but did receive an offer for tenure of this site in December 2022. Installation of a background monitoring well at this location will require an archaeological survey be completed prior to any ground disturbance.

## 2.3 Non-Compliance Reporting

A Non-compliance report (NCR) was submitted for the Kitwanga surface water program for exceedances to the short-term criteria of the British Columbia Working and Approved Water Quality Guidelines (BCWQG) for aquatic life for dissolved aluminum concentrations at the upstream surface water site in Spring 2022, as well as historical exceedances to the short-term BCAWQG criteria for dissolved aluminum at both the upstream and downstream surface water sites in 2018, 2020, and 2021 (all the years dissolved aluminum had been analysed). The proximity of the upstream site to the Landfill may not be indicative of background conditions, and the NCR included a commitment to sampling an additional site further upstream to explore if the exceedances were due to background conditions or from landfill influence.

A third site, called Further Upstream (SW22-01) and located 400 m upstream of the Upstream site, was sampled in fall of 2022. This site also exceeded the short-term BCWQG criteria for dissolved aluminum, as well as demonstrated lower limits of other analytes compared to the two downstream sites. Although SW22-01 is not part of the interim EEMP of the OC, it is included in the surface water results and discussion sections of this report.

# 3 Environmental Effects Monitoring Program

The EEMP at the Kitwanga Landfill currently consists of two surface water locations along Un-named Creek, Upstream and Downstream of the site (E278450 and E278499 respectively). The OC requires that these locations be sampled semi-annually in accordance with the requirements outlined in Table 3-1.

**Table 3-1: Interim EEMP Requirements**

| Sampling Locations | EMS ID | Frequency | Parameters |
|---|---|---|---|
| Un-named Creek U/S of Kitwanga Landfill, “Upstream” | E278450 | Twice annually, in April and September | Field Measurements: pH, dissolved oxygen, specific conductance, temperature |
| Un-named Creek D/S of Kitwanga Landfill, “Downstream” | E278499 | | Lab Analysis: BOD, total nitrogen, phosphorous, ammonia, pH, total and dissolved metals |

The requirements listed in the OC are an interim EEMP that requires review by a Qualified Professional (QP) to determine if the program is adequately monitoring impact from the Landfill.

This review is being undertaken by the RDKS and its consultant in 2023 and will result in recommended changes for the EEMP.

In August 2022, the RDKS installed three groundwater wells which will be incorporated into the EEMP. These wells were sampled for some parameters during the September event; however, because the groundwater monitoring is not part of the EEMP, the analytical results are not included in the discussion of this report. Groundwater will be analyzed once the appropriate parameters and water quality criteria have been determined by a QP.

## 3.1 Monitoring Locations

The location of three surface water sites and three groundwater wells are presented in Figure 1, attached as Appendix A. Table 3-2 summarizes the location details.

**Table 3-2: Monitoring Location Summary**

| Location Name | EMS ID | Sample Type | Location Coordinates | | |
|---|---|---|---|---|---|
| | | | UTM Zone | X | Y |
| MW22-01 | n/a | Monitoring Well | 09U | 563383 | 6111547 |
| MW22-02 | n/a | Monitoring Well | 09U | 563242 | 6111393 |
| MW22-03 | n/a | Monitoring Well | 09U | 563310 | 6111327 |
| SW22-01 | n/a | Surface Water | 09U | 563042 | 6111897 |
| SW-DS | E278449 | Surface Water | 09U | 563131 | 6111444 |
| SW-US | E278450 | Surface Water | 09U | 563312 | 6111659 |

## 3.2 Regulatory Framework

In accordance with Section 4.15 – Water Quality and Protection – of the Landfill's OC, groundwater is to be managed in compliance with the *Contaminated Sites Regulation* (CSR). Schedule 2 of the CSR lists specified industrial and commercial uses that indicate a site may be deemed contaminated; Subsection H – Waste Disposal and Recycling Operations and Activities describes the types of land use the Kitwanga Landfill falls under. Schedule 3.2 of the CSR presents generic numerical water standards for four water applications; Aquatic Life (AW), Irrigation (IW), Livestock (LW), and Drinking Water (DW). As per CSR Protocol 21, DW standards are considered to apply where groundwater on or within 500 m of the site is used as a drinking water source. Groundwater is not used for drinking on or within 500 m of the site, however future drinking water use must also be considered, and there is not adequate information to rule out the possibility of a drinking water source aquifer beneath the site. Therefore, the DW standards have been applied. CSR AW standards apply to groundwater due to the proximity of aquatic receiving environments, including wetlands and the unnamed tributary, within 500 m of the site.

Groundwater wells were first installed and the first set of groundwater samples obtained at the site in August 2022. Groundwater sampling requirements are not included in the EEMP currently, so the analysis of these samples is not included in the discussion of this report.

No water quality guidelines for surface water have been specified in the Landfill's OC. For comparison purposes, surface water sample results have been compared with the following BC guidelines:

- BC Approved Water Quality Guidelines for freshwater aquatic life (BC AWQG) long-term (LT) and short-term (ST),
- BC Working Water Quality Guidelines aquatic life (BC WWQG AL)

**Table 3-3: Regulatory Framework and Applicable Sites**

| Criteria or Guideline | Applicable |
|---|---|
| BC AWQG AL LT & ST, BC WWQG AL | SW-DS (E278449), SW-US (E278450), SW22-01 |
| CSR DW, CSR AW | MW22-01, MW22-02, MW22-03 |

## 3.3 Methodology

Monitoring and sampling of environmental media including groundwater and surface water are conducted as per the latest *BC Field Sampling Manual* and *Guidelines for Environmental Monitoring at Municipal Solid Waste Landfills.* Sampling and monitoring are completed in house by the RDKS Environmental Technician, and a field second, and is overseen by the RDKS Environmental Services Coordinator.

Field monitoring is conducted prior to sampling, and these measurements are recorded for compilation with lab results. Sampling includes collecting surface/groundwater, field filtering if needed, directly into sterile bottles that have been pre-charged with preservatives from the laboratory. The sample kits are packed with ice packs in coolers and sent via courier to ALS Environmental laboratory for analysis.

## 3.4 QAQC Program

The RDKS includes the following samples in the EEMP to ensure thorough quality assurance/quality control (QAQC) and uncompromised integrity of samples.

**Trip Blanks** (travel blanks) are used to assess potential contamination of samples during storage and transport. These samples use water that is not from the sample source (de-ionized, carbon free water is recommended).

**Field Blanks** are intended to detect the effects of ambient and environmental conditions on the sample characteristics. Typically, these are prepared by the laboratory or in the field, with de-ionized water that is exposed to the same conditions as the regular samples i.e. filtering, preservation, open air).

**Duplicate Samples** are those additional samples collected in the same area and time as regular samples, with the goal to get these as close as possible. Duplicates will provide information on sample handling and laboratory analysis and should show any discrepancies among sample results.

**Table 3-4: QAQC Samples**

| Sample Collection/Monitoring Date | Sample Type | Number of Field Blanks | Number of Duplicates | Number of Travel Blanks | Total Samples |
|---|---|---|---|---|---|
| April 13, 2022 | Surface Water | 1 | 1 | 1 | 5 |
| September 27, 2022 | Surface Water | 0 | 1 | 1 | 4 |
| September 27, 2022 | Groundwater | 1 | 0 | 0 | 3 |

# 4 Results and Discussion

As per the requirements of the OC, monitoring and sampling was completed semi-annually in the months of April and September. Additional parameters, including dissolved organic carbon (DOC) and hardness (CaCO3), were added to the required analysis of the OC to assist in comparing the results with the BC WQG AW. Photos obtained during field events on April 13th and September 27th 2022 are attached in Appendix C. The results of these monitoring and sampling events are discussed in the sections below.

## 4.1 Surface Water

### 4.1.1 Monitoring

Field measurements from monitoring activities are presented in the table below.

Monitoring results were generally consistent with those observed in 2021, with cooler water temperatures in April and warmer temperatures in September. Similarly, dissolved oxygen (DO) concentrations are typically higher in April than September. However, pH decreased from spring to fall, indicating a more acidity in the warmer water conditions. The Upstream location (E278450) specific conductance measurements increased significantly after April. Stream flow was observed to be much lower in the fall, resulting in less dilution.

**Table 4-1: Monitoring Results Summary**

| Date | Site | Water Temperature (degrees C) | DO mg/L | Specific Conductance (uS/cm) | pH (pH units) |
|---|---|---|---|---|---|
| 2022-04-13 | Upstream E278450 | 3.4 | 11.9 | 60.3 | 7.51 |
| 2022-04-14 | Downstream E278449 | 3.5 | 13.8 | 62.2 | 7.61 |
| 2022-09-27 | Upstream E278450 | 10.9 | 2.3 | 191.7 | 6.78 |
| 2022-09-27 | Downstream E278449 | 0 | 0 | 0 | 0 |
| 2022-09-27 | Further US SW22-01 | 11.2 | 0.6 | 329.6 | 7.14 |

As shown in Table 4-1, no data was collected in September for Downstream (E278449) because it was dry. Upstream (E278450) had very low flow in September but enough water was able to be collected using syringes to obtain measurements.

Specific conductance was monitored at the Northern Leachate Breakout in Spring; 3,110 uS/cm, pH: 6.97, Temp 9.4. The southern breakout was not monitored in the spring, and in the fall both breakouts were dry.

### 4.1.2 Sampling

Appendix E-1 attached presents the water quality results from sampling events in 2022. Appendix E-2 presents historical data since 2014. Compared to the regulatory water quality guidelines detailed in section 3.2, there are three locations with observed exceedances. These exceedances are summarized in Table 4-2 and discussed below.

**Table 4-2: Exceedance Summary**

| | Downstream (E278449) | Further Upstream (SW22-01) | Upstream (E278250) |
|---|---|---|---|
| **Lab Results** | | | |
| **Dissolved Metals** | | | |
| Aluminum (dissolved) | X | | X |
| Iron (dissolved) | | X | |
| Manganese (dissolved) | | X | |
| | | | |
| **Total Metals** | | | |
| Manganese (total) | | X | |
| Mercury (total) | | | X |

In 2022, elevated dissolved aluminum was observed at two monitoring locations, Downstream (E278449) and Upstream (E278450). These two locations were above the calculated limit (pH dependent) prescribed in the BC AWQG AL Long Term and Short-Term guidelines. These elevated aluminum concentrations were all observed in the April sampling results.

The Further Upstream (SW22-01) location also exhibited elevated concentrations of dissolved iron above the BC AWQG Short Term limit, dissolved manganese above the BC AWQG Long Term and BC SDWQG MAC limit, and total manganese above both the BC AWQG Long, Short Term, and BC SDWQG MAC limits.

The Upstream (E278250) location duplicate had one exceedance of dissolved aluminum and total mercury above the BC AWQG Long Term limit. Results from the fall event exhibited non-detect mercury concentrations.

The observed concentrations relative to applicable guidelines is presented in Table 4-3 below.

**Table 4-3: Exceedance Concentrations**

| Sample Location | Exceedance | Date | Guideline(s) | Guideline Limit(s) | Observed Concentration |
|---|---|---|---|---|---|
| Downstream E278449 | Aluminum, dissolved | April 13, 2022 | BCAWQG AL (LT) | Short term – 100 µg/L<br>Long term – 50 µg/L | 98.3 µg/L |
| Upstream E278450 | Aluminum, dissolved | April 13, 2022 | BCAWQG AL (LT)*, BCAWQG AL (ST)* | *See table note* | 124 µg/L |
| Further Upstream SW22-01 | Iron, dissolved | September 27, 2022 | BCAWQG AL (ST) | 350 µg/L | 546 µg/L |
| Further Upstream SW22-01 | Manganese, dissolved | September 27, 2022 | BCAWQG AW (LT)* | 1,058 µg/L | 1,360 µg/L |
| Further Upstream SW22-01 | Manganese, total | September 27, 2022 | BCAWQG AL (LT)*, BCAWQG AL (ST) | Short term – 1,710 µg/L<br>Long term – 1,070 µg/L | 1,740 µg/L |
| Upstream E278450 (duplicate) | Mercury, total | April 13, 2022 | BCAWQG AL (LT) | 0.01 µg/L | 0.120 µg/L |

*"*" - Calculated limit (pH or hardness dependent. See guideline notes in Appendix E).*

The BC WQG-AW for aluminum were updated in April 2023, changing the criteria from short and long-term thresholds of dissolved aluminum, to a long-term threshold for total aluminum using DOC, hardness, and pH to calculate a site-specific criterion. When comparing the 2022 results with the updated guidelines for dissolved Aluminum, only the downstream site exceeded the criteria.

The Further Upstream (SW22-01) sample location was in a slow-moving run of the unnamed tributary, on a low gradient of the upper reach of the stream. This location has a silt bottom and higher turbidity/suspended solids suggested by the high specific conductance reading. For more representative comparison with the Upstream (E278450) location, it is recommended to move the Further Upstream sampling site slightly downstream to where the gradient increases and the stream morphology is comparable to the down gradient reaches which are cascade with cobble boulder substrates. Higher readings of total metals may be attributed to the higher sediment load observed in the Further Upstream reach.

## 4.2 QAQC Results

In 2022, two field blanks, two travel blanks, and two duplicate samples were submitted with the other samples for analysis. The blank sample results are presented in Appendix E Table E-3, and the duplicate results are included in Table E-1.

As outlined in Part A of the BC Field Sampling Manual, the relative percent difference (RPD) between duplicate and its original sample should not exceed 20%. Exceedance of >50% RPD

indicates quality assurance issues and should be investigated. In 2022, one parameter in one sampling event exceeded 20% RPD (total titanium – 44.4% RPD, April 13, 2022).

The samples are analysed at ALS Environmental, which is a certified laboratory through the Canadian Association for Laboratory Accreditation (CALA). Analyses are completed with a quality control report appended to each Certificate of Analysis (COA). The reports contain:

- Laboratory Duplicate (DUP) Report; Relative Percent Difference (RPD) and Data Quality
- Matrix Spike (MS) Report; Recovery and Data Quality Objectives
- Method Blank (MB) Report; Recovery and Data Quality Objectives
- Laboratory Control Sample (LCS) Report; Recovery and Data Quality Objectives

COA's are attached in Appendix D.

# 5 Trend Analysis

No leachate indicator parameters were detected above guideline limits downstream of the Landfill. Following trend analysis of five parameters graphed in previous years, the figures presented in Appendix F visually illustrate current and historical trends as an indicator of potential exceedances.

The graphs show surface water quality results from 2014 – 2022, with parameters including conductivity, chloride, iron (total), aluminum (total), and copper (total). There is a gap in the data for the Upstream location between 2017 and 2019, due to an omitted analysis and two dry events. Results at the Downstream location for the fall 2019 event are missing due to the location being dry.

Generally, conductivity levels have been increasing since 2019. Chloride plateaued between 2019 and 2021, at a very low concentration, and was not sampled for in 2022. Aluminum and iron have similarly fluctuated since 2014, with several spikes in 2018, 2020, and 2022. The Downstream (E278249) and Upstream (E278250) locations have remained very close in many of these trends, with neither location exhibiting consistent high concentrations across all parameters and years.

# 6 Conclusion and Recommendations

The Upstream (E278250) and Further Upstream (SW22-01) samples collected in April and September 2022 showed five exceedances of total and dissolved metals, and the Downstream (W278249) sample collected in April showed one exceedance of dissolved aluminum. Surface water quality has been assessed by comparing results with several guidelines for the protection of aquatic life, with both short term and long-term limits. As the Further Upstream (SW22-01) location exhibited higher concentrations of various total and dissolved metals, there may be naturally elevated background concentrations, or increased suspended solids from the silt substrate, affecting water quality in the upper reach of Unnamed Creek. Recommendations made below are intended to help interpret the water quality of Unnamed Creek and understand any impact of the Kitwanga Landfill on the receiving environment.

Based on the findings of this report, the following are recommended for the RDKS's consideration in 2023:

- Include DOC and hardness in analysis for comparison of the updated BCWQG AW total aluminum and dissolved copper. Consider adding turbidity, total dissolved solids (TDS), and total suspended solids (TSS) to assist in interpretation of the source of elevated specific conductance and higher metal concentrations.
- Move Further Upstream (SW22-01) slightly downstream to a more appropriate reach of the stream with morphology like that of Upstream (E278450).
- Complete the planned review and update of the Kitwanga Landfill EEMP and introduce the groundwater monitoring wells installed in 2022 into the analysis and reporting program.
- Determine if SW22-01 is within the Landfill's sphere of influence or if it is representative of true background conditions.
    - If it is not true background, determine a true upgradient, background location with which to assess "natural" conditions and concentrations.
- Investigate the high RPD observed for Total Mercury at Upstream (E278450), and monitoring and sampling techniques for duplicate samples.
- Through annual reports and water quality trending, assess the final closure system and surface water management works' efficacy in minimizing potential leachate generation.

## 7 Closure

Please do not hesitate to contact the undersigned with questions regarding the contents of this report.

Sincerely,

**SPERLING HANSEN ASSOCIATES**

Report by:

Chloe Hetherington, BA
Environmental Analyst

Report reviewed by:


Megan Haley, P.Chem
Sr. Environmental Scientist

## References

Ministry of Environment and Climate Change Strategy, 2021. Operational Certificate MR-5767 for the Kitwanga Landfill.

Sperling Hansen Associates, 2018. Kitwanga Landfill 2017 Monitoring Report.

Tattersfield Consulting, 2019. Kitwanga Landfill 2018 Monitoring Report.

Tattersfield Consulting, 2020. Kitwanga Landfill 2019 Monitoring Report.

Tattersfield Consulting, 2021. Kitwanga Landfill 2020 Monitoring Report.

Tattersfield Consulting, 2022. Kitwanga Landfill 2021 Monitoring Report.

# Appendix A: Figure 1 Site Map


Esri Canada, Esri, HERE, Garmin, SafeGraph, METI/NASA, USGS, EPA, US Census Bureau, USDA, NRCan, Parks Canada, Esri, CGIAR, USGS, Esri Canada, Esri, HERE, Garmin, SafeGraph, FAO, METI/NASA, USGS, EPA, NRCan, Parks Canada, Sources: NRCan, Esri Canada, and Canadian Community Maps contributors., Esri Canada, Maxar
N:\Works & Services\Solid Waste\Mapping\solidwaste_basemapping\facility_maps_eemp_2022.aprx

Project:

# Kitwanga Landfill
# 2022 Environmental Effects Monitoring Program


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


Legend:

- Kitwanga Landfill
- Leachate Breakout
- Monitoring Well
- Surface Water Site
- Contour (20 m)
- Watercourse
- License of Occupation
- Statutory Right-of-Way
- Wetland


Title:

## Surface Water Sites & Groundwater Well Locations

| | |
|---|---|
| Scale: 2,500 | Projection: NAD 1983 UTM Zone 9N |
| File: 5360-03-03-02-05 | Date: January 26, 2023 |
| Drawn: N. Lavoie<br>Reviewed: E. Blaney | Figure No **Figure 1** |

# Appendix B: Operational Certificate

BRITISH COLUMBIA
The Best Place on Earth

File: MR-5767

Date: November 8, 2012

**REGISTERED MAIL**

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

Dear Operational Certificate Holder:

Enclosed is Operational Certificate MR-5767 issued under the provisions of the *Environmental Management Act*. Your attention is respectfully directed to the terms and conditions outlined in the operational certificate.

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

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

Administration of this operational certificate will be carried out by staff from the Skeena Region. Plans, data and reports pertinent to the operational certificate are to be submitted to the Director, Environmental Protection, at Ministry of Environment, Regional Operations, Skeena Region, 3726 Alfred Avenue, Box 5000, Smithers, BC, V0J 2N0.

Yours truly,

M. Love

Mark Love, P. Ag.
for Director, *Environmental Management Act*
Skeena Region

Enclosure

**Ministry of Environment**
Regional Operations
Skeena Region
Mailing/Location Address
3726 Alfred Avenue
Box 5000
Smithers, BC, V0J 2N0
Telephone: (250) 847-7260
Facsimile: (250) 847-7591
http://www.gov.bc.ca/env

**MINISTRY OF ENVIRONMENT**

# OPERATIONAL CERTIFICATE
# MR-5767

for the

# KITWANGA LANDFILL

*Under the Provisions of the Environmental Management Act*
*and in accordance with the approved*
*Regional District of Kitimat-Stikine Solid Waste Management Plan, the*

## Regional District of Kitimat-Stikine

**Suite 300-4545 Lazelle Avenue**

**Terrace, British Columbia**

**V8G 4E1**

is authorized to store, handle, treat and discharge municipal solid waste from Kitwanga and surrounding area at the Kitwanga landfill, subject to the conditions listed below. Contravention of any of these conditions is a violation of the *Environmental Management Act* and may result in prosecution.

## 1. LOCATION OF LANDFILL PROPERTY

The location of the property where discharges are authorized to occur is District Lot 1335 Cassiar Land District.

M. Love

Mark Love, P.Ag.
For Director, Environmental Management Act

## 2. AUTHORIZED DISCHARGES

### 2.1 Discharge of Municipal Solid Waste

This section applies to the discharge of municipal solid waste to ground at the landfill located approximately as shown on the attached site plan. The site reference number for this discharge is E209210. Refer to Section 5 for the operational requirements associated with this discharge.

2.1.1 Subject to Sections 4.2, 4.3 and 4.4, the characteristics of the discharge shall be typical of municipal solid waste.

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

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

### 2.2 Storage and Handling of Wastes for Salvage and Recycling

This section applies to the storage and handling of municipal solid wastes for salvage and recycling. Refer to Section 7 for the operational requirements associated with this discharge.

2.2.1 Subject to Section 4.2, the characteristics of the discharge shall be typical of recyclable municipal solid waste.

2.2.2 The quantity of recyclable wastes stored or handled is indeterminate.

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

### 2.3 Discharge of Air Contaminants from Open Burning

This section applies to the discharge of air contaminants to the atmosphere from the regulated open burning of wood and selected combustibles from a burn pile located approximately as shown on the attached site plan. The site reference number for this discharge is E219223. Refer to Section 8 for the operational requirements associated with this discharge.

2.3.1 The characteristics of the discharge shall be typical of those resulting from the regulated open burning of selected combustibles as per Section 8.3.

2.3.2 The maximum authorized rate of discharge is indeterminate.

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

## 3 LANDFILL DESIGN

### 3.1 Design by Qualified Professional(s)

The landfill and associated works [including but not limited to the size(s) and location(s) of disposal area(s), maximum allowable slopes of disposal area(s), leachate management system, progressive and final closure details, etc.] shall be designed by qualified professionals [such as engineer(s) and/or geoscientist(s)] registered in the Province of British Columbia who have expertise in the field of landfill design. These details shall be incorporated into a "Design, Operations and Closure Plan" (DOCP) and made available to the Director upon request. Where a design feature prepared by a qualified professional is in conflict with any requirement of this operational certificate, it shall be brought to the attention of the Director who shall determine a resolution to the conflict.

### 3.2 Construction

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

### 3.3 Engineered Footprint

The landfill design shall include preparation of an engineered final design footprint delineating the maximum extent of solid waste disposal allowable at the facility horizontally (in plan view). The engineered final design footprint shall be clearly shown on a scaled plan of the site and the plan made available in PDF format (see Section 3.6). These details shall be documented in the DOCP.

### 3.4 Engineered Excavation and Final Grade Contours

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

aid in depicting the landfill profile) and the drawings shall be made available in PDF format (see Section 3.6). These details shall be documented in the DOCP.

### 3.5 Legal Survey

The landfill property shall be legally surveyed on or before June 30, 2016, or a minimum of 6 months prior to closure, whichever is sooner.

### 3.6 Scaled Drawings

A scaled site plan accurately showing the legal survey (when completed), the engineered final design footprint, and final design contours, shall be included in the DOCP and made available in PDF format upon request by the Director. Additional scaled drawings showing excavation contours (if relevant) and typical cross sectional views of the site shall also be included in the DOCP.

## 4. GENERAL REQUIREMENTS

### 4.1 Site Identification

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

### 4.2 Prohibited Wastes

No wastes as defined by the *Hazardous Waste Regulation* shall be received, stored, treated or disposed of at this site except as authorized by the Director. Lead-acid batteries shall not be landfilled but may be salvaged/recycled provided they are stored, handled and shipped in compliance with the *Hazardous Waste Regulation* and with Section 8 of this operational certificate. Tires equal to or less than 22" in rim size and autohulks shall not be landfilled.

### 4.3 Waste Asbestos

Notwithstanding Section 4.2 of this operational certificate, the disposal of waste asbestos under Section 2.1 of this operational certificate and in compliance with the requirements of Section 40 of the *Hazardous Waste Regulation* is hereby authorized.

## 4.4 Contaminated Soil

Soil that contains contaminants in concentrations less than "Hazardous Waste" as defined by the *Hazardous Waste Regulation* may be disposed at the landfill site. Disposal includes monofilling, co-disposal with other wastes, use as a refuse cell berm material and use as a refuse cell cover material. Disposal must occur within a disposal area as authorized by Section 5 of this operational certificate. Disposal does not include use as final cover material.

## 4.5 Waste Measurement

The quantity of waste material landfilled at the site shall be measured or estimated by means suitable to the Director. The results shall be submitted in accordance with Section 10.5, once per year on or before June 30 for the previous year, expressed in tonnes/yr and/or $m^3$/yr.

## 4.6 Ozone Depleting Substances

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

## 4.7 Fire Prevention

The operational certificate holder shall make all reasonable efforts to prevent unauthorized fires from occurring at the landfill site. As a minimum, a fire break clear of all combustible materials at least 15 metres wide shall surround all disposal, treatment and individual storage areas which have received or are receiving combustible materials. Disposal areas that have had 30 cm of compacted mineral soil cell cover or final cover applied are exempt. Water supply and pumping capabilities and/or soil and earth moving equipment shall be maintained at a sufficient level to extinguish fires. In addition, reasonable efforts shall include, but are not necessarily limited to, the preparation of a Fire Prevention and Response Plan.

## 4.8 Extinguishment of Fires

In the event of an unauthorized fire (including any smouldering fire), the operational certificate holder shall immediately make all reasonable efforts to extinguish the fire. The operational certificate holder shall also immediately notify the Provincial Emergency Program (phone: 1-800-663-3456) and any local fire authority of an unauthorized fire.

### 4.9 Buffer Zone

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

### 4.10 Litter Control

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

### 4.11 Water Table Restriction

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

### 4.12 Surface Water Management

The distance between a natural body of surface water and any stored or buried materials shall be a minimum of 25 metres.

### 4.13 Inert Materials

Specific inert materials may be exempted from the requirements of Section 4.11 by the Director. The permission of the Director must be obtained in writing prior to any disposal or handling of inert materials on an exemption basis.

### 4.14 Landfill Gas Lower Explosive Limit

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

### 4.15 Water Quality and Protection

The landfill shall be operated in a manner such that ground or surface water quality does not decrease beyond that specified by the Director, at the landfill property boundary or other specified location.

If exceedences of the specified criteria occur as a result of landfill operations, the Director may require that leachate management control measures or works be undertaken. Terms of reference for any leachate management study and/or design work shall be submitted to the Director for approval prior to conducting the work.

In addition to requirements specified by the director, groundwater must be managed in accordance with the Contaminated Sites Regulation.

M. Love

Mark Love, P.Ag.
For Director, Environmental Management Act

## 4.16 Maintenance of Works and Emergency Procedures

The operational certificate holder shall inspect the operation regularly and maintain it in good working order. The operational certificate holder shall immediately notify the Director of any circumstance which prevents continuing operation in the approved manner or results in non-compliance with the requirements of this operational certificate.

## 4.17 Electric Fencing

### 4.17.1 Design, Construction and Maintenance

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

### 4.17.2 Fence Type

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

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

### 4.17.3 Wire Tension

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

be corrected for temperature by use of the following formula for 12-½ gauge high tensile steel wire:

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

where: *Tension* is in lbs force

*Temperature* is in °C

4.17.4 Post Spacing

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

4.17.5 Grounding System

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

4.17.6 Period of Operation

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

4.17.7 Minimum Voltage

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

4.17.8 Gate(s)

Any access through electric fencing for vehicles, equipment and personnel shall consist of an electrified gate system that is closed during non-operating hours. The gate system shall be electrified to a minimum voltage of 6,000 volts at all times except when being opened or closed. Any gate that is open during operating hours shall be periodically checked by the attendant for bear activity during hours of operation. Gaps between the gate and the fence and

ground, and between gate panels (for a double-hung gate), shall not exceed 10 cm.

4.17.9 Fence Inspections

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

Signs of digging or other attempts by bears to penetrate electric fencing shall be recorded in a log book. Any penetrations through electric fencing by bears shall be immediately reported to the Conservation Officer Service at 1-877-952-7277 and to the Director at 250-847-7260.

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

### 4.18 Other Agency Requirements

This operational certificate does not relieve the operational certificate holder from complying with requirements of federal, provincial, regional district or municipal authorities.

## 5. OPERATIONAL REQUIREMENTS FOR THE DISPOSAL OF SOLID WASTE

### 5.1 Location

The operational certificate holder shall identify an area for disposal of solid waste (herein referred to as the solid waste disposal area) that is within the authorized municipal solid waste disposal footprint (see Section 2.1.3). Signs which identify the nature of the waste acceptable at the designated solid waste disposal area shall be erected and maintained. The lettering on the sign shall be such that it is clearly readable by the public upon approach.

### 5.2 Nature of Wastes

Wastes disposed at the active face of the solid waste disposal area may include any municipal solid waste except liquid wastes and hot ashes or as otherwise restricted by Section 4.2.

## 5.3 Bear-Proofing

The solid waste disposal area shall be maintained inside an electric fence. The electric fence shall comply with all requirements of Section 4.17.

## 5.4 Waste Compaction

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

## 5.5 Maximum Lift Height

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

## 5.6 Waste Cover

Cover shall be applied to waste in the solid waste disposal area as specified below. The operational certificate holder shall maintain a log book to record all dates of cover application.

### 5.6.1 Active Face Cover

Except as otherwise stated in Sub-section 5.6.2, the active face of the solid waste disposal area does not normally require cover. Based on information concerning environmental or public health concerns related to exposed waste at the active face, however, the Director may require that the active face be covered completely at a specified frequency with 0.15 m of soil (or functional equivalent) for a specified period.

### 5.6.2 Cell Cover

A uniform cover of 30 cm compacted soil shall be applied to all sides of the active waste cell in the solid waste disposal area such that no more than 200 $m^2$ of waste are exposed at the active face at any time and such that the volume of waste in the cell does not exceed 2000 $m^3$. Once the maximum volume of waste has been reached in a cell, the active face shall be covered with 30 cm of compacted soil and a new waste cell begun.

### 5.6.3 Final Cover

Completed portions of the solid waste disposal area shall progressively receive final cover during the active life of the landfill (see Section 11.5).



Mark Love, P.Ag.
For Director, Environmental Management Act

### 5.7 Dead Animal Disposal

Dead animals and animal parts shall be disposed of in the solid waste disposal area and covered as soon as practicable with a minimum of 60 centimetres of soil and/or waste material such that flies and scavenging animals are prevented from accessing the carrion. Disposal of Specified Risk Material from cattle shall only be done in accordance with Canadian Food Inspection Agency requirements and procedures.

## 6. OPERATIONAL REQUIREMENTS FOR COMPOSTING

### 6.1 Composting

Composting operations shall comply with the requirements of the *Organic Matter Recycling Regulation* and any other relevant legislation.

### 6.2 Bear-Proofing

If the composting operation is to receive any organic wastes that are potential attractants to bears, then composting shall be completely enclosed by an electric fence or contained in a bear-proof structure (building or composting vessel). The electric fence shall comply with all requirements of Section 4.17.

## 7. OPERATIONAL REQUIREMENTS FOR STORAGE OF SELECTED WASTES FOR SALVAGE AND RECYCLING

### 7.1 Location

The operational certificate holder may identify an area for the storage of selected wastes for salvage and recycling (herein referred to as the salvage/recycling area). Any salvage/recycling shall be restricted to the designated salvage/recycling area. This area shall be clearly identified at the landfill site. Signs which identify the nature of the materials acceptable at the designated salvage/recycling area shall be erected and maintained. The lettering on the sign shall be such that it is clearly readable by the public upon approach.

### 7.2 Nature of Wastes

Wastes to be salvaged/recycled may be any items with potential salvage or recycling value such as tires, lead-acid batteries, auto hulks, white goods, furniture, used lumber, used goods and the like, but shall not include any refuse consisting of or containing putrescibles, any liquid wastes, hot ashes or materials otherwise restricted by Section 4.2.

### 7.3 Compliance

Salvage/recycling shall comply with the requirements of the *Storage of Recyclable Material Regulation* and any other relevant legislation and any additional requirements contained in this operational certificate.

### 7.4 Contamination

Contamination of any of the designated salvage/recycling storage piles with putrescible wastes shall be cleaned up immediately.

## 8. OPERATIONAL REQUIREMENTS FOR REGULATED OPEN BURNING

### 8.1 Location

The operational certificate holder may identify an area for the use of open burning to dispose of selected combustibles (herein referred to as the open burning area). Any open burning of selected wastes shall be restricted to the designated open burning area. This area shall be clearly identified at the landfill site. Signs which identify the nature of the waste acceptable at the designated open burning area shall be erected and maintained. The lettering on the sign(s) shall be such that it is clearly readable by the public upon approach.

### 8.2 Quantity, Timing, and Duration of Discharge

The maximum authorized quantity of wood residue to be open burned during each event is that which has accumulated at the time of burn initiation. The pile(s) shall be constructed so as to ensure a rapid and complete burn. The quantity of air contaminants is indeterminate.

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

Should a condition arise which prevents the burn pile(s) from being burned within this period, the Director must be notified in accordance with Section 8.10 of this authorization.

### 8.3 Nature of Wastes

No wastes shall be burned which are unacceptable to the Director. Acceptable materials for burning may only include dry, unpainted, untreated demolition, construction and packing-related wood residue, clean stumps and brush, but must exclude nuisance-causing combustibles such as glue-containing wood, painted

and treated wood, sawdust, yard wastes, mulch, wood chips, rubber, plastics, tars, insulation, roofing material, asphalt shingles, etc.

## 8.4 Favourable Weather for Smoke Dispersion

Open burning shall not proceed unless weather conditions are such that emissions are dispersed away from populated areas.

The operational certificate holder must also obtain a burn registration number from the Ministry of Forests (1-888-797-1717) prior to ignition.

Open burning of wood residue must not be initiated or continued if the local air flow will cause the smoke to negatively impact a nearby population or cause pollution.

No burning shall occur during periods of fire hazard or when burning is prohibited by other agencies.

## 8.5 Fire Accelerant

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

## 8.6 Minimization of Smoke

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

## 8.7 Contingency Plan

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

i) Inadequate smoke dispersion in the surrounding environment;

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

iii) the Director requires that the open burn be extinguished for environmental protection reasons.

At a minimum, the plan must detail the actions to be taken to extinguish the open burn should any of the above conditions occur. The plan shall be made available to the Director upon request.

### 8.8 Extinguishment

All combustion shall be completely extinguished at the end of the authorized period as set out in Section 8.2 "Quantity, Timing and Duration of Discharge."

### 8.9 Fire Supervision and Suppression

An attendant shall be on-site to supervise the burn. Adequate fire suppression equipment shall be available for the entire duration of the event, and must be capable of extinguishing the fire if necessary. Local fire departments must be notified of the operational certificate holder's intent to burn, prior to ignition.

### 8.10 Maintenance of Works and Emergency Procedures

The operational certificate holder shall inspect the burn piles regularly and ensure that they are burning well. In the event of an emergency, or condition beyond the control of the operational certificate holder which prevents continuing operation of the approved method of open burning, the operational certificate holder shall notify the Director within two hours. If notification is necessary, it shall be accomplished by contacting the Environmental Protection program at (250) 847 – 7260.

The Director may require additional controls on the burning process and may require that the burn be extinguished at any time based on its impacts on the receiving environment.

### 8.11 Documentation

Following completion of each burn, notice shall be sent to the Director by fax (250-847-7591) or by e-mail to a Skeena Environmental Protection staff member advising of the following details: time of burn initiation, time of burn cessation, volume of wood residue burned, venting index values obtained for burning, and any extraordinary conditions encountered during the burn

## 9. MONITORING REQUIREMENTS

The operational certificate holder shall have a qualified professional evaluate whether an environmental effects monitoring program is needed. The assessment and recommended monitoring program, should one be required, shall be submitted for Director's approval on or before June 30, 2013. In addition to surface water sites, the qualified professional should consider the necessity of establishing ground water

M. Love

Mark Love, P.Ag.
For Director, Environmental Management Act

monitoring locations.

Until June 30, 2013, an interim monitoring program shall be implemented as follows:

| Sampling Locations[1] and EMS ID | Frequency[3] | Parameters[3] |
|---|---|---|
| Unnamed Creek U/S of Kitwanga Landfill E278450<br><br>Unnamed Creek D/S of Kitwanga Landfill E278449 | twice annually, in April and September | **Field Measurements:**<br>pH, dissolved oxygen, specific conductance, temperature<br>**Lab Analysis:**<br>BOD, total nitrogen, phosphorous, ammonia, pH, total and dissolved metals[2] |
| [1] Sampling locations are shown on the site plan<br>[2] Lab analysis for dissolved metals shall use a low level scan<br>[3] May be altered in future, depending on results | | |

## 10. REPORTING REQUIREMENTS

### 10.1 Reporting

All reports, drawings, data, studies and the like shall be submitted in hardcopy and electronic formats unless otherwise specified by the Director.

### 10.2 Log Book

As required by Sections 4.17.9 and 5.6 the operational certificate holder shall maintain a log book. The log book shall be made available for inspection by Ministry staff upon request.

### 10.3 Non-compliance Reporting

The operational certificate holder shall immediately notify the Director of any non-compliance with the requirements of this operational certificate and take appropriate remedial action. Written confirmation of all non-compliance events, including available test results, is required by facsimile or email to Environmental Protection staff within 24 hours of the original notification unless otherwise directed by the Director.

### 10.4 Non-compliance Follow-up

Upon request, the operational certificate holder shall submit to the Director a written report within 30 days of the non-compliance

M. Love

Mark Love, P.Ag.
For Director, Environmental Management Act

occurrence. The report shall include, but not necessarily be limited to, the following:

i) All relevant information and test results related to the non-compliance;

ii) an explanation of the most probably cause(s) of the non-compliance; and,

iii) remedial action planned and/or taken to prevent similar non-compliance(s) in the future.

### 10.5 Annual Report

The operational certificate holder shall submit a basic annual report to the Director on or before June 30 each year for the previous calendar year.

The report shall contain, at a minimum:

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

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

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

## 11. CLOSURE REQUIREMENTS

### 11.1 Notification of Closure

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

### 11.2 Closure Plan

A closure plan shall be submitted to the Director no later than 6 months in advance of scheduled closure. The closure plan shall, at a minimum, include the following:

i) Proposed end-use of the landfill property after closure;

ii) anticipated total waste volume, tonnage, and life remaining of the landfill;

iii) a topographic plan showing the final elevation contours of the landfill and surface water diversion and drainage controls;

iv) design of the final cover suited to the intended end-use of the site, including the thickness and permeability of barrier layers and drainage layers, and information on topsoil, vegetative cover and erosion prevention controls;

v) procedures for notifying the public about the closure and about alternative waste disposal facilities;

vi) rodent and nuisance wildlife control procedures;

vii) a comprehensive monitoring plan, if determined to be necessary by a qualified professional, including groundwater monitoring, surface water monitoring, landfill gas monitoring, leachate monitoring, final cover monitoring, and erosion and settlement monitoring, for a minimum post-closure period of 25 years;

viii) a plan and accompanying design for the collection, storage and treatment/use of landfill gas for a minimum 25 year post-closure period (if required);

ix) a plan for operation of any required pollution abatement engineering works such as leachate collection and treatment systems, for a minimum post-closure period of 25 years; and,

x) an estimated cost, updated annually, to carry out closure and post-closure activities for a minimum period of 25 years.

## 11.3 Closure Funding

The operational certificate holder shall ensure that sufficient funds will be available to provide for all closure and post-closure requirements as outlined in the closure plan required by Section 11.2, plus a reasonable contingency for any remediation which may be required.

## 11.4 Final Cover

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

cover shall consist of a layer of 1 metre of low permeability (<1 x $10^{-5}$ cm/s) compacted soil followed by a layer of topsoil suitable for establishment of vegetation. Higher permeability soil may be used if determined to be acceptable by a qualified professional and specified in the DOCP. The final cover shall be constructed with minimum and maximum slopes as specified by a qualified professional (see Section 3.4) to promote runoff and minimize erosion, with appropriate runon/runoff drainage controls, erosion controls, and gas venting controls. The site shall be seeded with a grass/legume mixture suited to the local climate.

### 11.5 Progressive Application of Final Cover

Completed portions of the landfill shall progressively receive final cover during the active life of the landfill. The maximum area of disposed refuse that has not yet received final cover shall not exceed 25% of the total final footprint area. Final cover is to be applied according to the specifications identified in Section 11.4.

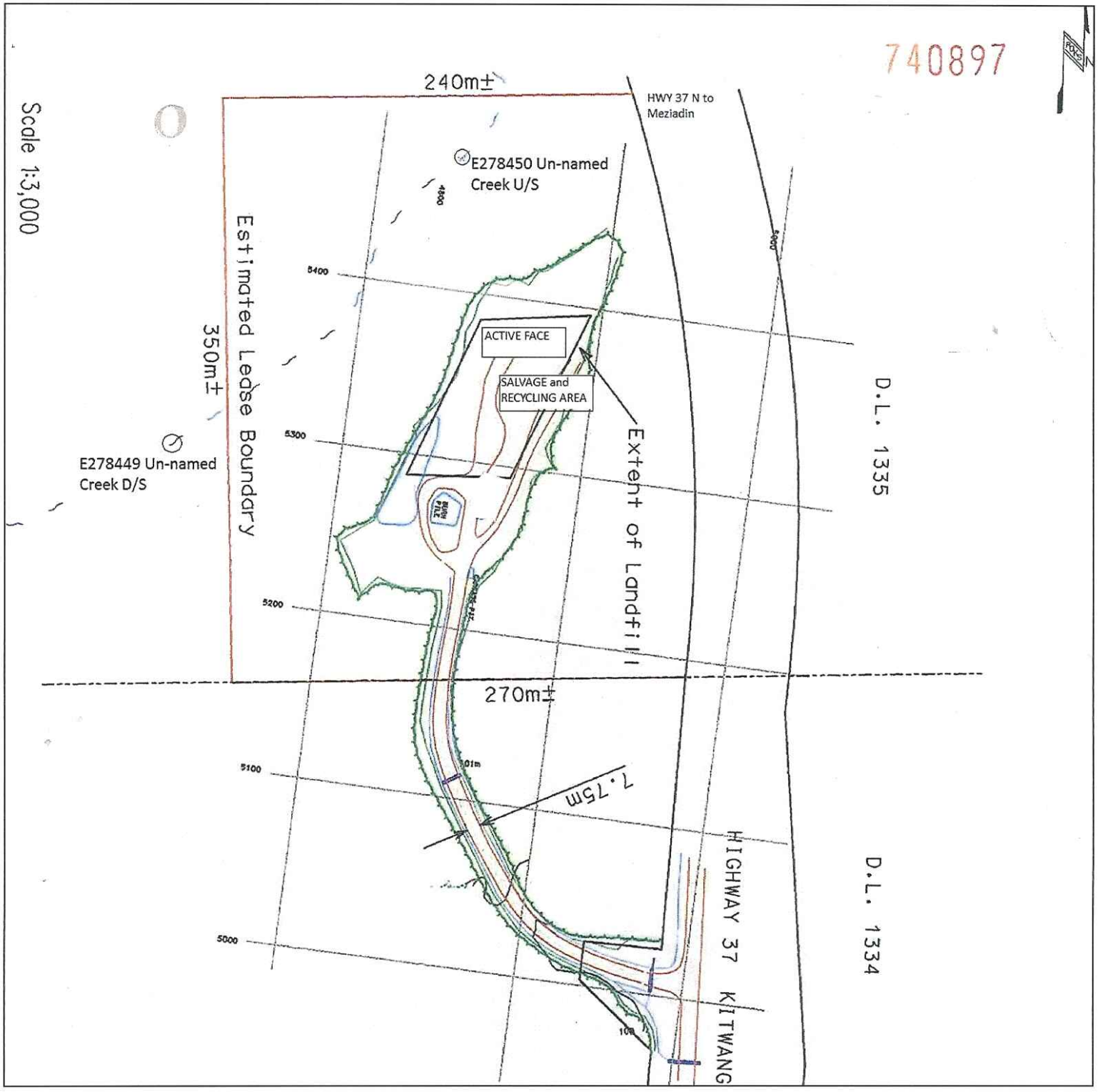
## 12. ENVIRONMENTAL IMPACT

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

M. Love

Mark Love, P.Ag.
For Director, Environmental Management Act

# SITE PLAN




Date Issued: November 8, 2012
Date Amended:
(most recent)

H. Love

Mark Love, P.Ag
for Director, *Environmental Management Act*
Skeena Region
Permit Number: MR-5767

# Appendix C: Field Photos

Photo 1: Kitwanga Landfill Upstream Surface Water Site, looking upstream, April 13, 2022

Photo 2: Kitwanga Landfill Upstream Surface Water Site, looking downstream, April 13, 2022

Photo 3: Kitwanga Landfill Downstream Surface Water Site, looking upstream, April 13, 2022

Photo 4: Kitwanga Landfill Downstream Surface Water Site, looking downstream, April 13, 2022

**Photo 5: Kitwanga Landfill leachate breakout near northwest corner of landfill, looking south, April 13, 2022**

**Photo 6: Kitwanga Landfill leachate breakout near northwest corner of landfill, looking west, April 13, 2022**

Photo 7: Kitwanga Landfill Upstream Surface Water Site, looking upstream, September 27, 2022

Photo 8: Kitwanga Landfill Upstream Surface Water Site, looking downstream, September 27, 2022

Photo 9: Kitwanga Landfill Downstream Surface Water Site, looking upstream, September 27, 2022

Photo 10: Kitwanga Landfill Downstream Surface Water Site, looking downstream, September 27, 2022

Photo 11: Kitwanga Landfill SW22-01, looking upstream, September 27, 2022

Photo 12: Kitwanga Landfill SW22-01, looking downstream, September 27, 2022

Photo 13: Kitwanga Landfill leachate breakout near MW22-03, looking north, September 27, 2022

Photo 14: Kitwanga Landfill leachate breakout near MW22-03, at the fence line, September 27, 2022

# Appendix D: Lab Reports

ALS Environmental

# CERTIFICATE OF ANALYSIS

| | | | |
|---|---|---|---|
| **Work Order** | : **VA22A8039** | Page | : 1 of 6 |
| Client | : **Regional District of Kitimat-Stikine** | Laboratory | : Vancouver - Environmental |
| Contact | : Hannah Shinton | Account Manager | : Amber Springer |
| Address | : # 300 - 4545 Lazelle Avenue<br>Terrace BC Canada V8G 4E1 | Address | : 8081 Lougheed Highway<br>Burnaby BC Canada V5A 1W9 |
| Telephone | : ---- | Telephone | : +1 604 253 4188 |
| Project | : Kitwanga Landfill Surface Water | Date Samples Received | : 14-Apr-2022 21:40 |
| PO | : ---- | Date Analysis Commenced | : 16-Apr-2022 |
| C-O-C number | : ---- | Issue Date | : 04-May-2022 11:04 |
| Sampler | : Hannah Shinton | | |
| Site | : | | |
| Quote number | : Q62338 | | |
| No. of samples received | : 5 | | |
| No. of samples analysed | : 5 | | |

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QC Interpretive report to assist with Quality Review and Sample Receipt Notification (SRN).

## *Signatories*

This document has been electronically signed by the authorized signatories below. Electronic signing is conducted in accordance with US FDA 21 CFR Part 11.

| *Signatories* | *Position* | *Laboratory Department* |
|---|---|---|
| Angela Ren | Team Leader - Metals | Metals, Burnaby, British Columbia |
| Angelo Salandanan | Lab Assistant | Metals, Burnaby, British Columbia |
| Caitlin Macey | Team Leader - Inorganics | Inorganics, Burnaby, British Columbia |
| Caleb Deroche | Lab Analyst | Metals, Burnaby, British Columbia |
| Dan Gebert | Laboratory Analyst | Metals, Burnaby, British Columbia |
| Kevin Duarte | Supervisor - Metals ICP Instrumentation | Metals, Burnaby, British Columbia |
| Miles Gropen | Department Manager - Inorganics | Inorganics, Burnaby, British Columbia |
| Owen Cheng | | Metals, Burnaby, British Columbia |

## General Comments

The analytical methods used by ALS are developed using internationally recognized reference methods (where available), such as those published by US EPA, APHA Standard Methods, ASTM, ISO, Environment Canada, BC MOE, and Ontario MOE. Refer to the ALS Quality Control Interpretive report (QCI) for applicable references and methodology summaries. Reference methods may incorporate modifications to improve performance.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Please refer to Quality Control Interpretive report (QCI) for information regarding Holding Time compliance.

Key : CAS Number: Chemical Abstracts Services number is a unique identifier assigned to discrete substances
LOR: Limit of Reporting (detection limit).

| *Unit* | *Description* |
|---|---|
| - | No Unit |
| µS/cm | Microsiemens per centimetre |
| mg/L | milligrams per litre |
| pH units | pH units |

<: less than.

>: greater than.

Surrogate: An analyte that is similar in behavior to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED on SRN or QCI Report, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

## Qualifiers

| *Qualifier* | *Description* |
|---|---|
| *DLM* | *Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).* |
| *RRV* | *Reported result verified by repeat analysis.* |

## Analytical Results

Sub-Matrix: **Water**
(Matrix: **Water**)

| Analyte | CAS Number | Method | LOR | Unit | Client sample ID | Upstream | Downstream | Field Blank | DUP | Travel Blank |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Client sampling date / time | 13-Apr-2022 03:35 | 13-Apr-2022 05:22 | 13-Apr-2022 09:20 | 13-Apr-2022 12:00 | 13-Apr-2022 |
| | | | | | | VA22A8039-001 | VA22A8039-002 | VA22A8039-003 | VA22A8039-004 | VA22A8039-005 |
| | | | | | | Result | Result | Result | Result | Result |
| **Physical Tests** | | | | | | | | | | |
| **conductivity** | ---- | E100 | 2.0 | µS/cm | | 60.5 | 62.4 | <2.0 | 61.0 | ---- |
| **hardness (as CaCO3), dissolved** | ---- | EC100 | 0.60 | mg/L | | 26.4 | 27.0 | <0.60 | 26.6 | <0.60 |
| **hardness (as CaCO3), from total Ca/Mg** | ---- | EC100A | 0.60 | mg/L | | 27.5 | 28.6 | <0.60 | 27.0 | <0.60 |
| **pH** | ---- | E108 | 0.10 | pH units | | 7.58 | 7.58 | 5.48 | 7.56 | ---- |
| **Anions and Nutrients** | | | | | | | | | | |
| **ammonia, total (as N)** | 7664-41-7 | E298 | 0.0050 | mg/L | | <0.0050 | <0.0050 | <0.0050 | 0.0086 RRV | <0.0050 |
| **nitrogen, total** | 7727-37-9 | E366 | 0.030 | mg/L | | 0.272 | 0.282 | <0.030 | 0.264 | ---- |
| **phosphorus, total** | 7723-14-0 | E372-U | 0.0020 | mg/L | | 0.0098 | 0.0210 | <0.0020 | 0.0182 | ---- |
| **Organic / Inorganic Carbon** | | | | | | | | | | |
| **carbon, dissolved organic [DOC]** | ---- | E358-L | 0.50 | mg/L | | 12.2 | 12.3 | ---- | 12.2 | ---- |
| **Total Metals** | | | | | | | | | | |
| **aluminum, total** | 7429-90-5 | E420 | 0.0030 | mg/L | | 0.250 | 0.512 | <0.0030 | 0.246 | <0.0030 |
| **antimony, total** | 7440-36-0 | E420 | 0.00010 | mg/L | | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| **arsenic, total** | 7440-38-2 | E420 | 0.00010 | mg/L | | 0.00033 | 0.00041 | <0.00010 | 0.00032 | <0.00010 |
| **barium, total** | 7440-39-3 | E420 | 0.00010 | mg/L | | 0.0197 | 0.0220 | <0.00010 | 0.0191 | <0.00010 |
| **beryllium, total** | 7440-41-7 | E420 | 0.000100 | mg/L | | <0.000100 | <0.000100 | <0.000100 | <0.000100 | <0.000100 |
| **bismuth, total** | 7440-69-9 | E420 | 0.000050 | mg/L | | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| **boron, total** | 7440-42-8 | E420 | 0.010 | mg/L | | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 |
| **cadmium, total** | 7440-43-9 | E420 | 0.0000050 | mg/L | | 0.0000061 | 0.0000054 | <0.0000050 | 0.0000057 | <0.0000050 |
| **calcium, total** | 7440-70-2 | E420 | 0.050 | mg/L | | 7.69 | 7.91 | <0.050 | 7.52 | <0.050 |
| **cesium, total** | 7440-46-2 | E420 | 0.000010 | mg/L | | 0.000019 | 0.000054 | <0.000010 | 0.000020 | <0.000010 |
| **chromium, total** | 7440-47-3 | E420 | 0.00050 | mg/L | | <0.00050 | 0.00076 | <0.00050 | <0.00050 | <0.00050 |
| **cobalt, total** | 7440-48-4 | E420 | 0.00010 | mg/L | | 0.00011 | 0.00026 | <0.00010 | 0.00011 | <0.00010 |
| **copper, total** | 7440-50-8 | E420 | 0.00050 | mg/L | | 0.00163 | 0.00211 | <0.00050 | 0.00172 | <0.00050 |
| **iron, total** | 7439-89-6 | E420 | 0.010 | mg/L | | 0.328 | 0.661 | <0.010 | 0.316 | <0.010 |
| **lead, total** | 7439-92-1 | E420 | 0.000050 | mg/L | | 0.000055 | 0.000154 | <0.000050 | 0.000068 | <0.000050 |
| **lithium, total** | 7439-93-2 | E420 | 0.0010 | mg/L | | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 |
| **magnesium, total** | 7439-95-4 | E420 | 0.0050 | mg/L | | 2.01 | 2.16 | <0.0050 | 2.00 | <0.0050 |
| **manganese, total** | 7439-96-5 | E420 | 0.00010 | mg/L | | 0.0261 | 0.0318 | <0.00010 | 0.0262 | <0.00010 |
| **mercury, total** | 7439-97-6 | E508 | 0.0000050 | mg/L | | 0.0000078 | 0.0000081 | <0.0000050 | 0.000120 | <0.0000050 |

## Analytical Results

Sub-Matrix: **Water**
(Matrix: **Water**)

| Analyte | CAS Number | Method | LOR | Unit | Client sample ID | Upstream | Downstream | Field Blank | DUP | Travel Blank |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Client sampling date / time | 13-Apr-2022 03:35 | 13-Apr-2022 05:22 | 13-Apr-2022 09:20 | 13-Apr-2022 12:00 | 13-Apr-2022 |
| | | | | | | VA22A8039-001 | VA22A8039-002 | VA22A8039-003 | VA22A8039-004 | VA22A8039-005 |
| | | | | | | Result | Result | Result | Result | Result |
| **Total Metals** | | | | | | | | | | |
| **molybdenum, total** | 7439-98-7 | E420 | 0.000050 | mg/L | | 0.000060 | 0.000066 | <0.000050 | 0.000062 | <0.000050 |
| **nickel, total** | 7440-02-0 | E420 | 0.00050 | mg/L | | 0.00073 | 0.00124 | <0.00050 | 0.00074 | <0.00050 |
| **phosphorus, total** | 7723-14-0 | E420 | 0.050 | mg/L | | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 |
| **potassium, total** | 7440-09-7 | E420 | 0.050 | mg/L | | 0.402 | 0.427 | <0.050 | 0.376 | <0.050 |
| **rubidium, total** | 7440-17-7 | E420 | 0.00020 | mg/L | | 0.00026 | 0.00037 | <0.00020 | <0.00020 | <0.00020 |
| **selenium, total** | 7782-49-2 | E420 | 0.000050 | mg/L | | <0.000050 | 0.000059 | <0.000050 | 0.000062 | <0.000050 |
| **silicon, total** | 7440-21-3 | E420 | 0.10 | mg/L | | 3.61 | 3.78 | <0.10 | 3.28 | <0.10 |
| **silver, total** | 7440-22-4 | E420 | 0.000010 | mg/L | | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| **sodium, total** | 7440-23-5 | E420 | 0.050 | mg/L | | 2.93 | 3.07 | <0.050 | 2.98 | <0.050 |
| **strontium, total** | 7440-24-6 | E420 | 0.00020 | mg/L | | 0.0794 | 0.0811 | <0.00020 | 0.0765 | <0.00020 |
| **sulfur, total** | 7704-34-9 | E420 | 0.50 | mg/L | | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| **tellurium, total** | 13494-80-9 | E420 | 0.00020 | mg/L | | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 |
| **thallium, total** | 7440-28-0 | E420 | 0.000010 | mg/L | | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| **thorium, total** | 7440-29-1 | E420 | 0.00010 | mg/L | | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| **tin, total** | 7440-31-5 | E420 | 0.00010 | mg/L | | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| **titanium, total** | 7440-32-6 | E420 | 0.00030 | mg/L | | 0.00476 | <0.00960 DLM | <0.00030 | 0.00502 | <0.00030 |
| **tungsten, total** | 7440-33-7 | E420 | 0.00010 | mg/L | | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| **uranium, total** | 7440-61-1 | E420 | 0.000010 | mg/L | | <0.000010 | 0.000016 | <0.000010 | <0.000010 | <0.000010 |
| **vanadium, total** | 7440-62-2 | E420 | 0.00050 | mg/L | | 0.00097 | 0.00124 | <0.00050 | 0.00061 | <0.00050 |
| **zinc, total** | 7440-66-6 | E420 | 0.0030 | mg/L | | <0.0030 | <0.0030 | <0.0030 | <0.0030 | <0.0030 |
| **zirconium, total** | 7440-67-7 | E420 | 0.00020 | mg/L | | 0.00048 | 0.00051 | <0.00020 | 0.00061 | <0.00020 |
| **Dissolved Metals** | | | | | | | | | | |
| **aluminum, dissolved** | 7429-90-5 | E421 | 0.0010 | mg/L | | 0.124 | 0.0983 | <0.0010 | 0.134 | <0.0010 |
| **antimony, dissolved** | 7440-36-0 | E421 | 0.00010 | mg/L | | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| **arsenic, dissolved** | 7440-38-2 | E421 | 0.00010 | mg/L | | 0.00024 | 0.00022 | <0.00010 | 0.00024 | <0.00010 |
| **barium, dissolved** | 7440-39-3 | E421 | 0.00010 | mg/L | | 0.0178 | 0.0167 | <0.00010 | 0.0178 | <0.00010 |
| **beryllium, dissolved** | 7440-41-7 | E421 | 0.000100 | mg/L | | <0.000100 | <0.000100 | <0.000100 | <0.000100 | <0.000100 |
| **bismuth, dissolved** | 7440-69-9 | E421 | 0.000050 | mg/L | | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| **boron, dissolved** | 7440-42-8 | E421 | 0.010 | mg/L | | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 |
| **cadmium, dissolved** | 7440-43-9 | E421 | 0.0000050 | mg/L | | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 |
| **calcium, dissolved** | 7440-70-2 | E421 | 0.050 | mg/L | | 7.29 | 7.58 | <0.050 | 7.44 | <0.050 |

## Analytical Results

Sub-Matrix: **Water**
(Matrix: **Water**)

| Analyte | CAS Number | Method | LOR | Unit | Client sample ID | Upstream | Downstream | Field Blank | DUP | Travel Blank |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Client sampling date / time | 13-Apr-2022 03:35 | 13-Apr-2022 05:22 | 13-Apr-2022 09:20 | 13-Apr-2022 12:00 | 13-Apr-2022 |
| | | | | | | VA22A8039-001 | VA22A8039-002 | VA22A8039-003 | VA22A8039-004 | VA22A8039-005 |
| | | | | | | Result | Result | Result | Result | Result |
| **Dissolved Metals** | | | | | | | | | | |
| **cesium, dissolved** | 7440-46-2 | E421 | 0.000010 | mg/L | | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| **chromium, dissolved** | 7440-47-3 | E421 | 0.00050 | mg/L | | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 |
| **cobalt, dissolved** | 7440-48-4 | E421 | 0.00010 | mg/L | | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| **copper, dissolved** | 7440-50-8 | E421 | 0.00020 | mg/L | | 0.00147 | 0.00138 | <0.00020 | 0.00145 | <0.00020 |
| **iron, dissolved** | 7439-89-6 | E421 | 0.010 | mg/L | | 0.185 | 0.160 | <0.010 | 0.178 | <0.010 |
| **lead, dissolved** | 7439-92-1 | E421 | 0.000050 | mg/L | | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| **lithium, dissolved** | 7439-93-2 | E421 | 0.0010 | mg/L | | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 |
| **magnesium, dissolved** | 7439-95-4 | E421 | 0.0050 | mg/L | | 2.00 | 1.97 | <0.0050 | 1.96 | <0.0050 |
| **manganese, dissolved** | 7439-96-5 | E421 | 0.00010 | mg/L | | 0.0167 | 0.0103 | <0.00010 | 0.0165 | <0.00010 |
| **mercury, dissolved** | 7439-97-6 | E509 | 0.0000050 | mg/L | | 0.0000155 | 0.0000088 | <0.0000050 | 0.0000076 | <0.0000050 |
| **molybdenum, dissolved** | 7439-98-7 | E421 | 0.000050 | mg/L | | 0.000057 | 0.000056 | <0.000050 | 0.000052 | <0.000050 |
| **nickel, dissolved** | 7440-02-0 | E421 | 0.00050 | mg/L | | 0.00057 | 0.00052 | <0.00050 | 0.00061 | <0.00050 |
| **phosphorus, dissolved** | 7723-14-0 | E421 | 0.050 | mg/L | | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 |
| **potassium, dissolved** | 7440-09-7 | E421 | 0.050 | mg/L | | 0.366 | 0.365 | <0.050 | 0.383 | <0.050 |
| **rubidium, dissolved** | 7440-17-7 | E421 | 0.00020 | mg/L | | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 |
| **selenium, dissolved** | 7782-49-2 | E421 | 0.000050 | mg/L | | 0.000061 | <0.000050 | <0.000050 | 0.000054 | <0.000050 |
| **silicon, dissolved** | 7440-21-3 | E421 | 0.050 | mg/L | | 3.36 | 3.32 | <0.050 | 3.39 | <0.050 |
| **silver, dissolved** | 7440-22-4 | E421 | 0.000010 | mg/L | | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| **sodium, dissolved** | 7440-23-5 | E421 | 0.050 | mg/L | | 3.03 | 3.10 | <0.050 | 3.02 | <0.050 |
| **strontium, dissolved** | 7440-24-6 | E421 | 0.00020 | mg/L | | 0.0792 | 0.0789 | <0.00020 | 0.0790 | <0.00020 |
| **sulfur, dissolved** | 7704-34-9 | E421 | 0.50 | mg/L | | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| **tellurium, dissolved** | 13494-80-9 | E421 | 0.00020 | mg/L | | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 |
| **thallium, dissolved** | 7440-28-0 | E421 | 0.000010 | mg/L | | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| **thorium, dissolved** | 7440-29-1 | E421 | 0.00010 | mg/L | | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| **tin, dissolved** | 7440-31-5 | E421 | 0.00010 | mg/L | | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| **titanium, dissolved** | 7440-32-6 | E421 | 0.00030 | mg/L | | 0.00234 | 0.00197 | <0.00030 | 0.00250 | <0.00030 |
| **tungsten, dissolved** | 7440-33-7 | E421 | 0.00010 | mg/L | | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| **uranium, dissolved** | 7440-61-1 | E421 | 0.000010 | mg/L | | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| **vanadium, dissolved** | 7440-62-2 | E421 | 0.00050 | mg/L | | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 |
| **zinc, dissolved** | 7440-66-6 | E421 | 0.0010 | mg/L | | <0.0010 | <0.0010 | <0.0010 | 0.0014 | <0.0010 |
| **zirconium, dissolved** | 7440-67-7 | E421 | 0.00020 | mg/L | | <0.00060 DLM | 0.00041 | <0.00020 | 0.00040 | <0.00020 |

## Analytical Results

| Sub-Matrix: **Water** (Matrix: **Water**) | | | | | Client sample ID | Upstream | Downstream | Field Blank | DUP | Travel Blank |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Client sampling date / time | 13-Apr-2022 03:35 | 13-Apr-2022 05:22 | 13-Apr-2022 09:20 | 13-Apr-2022 12:00 | 13-Apr-2022 |
| *Analyte* | *CAS Number* | *Method* | *LOR* | *Unit* | | **VA22A8039-001** | **VA22A8039-002** | **VA22A8039-003** | **VA22A8039-004** | **VA22A8039-005** |
| | | | | | | Result | Result | Result | Result | Result |
| **Dissolved Metals** | | | | | | | | | | |
| **dissolved mercury filtration location** | ---- | EP509 | - | - | | Field | Field | Field | Field | Field |
| **dissolved metals filtration location** | ---- | EP421 | - | - | | Field | Field | Field | Field | Field |
| **Aggregate Organics** | | | | | | | | | | |
| **biochemical oxygen demand [BOD]** | ---- | E550 | 2.0 | mg/L | | <2.0 | <2.0 | <2.0 | <2.0 | <2.0 |

Please refer to the General Comments section for an explanation of any qualifiers detected.

# QUALITY CONTROL INTERPRETIVE REPORT

| | | | |
|---|---|---|---|
| **Work Order** | : **VA22A8039** | Page | : 1 of 14 |
| Client | : **Regional District of Kitimat-Stikine** | Laboratory | : Vancouver - Environmental |
| Contact | : Hannah Shinton | Account Manager | : Amber Springer |
| Address | : # 300 - 4545 Lazelle Avenue<br>Terrace BC Canada V8G 4E1 | Address | : 8081 Lougheed Highway<br>Burnaby, British Columbia Canada V5A 1W9 |
| Telephone | : ---- | Telephone | : +1 604 253 4188 |
| Project | : Kitwanga Landfill Surface Water | Date Samples Received | : 14-Apr-2022 21:40 |
| PO | : ---- | Issue Date | : 04-May-2022 11:04 |
| C-O-C number | : ---- | | |
| Sampler | : Hannah Shinton | | |
| Site | : | | |
| Quote number | : Q62338 | | |
| No. of samples received | : 5 | | |
| No. of samples analysed | : 5 | | |

**This report is automatically generated by the ALS LIMS (Laboratory Information Management System) through evaluation of Quality Control (QC) results and other QA parameters associated with this submission, and is intended to facilitate rapid data validation by auditors or reviewers. The report highlights any exceptions and outliers to ALS Data Quality Objectives, provides holding time details and exceptions, summarizes QC sample frequencies, and lists applicable methodology references and summaries.**

**Key**

**Anonymous: Refers to samples which are not part of this work order, but which formed part of the QC process lot.**
**CAS Number: Chemical Abstracts Services number is a unique identifier assigned to discrete substances.**
**DQO: Data Quality Objective.**
**LOR: Limit of Reporting (detection limit).**
**RPD: Relative Percent Difference.**

## Workorder Comments

Holding times are displayed as "---" if no guidance exists from CCME, Canadian provinces, or broadly recognized international references.

## Summary of Outliers

### Outliers : Quality Control Samples

- No Method Blank value outliers occur.
- No Laboratory Control Sample (LCS) outliers occur
- No Matrix Spike outliers occur.
- Duplicate outliers occur - please see following pages for full details.
- No Test sample Surrogate recovery outliers exist.

### Outliers: Reference Material (RM) Samples

- No Reference Material (RM) Sample outliers occur.

### Outliers : Analysis Holding Time Compliance (Breaches)

- Analysis Holding Time Outliers exist - please see following pages for full details.

## *Outliers : Frequency of Quality Control Samples*

- Quality Control Sample Frequency Outliers occur - please see following pages for full details.

## Outliers : Quality Control Samples

*Duplicates, Method Blanks, Laboratory Control Samples and Matrix Spikes*

Matrix: **Water**

| Analyte Group | Laboratory sample ID | Client/Ref Sample ID | Analyte | CAS Number | Method | Result | Limits | Comment |
|---|---|---|---|---|---|---|---|---|
| **Duplicate (DUP) RPDs** | | | | | | | | |
| Total Metals | VA22A8039-001 | Upstream | titanium, total | 7440-32-6 | E420 | 44.4 % DUP-H | 20% | Duplicate RPD does not meet the DQO for this test. |

## Result Qualifiers

| Qualifier | Description |
|---|---|
| *DUP-H* | *Duplicate results outside ALS DQO, due to sample heterogeneity.* |

# Analysis Holding Time Compliance

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times, which are selected to meet known provincial and /or federal requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by organizations such as CCME, US EPA, APHA Standard Methods, ASTM, or Environment Canada (where available). Dates and holding times reported below represent the first dates of extraction or analysis. If subsequent tests or dilutions exceeded holding times, qualifiers are added (refer to COA).

If samples are identified below as having been analyzed or extracted outside of recommended holding times, measurement uncertainties may be increased, and this should be taken into consideration when interpreting results.

Where actual sampling date is not provided on the chain of custody, the date of receipt with time at 00:00 is used for calculation purposes.

Where only the sample date without time is provided on the chain of custody, the sampling date at 00:00 is used for calculation purposes.

Matrix: **Water**

Evaluation: × = Holding time exceedance ; ✓ = Within Holding Time

| Analyte Group / Container / Client Sample ID(s) | Method | Sampling Date | Extraction / Preparation | | | | Analysis | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Preparation Date | Holding Times Rec | Holding Times Actual | Eval | Analysis Date | Holding Times Rec | Holding Times Actual | Eval |
| **Aggregate Organics : Biochemical Oxygen Demand - 5 day** | | | | | | | | | | |
| **HDPE [BOD HT 3d]** Downstream | E550 | 13-Apr-2022 | ---- | ---- | ---- | | 16-Apr-2022 | 3 days | 3 days | ✓ |
| **Aggregate Organics : Biochemical Oxygen Demand - 5 day** | | | | | | | | | | |
| **HDPE [BOD HT 3d]** DUP | E550 | 13-Apr-2022 | ---- | ---- | ---- | | 16-Apr-2022 | 3 days | 3 days | ✓ |
| **Aggregate Organics : Biochemical Oxygen Demand - 5 day** | | | | | | | | | | |
| **HDPE [BOD HT 3d]** Field Blank | E550 | 13-Apr-2022 | ---- | ---- | ---- | | 16-Apr-2022 | 3 days | 3 days | ✓ |
| **Aggregate Organics : Biochemical Oxygen Demand - 5 day** | | | | | | | | | | |
| **HDPE [BOD HT 3d]** Travel Blank | E550 | 13-Apr-2022 | ---- | ---- | ---- | | 16-Apr-2022 | 3 days | 3 days | ✓ |
| **Aggregate Organics : Biochemical Oxygen Demand - 5 day** | | | | | | | | | | |
| **HDPE [BOD HT 3d]** Upstream | E550 | 13-Apr-2022 | ---- | ---- | ---- | | 16-Apr-2022 | 3 days | 3 days | ✓ |
| **Anions and Nutrients : Ammonia by Fluorescence** | | | | | | | | | | |
| **Amber glass total (sulfuric acid)** Downstream | E298 | 13-Apr-2022 | 01-May-2022 | ---- | ---- | | 02-May-2022 | 28 days | 19 days | ✓ |
| **Anions and Nutrients : Ammonia by Fluorescence** | | | | | | | | | | |
| **Amber glass total (sulfuric acid)** DUP | E298 | 13-Apr-2022 | 01-May-2022 | ---- | ---- | | 02-May-2022 | 28 days | 19 days | ✓ |

Matrix: **Water**

Evaluation: × = Holding time exceedance ; ✓ = Within Holding Time

| Analyte Group / Container / Client Sample ID(s) | Method | Sampling Date | Extraction / Preparation | | | | Analysis | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Preparation Date | Holding Times Rec | Holding Times Actual | Eval | Analysis Date | Holding Times Rec | Holding Times Actual | Eval |
| **Anions and Nutrients : Ammonia by Fluorescence** | | | | | | | | | | |
| **Amber glass total (sulfuric acid)** | | | | | | | | | | |
| Field Blank | E298 | 13-Apr-2022 | 01-May-2022 | ---- | ---- | | 02-May-2022 | 28 days | 19 days | ✓ |
| **Anions and Nutrients : Ammonia by Fluorescence** | | | | | | | | | | |
| **Amber glass total (sulfuric acid)** | | | | | | | | | | |
| Travel Blank | E298 | 13-Apr-2022 | 01-May-2022 | ---- | ---- | | 02-May-2022 | 28 days | 19 days | ✓ |
| **Anions and Nutrients : Ammonia by Fluorescence** | | | | | | | | | | |
| **Amber glass total (sulfuric acid)** | | | | | | | | | | |
| Upstream | E298 | 13-Apr-2022 | 01-May-2022 | ---- | ---- | | 02-May-2022 | 28 days | 20 days | ✓ |
| **Anions and Nutrients : Total Nitrogen by Colourimetry** | | | | | | | | | | |
| **Amber glass total (sulfuric acid)** | | | | | | | | | | |
| Downstream | E366 | 13-Apr-2022 | 01-May-2022 | ---- | ---- | | 03-May-2022 | 28 days | 20 days | ✓ |
| **Anions and Nutrients : Total Nitrogen by Colourimetry** | | | | | | | | | | |
| **Amber glass total (sulfuric acid)** | | | | | | | | | | |
| DUP | E366 | 13-Apr-2022 | 01-May-2022 | ---- | ---- | | 03-May-2022 | 28 days | 20 days | ✓ |
| **Anions and Nutrients : Total Nitrogen by Colourimetry** | | | | | | | | | | |
| **Amber glass total (sulfuric acid)** | | | | | | | | | | |
| Field Blank | E366 | 13-Apr-2022 | 01-May-2022 | ---- | ---- | | 03-May-2022 | 28 days | 20 days | ✓ |
| **Anions and Nutrients : Total Nitrogen by Colourimetry** | | | | | | | | | | |
| **Amber glass total (sulfuric acid)** | | | | | | | | | | |
| Upstream | E366 | 13-Apr-2022 | 01-May-2022 | ---- | ---- | | 03-May-2022 | 28 days | 20 days | ✓ |
| **Anions and Nutrients : Total Phosphorus by Colourimetry (Ultra Trace)** | | | | | | | | | | |
| **Amber glass total (sulfuric acid)** | | | | | | | | | | |
| Downstream | E372-U | 13-Apr-2022 | 01-May-2022 | ---- | ---- | | 03-May-2022 | 28 days | 20 days | ✓ |
| **Anions and Nutrients : Total Phosphorus by Colourimetry (Ultra Trace)** | | | | | | | | | | |
| **Amber glass total (sulfuric acid)** | | | | | | | | | | |
| DUP | E372-U | 13-Apr-2022 | 01-May-2022 | ---- | ---- | | 03-May-2022 | 28 days | 20 days | ✓ |

Matrix: **Water**

Evaluation: × = Holding time exceedance ; ✓ = Within Holding Time

| Analyte Group / Container / Client Sample ID(s) | Method | Sampling Date | Extraction / Preparation | | | | Analysis | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Preparation Date | Holding Times Rec | Holding Times Actual | Eval | Analysis Date | Holding Times Rec | Holding Times Actual | Eval |
| **Anions and Nutrients : Total Phosphorus by Colourimetry (Ultra Trace)** | | | | | | | | | | |
| **Amber glass total (sulfuric acid)** | | | | | | | | | | |
| Field Blank | E372-U | 13-Apr-2022 | 01-May-2022 | ---- | ---- | | 03-May-2022 | 28 days | 20 days | ✓ |
| **Anions and Nutrients : Total Phosphorus by Colourimetry (Ultra Trace)** | | | | | | | | | | |
| **Amber glass total (sulfuric acid)** | | | | | | | | | | |
| Upstream | E372-U | 13-Apr-2022 | 01-May-2022 | ---- | ---- | | 03-May-2022 | 28 days | 21 days | ✓ |
| **Dissolved Metals : Dissolved Mercury in Water by CVAAS** | | | | | | | | | | |
| **Glass vial dissolved (hydrochloric acid)** | | | | | | | | | | |
| DUP | E509 | 13-Apr-2022 | 18-Apr-2022 | ---- | ---- | | 18-Apr-2022 | 28 days | 5 days | ✓ |
| **Dissolved Metals : Dissolved Mercury in Water by CVAAS** | | | | | | | | | | |
| **Glass vial dissolved (hydrochloric acid)** | | | | | | | | | | |
| Field Blank | E509 | 13-Apr-2022 | 18-Apr-2022 | ---- | ---- | | 18-Apr-2022 | 28 days | 5 days | ✓ |
| **Dissolved Metals : Dissolved Mercury in Water by CVAAS** | | | | | | | | | | |
| **Glass vial - dissolved (lab preserved)** | | | | | | | | | | |
| Travel Blank | E509 | 13-Apr-2022 | 18-Apr-2022 | ---- | ---- | | 18-Apr-2022 | 28 days | 5 days | ✓ |
| **Dissolved Metals : Dissolved Mercury in Water by CVAAS** | | | | | | | | | | |
| **Glass vial dissolved (hydrochloric acid)** | | | | | | | | | | |
| Downstream | E509 | 13-Apr-2022 | 18-Apr-2022 | ---- | ---- | | 18-Apr-2022 | 28 days | 6 days | ✓ |
| **Dissolved Metals : Dissolved Mercury in Water by CVAAS** | | | | | | | | | | |
| **Glass vial dissolved (hydrochloric acid)** | | | | | | | | | | |
| Upstream | E509 | 13-Apr-2022 | 18-Apr-2022 | ---- | ---- | | 18-Apr-2022 | 28 days | 6 days | ✓ |
| **Dissolved Metals : Dissolved Metals in Water by CRC ICPMS** | | | | | | | | | | |
| **HDPE dissolved (nitric acid)** | | | | | | | | | | |
| Downstream | E421 | 13-Apr-2022 | 22-Apr-2022 | ---- | ---- | | 24-Apr-2022 | 180 days | 11 days | ✓ |
| **Dissolved Metals : Dissolved Metals in Water by CRC ICPMS** | | | | | | | | | | |
| **HDPE dissolved (nitric acid)** | | | | | | | | | | |
| DUP | E421 | 13-Apr-2022 | 22-Apr-2022 | ---- | ---- | | 24-Apr-2022 | 180 days | 11 days | ✓ |

Matrix: **Water**

Evaluation: × = Holding time exceedance ; ✓ = Within Holding Time

| Analyte Group / Container / Client Sample ID(s) | Method | Sampling Date | Extraction / Preparation | | | | Analysis | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Preparation Date | Holding Times Rec | Holding Times Actual | Eval | Analysis Date | Holding Times Rec | Holding Times Actual | Eval |
| **Dissolved Metals : Dissolved Metals in Water by CRC ICPMS** | | | | | | | | | | |
| **HDPE dissolved (nitric acid)** Field Blank | E421 | 13-Apr-2022 | 22-Apr-2022 | ---- | ---- | | 24-Apr-2022 | 180 days | 11 days | ✓ |
| **Dissolved Metals : Dissolved Metals in Water by CRC ICPMS** | | | | | | | | | | |
| **HDPE - dissolved (lab preserved)** Travel Blank | E421 | 13-Apr-2022 | 22-Apr-2022 | ---- | ---- | | 24-Apr-2022 | 180 days | 11 days | ✓ |
| **Dissolved Metals : Dissolved Metals in Water by CRC ICPMS** | | | | | | | | | | |
| **HDPE dissolved (nitric acid)** Upstream | E421 | 13-Apr-2022 | 22-Apr-2022 | ---- | ---- | | 24-Apr-2022 | 180 days | 12 days | ✓ |
| **Organic / Inorganic Carbon : Dissolved Organic Carbon by Combustion (Low Level)** | | | | | | | | | | |
| **Amber glass dissolved (sulfuric acid)** Downstream | E358-L | 13-Apr-2022 | 02-May-2022 | ---- | ---- | | 02-May-2022 | 28 days | 19 days | ✓ |
| **Organic / Inorganic Carbon : Dissolved Organic Carbon by Combustion (Low Level)** | | | | | | | | | | |
| **Amber glass dissolved (sulfuric acid)** DUP | E358-L | 13-Apr-2022 | 02-May-2022 | ---- | ---- | | 02-May-2022 | 28 days | 19 days | ✓ |
| **Organic / Inorganic Carbon : Dissolved Organic Carbon by Combustion (Low Level)** | | | | | | | | | | |
| **Amber glass dissolved (sulfuric acid)** Upstream | E358-L | 13-Apr-2022 | 02-May-2022 | ---- | ---- | | 02-May-2022 | 28 days | 19 days | ✓ |
| **Physical Tests : Conductivity in Water** | | | | | | | | | | |
| **HDPE** Downstream | E100 | 13-Apr-2022 | ---- | ---- | ---- | | 20-Apr-2022 | 28 days | 7 days | ✓ |
| **Physical Tests : Conductivity in Water** | | | | | | | | | | |
| **HDPE** DUP | E100 | 13-Apr-2022 | ---- | ---- | ---- | | 20-Apr-2022 | 28 days | 7 days | ✓ |
| **Physical Tests : Conductivity in Water** | | | | | | | | | | |
| **HDPE** Field Blank | E100 | 13-Apr-2022 | ---- | ---- | ---- | | 20-Apr-2022 | 28 days | 7 days | ✓ |

Matrix: **Water**

Evaluation: × = Holding time exceedance ; ✓ = Within Holding Time

| Analyte Group / Container / Client Sample ID(s) | Method | Sampling Date | Extraction / Preparation | | | | Analysis | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Preparation Date | Holding Times Rec | Holding Times Actual | Eval | Analysis Date | Holding Times Rec | Holding Times Actual | Eval |
| **Physical Tests : Conductivity in Water** | | | | | | | | | | |
| **HDPE** | | | | | | | | | | |
| Upstream | E100 | 13-Apr-2022 | ---- | ---- | ---- | | 20-Apr-2022 | 28 days | 7 days | ✓ |
| **Physical Tests : pH by Meter** | | | | | | | | | | |
| **HDPE** | | | | | | | | | | |
| DUP | E108 | 13-Apr-2022 | ---- | ---- | ---- | | 20-Apr-2022 | 0.25 hrs | 170 hrs | × EHTR-FM |
| **Physical Tests : pH by Meter** | | | | | | | | | | |
| **HDPE** | | | | | | | | | | |
| Field Blank | E108 | 13-Apr-2022 | ---- | ---- | ---- | | 20-Apr-2022 | 0.25 hrs | 173 hrs | × EHTR-FM |
| **Physical Tests : pH by Meter** | | | | | | | | | | |
| **HDPE** | | | | | | | | | | |
| Downstream | E108 | 13-Apr-2022 | ---- | ---- | ---- | | 20-Apr-2022 | 0.25 hrs | 177 hrs | × EHTR-FM |
| **Physical Tests : pH by Meter** | | | | | | | | | | |
| **HDPE** | | | | | | | | | | |
| Upstream | E108 | 13-Apr-2022 | ---- | ---- | ---- | | 20-Apr-2022 | 0.25 hrs | 179 hrs | × EHTR-FM |
| **Total Metals : Total Mercury in Water by CVAAS** | | | | | | | | | | |
| **Glass vial total (hydrochloric acid)** | | | | | | | | | | |
| Downstream | E508 | 13-Apr-2022 | ---- | ---- | ---- | | 21-Apr-2022 | 28 days | 8 days | ✓ |
| **Total Metals : Total Mercury in Water by CVAAS** | | | | | | | | | | |
| **Glass vial total (hydrochloric acid)** | | | | | | | | | | |
| DUP | E508 | 13-Apr-2022 | ---- | ---- | ---- | | 21-Apr-2022 | 28 days | 8 days | ✓ |
| **Total Metals : Total Mercury in Water by CVAAS** | | | | | | | | | | |
| **Glass vial total (hydrochloric acid)** | | | | | | | | | | |
| Field Blank | E508 | 13-Apr-2022 | ---- | ---- | ---- | | 21-Apr-2022 | 28 days | 8 days | ✓ |
| **Total Metals : Total Mercury in Water by CVAAS** | | | | | | | | | | |
| **Glass vial - total (lab preserved)** | | | | | | | | | | |
| Travel Blank | E508 | 13-Apr-2022 | ---- | ---- | ---- | | 21-Apr-2022 | 28 days | 8 days | ✓ |

Matrix: **Water**

Evaluation: × = Holding time exceedance ; ✓ = Within Holding Time

| Analyte Group / Container / Client Sample ID(s) | Method | Sampling Date | Extraction / Preparation | | | | Analysis | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Preparation Date | Holding Times Rec | Holding Times Actual | Eval | Analysis Date | Holding Times Rec | Holding Times Actual | Eval |
| **Total Metals : Total Mercury in Water by CVAAS** | | | | | | | | | | |
| **Glass vial total (hydrochloric acid)** | | | | | | | | | | |
| Upstream | E508 | 13-Apr-2022 | ---- | ---- | ---- | | 21-Apr-2022 | 28 days | 8 days | ✓ |
| **Total Metals : Total Metals in Water by CRC ICPMS** | | | | | | | | | | |
| **HDPE total (nitric acid)** | | | | | | | | | | |
| DUP | E420 | 13-Apr-2022 | ---- | ---- | ---- | | 02-May-2022 | 180 days | 19 days | ✓ |
| **Total Metals : Total Metals in Water by CRC ICPMS** | | | | | | | | | | |
| **HDPE total (nitric acid)** | | | | | | | | | | |
| Field Blank | E420 | 13-Apr-2022 | ---- | ---- | ---- | | 02-May-2022 | 180 days | 19 days | ✓ |
| **Total Metals : Total Metals in Water by CRC ICPMS** | | | | | | | | | | |
| **HDPE - total (lab preserved)** | | | | | | | | | | |
| Travel Blank | E420 | 13-Apr-2022 | ---- | ---- | ---- | | 02-May-2022 | 180 days | 19 days | ✓ |
| **Total Metals : Total Metals in Water by CRC ICPMS** | | | | | | | | | | |
| **HDPE total (nitric acid)** | | | | | | | | | | |
| Downstream | E420 | 13-Apr-2022 | ---- | ---- | ---- | | 02-May-2022 | 180 days | 20 days | ✓ |
| **Total Metals : Total Metals in Water by CRC ICPMS** | | | | | | | | | | |
| **HDPE total (nitric acid)** | | | | | | | | | | |
| Upstream | E420 | 13-Apr-2022 | ---- | ---- | ---- | | 02-May-2022 | 180 days | 20 days | ✓ |

**Legend & Qualifier Definitions**

EHTR-FM: Exceeded ALS recommended hold time prior to sample receipt. Field Measurement recommended

Rec. HT: ALS recommended hold time (see units).

# Quality Control Parameter Frequency Compliance

The following report summarizes the frequency of laboratory QC samples analyzed within the analytical batches (QC lots) in which the submitted samples were processed. The actual frequency should be greater than or equal to the expected frequency.

Matrix: **Water**

Evaluation: × = QC frequency outside specification; ✓ = QC frequency within specification.

| Quality Control Sample Type | | | Count | | Frequency (%) | | |
|---|---|---|---|---|---|---|---|
| *Analytical Methods* | *Method* | *QC Lot #* | *QC* | *Regular* | *Actual* | *Expected* | *Evaluation* |
| **Laboratory Duplicates (DUP)** | | | | | | | |
| Ammonia by Fluorescence | E298 | 473788 | 1 | 11 | 9.0 | 5.0 | ✓ |
| Biochemical Oxygen Demand - 5 day | E550 | 460048 | 0 | 5 | 0.0 | 5.0 | × |
| Conductivity in Water | E100 | 461164 | 1 | 17 | 5.8 | 5.0 | ✓ |
| Dissolved Mercury in Water by CVAAS | E509 | 461415 | 1 | 20 | 5.0 | 5.0 | ✓ |
| Dissolved Metals in Water by CRC ICPMS | E421 | 465554 | 1 | 20 | 5.0 | 5.0 | ✓ |
| Dissolved Organic Carbon by Combustion (Low Level) | E358-L | 473789 | 1 | 11 | 9.0 | 5.0 | ✓ |
| pH by Meter | E108 | 461163 | 1 | 19 | 5.2 | 5.0 | ✓ |
| Total Mercury in Water by CVAAS | E508 | 464705 | 1 | 20 | 5.0 | 5.0 | ✓ |
| Total Metals in Water by CRC ICPMS | E420 | 472741 | 1 | 20 | 5.0 | 5.0 | ✓ |
| Total Nitrogen by Colourimetry | E366 | 473791 | 1 | 8 | 12.5 | 5.0 | ✓ |
| Total Phosphorus by Colourimetry (Ultra Trace) | E372-U | 473787 | 1 | 12 | 8.3 | 5.0 | ✓ |
| **Laboratory Control Samples (LCS)** | | | | | | | |
| Ammonia by Fluorescence | E298 | 473788 | 1 | 11 | 9.0 | 5.0 | ✓ |
| Biochemical Oxygen Demand - 5 day | E550 | 460048 | 1 | 5 | 20.0 | 5.0 | ✓ |
| Conductivity in Water | E100 | 461164 | 1 | 17 | 5.8 | 5.0 | ✓ |
| Dissolved Mercury in Water by CVAAS | E509 | 461415 | 1 | 20 | 5.0 | 5.0 | ✓ |
| Dissolved Metals in Water by CRC ICPMS | E421 | 465554 | 1 | 20 | 5.0 | 5.0 | ✓ |
| Dissolved Organic Carbon by Combustion (Low Level) | E358-L | 473789 | 1 | 11 | 9.0 | 5.0 | ✓ |
| pH by Meter | E108 | 461163 | 1 | 19 | 5.2 | 5.0 | ✓ |
| Total Mercury in Water by CVAAS | E508 | 464705 | 1 | 20 | 5.0 | 5.0 | ✓ |
| Total Metals in Water by CRC ICPMS | E420 | 472741 | 1 | 20 | 5.0 | 5.0 | ✓ |
| Total Nitrogen by Colourimetry | E366 | 473791 | 1 | 8 | 12.5 | 5.0 | ✓ |
| Total Phosphorus by Colourimetry (Ultra Trace) | E372-U | 473787 | 1 | 12 | 8.3 | 5.0 | ✓ |
| **Method Blanks (MB)** | | | | | | | |
| Ammonia by Fluorescence | E298 | 473788 | 1 | 11 | 9.0 | 5.0 | ✓ |
| Biochemical Oxygen Demand - 5 day | E550 | 460048 | 1 | 5 | 20.0 | 5.0 | ✓ |
| Conductivity in Water | E100 | 461164 | 1 | 17 | 5.8 | 5.0 | ✓ |
| Dissolved Mercury in Water by CVAAS | E509 | 461415 | 1 | 20 | 5.0 | 5.0 | ✓ |
| Dissolved Metals in Water by CRC ICPMS | E421 | 465554 | 1 | 20 | 5.0 | 5.0 | ✓ |
| Dissolved Organic Carbon by Combustion (Low Level) | E358-L | 473789 | 1 | 11 | 9.0 | 5.0 | ✓ |
| Total Mercury in Water by CVAAS | E508 | 464705 | 1 | 20 | 5.0 | 5.0 | ✓ |
| Total Metals in Water by CRC ICPMS | E420 | 472741 | 1 | 20 | 5.0 | 5.0 | ✓ |
| Total Nitrogen by Colourimetry | E366 | 473791 | 1 | 8 | 12.5 | 5.0 | ✓ |
| Total Phosphorus by Colourimetry (Ultra Trace) | E372-U | 473787 | 1 | 12 | 8.3 | 5.0 | ✓ |
| **Matrix Spikes (MS)** | | | | | | | |
| Ammonia by Fluorescence | E298 | 473788 | 1 | 11 | 9.0 | 5.0 | ✓ |
| Dissolved Mercury in Water by CVAAS | E509 | 461415 | 1 | 20 | 5.0 | 5.0 | ✓ |

Matrix: **Water**

Evaluation: × = *QC frequency outside specification*; ✓ = *QC frequency within specification.*

| Quality Control Sample Type | | | Count | | Frequency (%) | | |
|---|---|---|---|---|---|---|---|
| *Analytical Methods* | *Method* | *QC Lot #* | *QC* | *Regular* | *Actual* | *Expected* | *Evaluation* |
| Matrix Spikes (MS) - Continued | | | | | | | |
| Dissolved Metals in Water by CRC ICPMS | E421 | 465554 | 1 | 20 | 5.0 | 5.0 | ✓ |
| Dissolved Organic Carbon by Combustion (Low Level) | E358-L | 473789 | 1 | 11 | 9.0 | 5.0 | ✓ |
| Total Mercury in Water by CVAAS | E508 | 464705 | 1 | 20 | 5.0 | 5.0 | ✓ |
| Total Metals in Water by CRC ICPMS | E420 | 472741 | 1 | 20 | 5.0 | 5.0 | ✓ |
| Total Nitrogen by Colourimetry | E366 | 473791 | 1 | 8 | 12.5 | 5.0 | ✓ |
| Total Phosphorus by Colourimetry (Ultra Trace) | E372-U | 473787 | 1 | 12 | 8.3 | 5.0 | ✓ |

## Methodology References and Summaries

The analytical methods used by ALS are developed using internationally recognized reference methods (where available), such as those published by US EPA, APHA Standard Methods, ASTM, ISO, Environment Canada, BC MOE, and Ontario MOE. Reference methods may incorporate modifications to improve performance (indicated by "mod").

| Analytical Methods | Method / Lab | Matrix | Method Reference | Method Descriptions |
|---|---|---|---|---|
| Conductivity in Water | E100<br>Vancouver - Environmental | Water | APHA 2510 (mod) | Conductivity, also known as Electrical Conductivity (EC) or Specific Conductance, is measured by immersion of a conductivity cell with platinum electrodes into a water sample. Conductivity measurements are temperature-compensated to 25°C. |
| pH by Meter | E108<br>Vancouver - Environmental | Water | APHA 4500-H (mod) | pH is determined by potentiometric measurement with a pH electrode, and is conducted at ambient laboratory temperature (normally 20 ± 5°C). For high accuracy test results, pH should be measured in the field within the recommended 15 minute hold time. |
| Ammonia by Fluorescence | E298<br>Vancouver - Environmental | Water | J. Environ. Monit., 2005, 7, 37-42 (mod) | Ammonia in water is analyzed by flow-injection analysis with fluorescence detection after reaction with orthophthaldialdehyde (OPA). |
| Dissolved Organic Carbon by Combustion (Low Level) | E358-L<br>Vancouver - Environmental | Water | APHA 5310 B (mod) | Dissolved Organic Carbon (Non-Purgeable), also known as NPOC (dissolved), is a direct measurement of DOC after a filtered (0.45 micron) sample has been acidified and purged to remove inorganic carbon (IC). Analysis is by high temperature combustion with infrared detection of CO2. NPOC does not include volatile organic species that are purged off with IC. For samples where the majority of DC (dissolved carbon) is comprised of IC (which is common), this method is more accurate and more reliable than the DOC by subtraction method (i.e. DC minus DIC). |
| Total Nitrogen by Colourimetry | E366<br>Vancouver - Environmental | Water | APHA 4500-P J (mod) | Total Nitrogen is determined colourimetrically using a discrete analyzer after heated persulfate digestion of the sample. |
| Total Phosphorus by Colourimetry (Ultra Trace) | E372-U<br>Vancouver - Environmental | Water | APHA 4500-P E (mod). | Total Phosphorus is determined colourimetrically using a discrete analyzer after heated persulfate digestion of the sample. |
| Total Metals in Water by CRC ICPMS | E420<br>Vancouver - Environmental | Water | EPA 200.2/6020B (mod) | Water samples are digested with nitric and hydrochloric acids, and analyzed by Collision/Reaction Cell ICPMS.<br><br>Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. |
| Dissolved Metals in Water by CRC ICPMS | E421<br>Vancouver - Environmental | Water | APHA 3030B/EPA 6020B (mod) | Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by Collision/Reaction Cell ICPMS.<br><br>Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. |
| Total Mercury in Water by CVAAS | E508<br>Vancouver - Environmental | Water | EPA 1631E (mod) | Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS |

| Analytical Methods | Method / Lab | Matrix | Method Reference | Method Descriptions |
|---|---|---|---|---|
| Dissolved Mercury in Water by CVAAS | E509<br>Vancouver - Environmental | Water | APHA 3030B/EPA 1631E (mod) | Water samples are filtered (0.45 um), preserved with HCl, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS. |
| Biochemical Oxygen Demand - 5 day | E550<br>Vancouver - Environmental | Water | APHA 5210 B (mod) | Samples are diluted and incubated for a specified time period, after which the oxygen depletion is measured using a dissolved oxygen meter.<br><br>Free chlorine is a negative interference in the BOD method; please advise ALS when free chlorine is present in samples. |
| Dissolved Hardness (Calculated) | EC100<br>Vancouver - Environmental | Water | APHA 2340B | "Hardness (as CaCO3), dissolved" is calculated from the sum of dissolved Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. "Total Hardness" refers to the sum of Calcium and Magnesium Hardness. Hardness is normally or preferentially calculated from dissolved Calcium and Magnesium concentrations, because it is a property of water due to dissolved divalent cations. |
| Hardness (Calculated) from Total Ca/Mg | EC100A<br>Vancouver - Environmental | Water | APHA 2340B | "Hardness (as CaCO3), from total Ca/Mg" is calculated from the sum of total Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. "Total Hardness" refers to the sum of Calcium and Magnesium Hardness. Hardness is normally or preferentially calculated from dissolved Calcium and Magnesium concentrations, because it is a property of water due to dissolved divalent cations. Hardness from total Ca/Mg is normally comparable to Dissolved Hardness in non-turbid waters. |

| Preparation Methods | Method / Lab | Matrix | Method Reference | Method Descriptions |
|---|---|---|---|---|
| Preparation for Ammonia | EP298<br>Vancouver - Environmental | Water | | Sample preparation for Preserved Nutrients Water Quality Analysis. |
| Preparation for Dissolved Organic Carbon for Combustion | EP358<br>Vancouver - Environmental | Water | APHA 5310 B (mod) | Preparation for Dissolved Organic Carbon |
| Digestion for Total Nitrogen in water | EP366<br>Vancouver - Environmental | Water | APHA 4500-P J (mod) | Samples are heated with a persulfate digestion reagent. |
| Digestion for Total Phosphorus in water | EP372<br>Vancouver - Environmental | Water | APHA 4500-P E (mod). | Samples are heated with a persulfate digestion reagent. |
| Dissolved Metals Water Filtration | EP421<br>Vancouver - Environmental | Water | APHA 3030B | Water samples are filtered (0.45 um), and preserved with HNO3. |
| Dissolved Mercury Water Filtration | EP509<br>Vancouver - Environmental | Water | APHA 3030B | Water samples are filtered (0.45 um), and preserved with HCl. |

ALS Environmental

# QUALITY CONTROL REPORT

| | | | |
|---|---|---|---|
| **Work Order** | : **VA22A8039** | Page | : 1 of 14 |
| Client | : Regional District of Kitimat-Stikine | Laboratory | : Vancouver - Environmental |
| Contact | : Hannah Shinton | Account Manager | : Amber Springer |
| Address | : # 300 - 4545 Lazelle Avenue Terrace BC Canada V8G 4E1 | Address | : 8081 Lougheed Highway Burnaby, British Columbia Canada V5A 1W9 |
| Telephone | : ---- | Telephone | : +1 604 253 4188 |
| Project | : Kitwanga Landfill Surface Water | Date Samples Received | : 14-Apr-2022 21:40 |
| PO | : ---- | Date Analysis Commenced | : 16-Apr-2022 |
| C-O-C number | : ---- | Issue Date | : 04-May-2022 11:04 |
| Sampler | : Hannah Shinton | | |
| Site | : | | |
| Quote number | : Q62338 | | |
| No. of samples received | : 5 | | |
| No. of samples analysed | : 5 | | |

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits
- Reference Material (RM) Report; Recovery and Acceptance Limits
- Method Blank (MB) Report; Recovery and Acceptance Limits
- Laboratory Control Sample (LCS) Report; Recovery and Acceptance Limits

## *Signatories*

This document has been electronically signed by the authorized signatories below. Electronic signing is conducted in accordance with US FDA 21 CFR Part 11.

| *Signatories* | *Position* | *Laboratory Department* |
|---|---|---|
| Angela Ren | Team Leader - Metals | Metals, Burnaby, British Columbia |
| Angelo Salandanan | Lab Assistant | Metals, Burnaby, British Columbia |
| Caitlin Macey | Team Leader - Inorganics | Inorganics, Burnaby, British Columbia |
| Caleb Deroche | Lab Analyst | Metals, Burnaby, British Columbia |
| Dan Gebert | Laboratory Analyst | Metals, Burnaby, British Columbia |
| Kevin Duarte | Supervisor - Metals ICP Instrumentation | Metals, Burnaby, British Columbia |
| Miles Gropen | Department Manager - Inorganics | Inorganics, Burnaby, British Columbia |
| Owen Cheng | | Metals, Burnaby, British Columbia |

## General Comments

The ALS Quality Control (QC) report is optionally provided to ALS clients upon request. ALS test methods include comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against predetermined Data Quality Objectives (DQOs) to provide confidence in the accuracy of associated test results. This report contains detailed results for all QC results applicable to this sample submission. Please refer to the ALS Quality Control Interpretation report (QCI) for applicable method references and methodology summaries.

Key :

Anonymous = Refers to samples which are not part of this work order, but which formed part of the QC process lot.
CAS Number = Chemical Abstracts Services number is a unique identifier assigned to discrete substances.
DQO = Data Quality Objective.
LOR = Limit of Reporting (detection limit).
RPD = Relative Percentage Difference
# = Indicates a QC result that did not meet the ALS DQO.

## Workorder Comments

Holding times are displayed as "---" if no guidance exists from CCME, Canadian provinces, or broadly recognized international references.

## Laboratory Duplicate (DUP) Report

A Laboratory Duplicate (DUP) is a randomly selected intralaboratory replicate sample. Laboratory Duplicates provide information regarding method precision and sample heterogeneity. ALS DQOs for Laboratory Duplicates are expressed as test-specific limits for Relative Percent Difference (RPD), or as an absolute difference limit of 2 times the LOR for low concentration duplicates within ~ 4-10 times the LOR (cut-off is test specific).

Sub-Matrix: **Water**

| | | | | | Laboratory Duplicate (DUP) Report | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *Laboratory sample ID* | *Client sample ID* | *Analyte* | *CAS Number* | *Method* | *LOR* | *Unit* | *Original Result* | *Duplicate Result* | *RPD(%) or Difference* | *Duplicate Limits* | *Qualifier* |
| **Physical Tests (QC Lot: 461163)** | | | | | | | | | | | |
| FJ2200896-017 | Anonymous | pH | ---- | E108 | 0.10 | pH units | 8.31 | 8.31 | 0.00% | 4% | ---- |
| **Physical Tests (QC Lot: 461164)** | | | | | | | | | | | |
| FJ2200896-017 | Anonymous | conductivity | ---- | E100 | 2.0 | µS/cm | 690 | 692 | 0.289% | 10% | ---- |
| **Anions and Nutrients (QC Lot: 473787)** | | | | | | | | | | | |
| KS2201437-001 | Anonymous | phosphorus, total | 7723-14-0 | E372-U | 0.0020 | mg/L | 0.0126 | 0.0124 | 0.0001 | Diff <2x LOR | ---- |
| **Anions and Nutrients (QC Lot: 473788)** | | | | | | | | | | | |
| KS2201437-001 | Anonymous | ammonia, total (as N) | 7664-41-7 | E298 | 0.0050 | mg/L | <0.0050 | <0.0050 | 0 | Diff <2x LOR | ---- |
| **Anions and Nutrients (QC Lot: 473791)** | | | | | | | | | | | |
| VA22A8039-001 | Upstream | nitrogen, total | 7727-37-9 | E366 | 0.030 | mg/L | 0.272 | 0.271 | 0.0010 | Diff <2x LOR | ---- |
| **Organic / Inorganic Carbon (QC Lot: 473789)** | | | | | | | | | | | |
| FJ2201025-001 | Anonymous | carbon, dissolved organic [DOC] | ---- | E358-L | 0.50 | mg/L | 16.2 | 17.4 | 6.95% | 20% | ---- |
| **Total Metals (QC Lot: 464705)** | | | | | | | | | | | |
| KS2201250-001 | Anonymous | mercury, total | 7439-97-6 | E508 | 0.0000050 | mg/L | <0.0000050 | <0.0000050 | 0 | Diff <2x LOR | ---- |
| **Total Metals (QC Lot: 472741)** | | | | | | | | | | | |
| VA22A8039-001 | Upstream | aluminum, total | 7429-90-5 | E420 | 0.0030 | mg/L | 0.250 | 0.212 | 16.4% | 20% | ---- |
| | | antimony, total | 7440-36-0 | E420 | 0.00010 | mg/L | <0.00010 | <0.00010 | 0 | Diff <2x LOR | ---- |
| | | arsenic, total | 7440-38-2 | E420 | 0.00010 | mg/L | 0.00033 | 0.00031 | 0.00002 | Diff <2x LOR | ---- |
| | | barium, total | 7440-39-3 | E420 | 0.00010 | mg/L | 0.0197 | 0.0187 | 5.03% | 20% | ---- |
| | | beryllium, total | 7440-41-7 | E420 | 0.000100 | mg/L | <0.000100 | <0.000100 | 0 | Diff <2x LOR | ---- |
| | | bismuth, total | 7440-69-9 | E420 | 0.000050 | mg/L | <0.000050 | <0.000050 | 0 | Diff <2x LOR | ---- |
| | | boron, total | 7440-42-8 | E420 | 0.010 | mg/L | <0.010 | <0.010 | 0 | Diff <2x LOR | ---- |
| | | cadmium, total | 7440-43-9 | E420 | 0.0000050 | mg/L | 0.0000061 | <0.0000050 | 0.0000011 | Diff <2x LOR | ---- |
| | | calcium, total | 7440-70-2 | E420 | 0.050 | mg/L | 7.69 | 7.60 | 1.05% | 20% | ---- |
| | | cesium, total | 7440-46-2 | E420 | 0.000010 | mg/L | 0.000019 | 0.000020 | 0.000002 | Diff <2x LOR | ---- |
| | | chromium, total | 7440-47-3 | E420 | 0.00050 | mg/L | <0.00050 | <0.00050 | 0 | Diff <2x LOR | ---- |
| | | cobalt, total | 7440-48-4 | E420 | 0.00010 | mg/L | 0.00011 | 0.00011 | 0.0000007 | Diff <2x LOR | ---- |
| | | copper, total | 7440-50-8 | E420 | 0.00050 | mg/L | 0.00163 | 0.00159 | 0.00003 | Diff <2x LOR | ---- |
| | | iron, total | 7439-89-6 | E420 | 0.010 | mg/L | 0.328 | 0.314 | 4.18% | 20% | ---- |
| | | lead, total | 7439-92-1 | E420 | 0.000050 | mg/L | 0.000055 | 0.000051 | 0.000004 | Diff <2x LOR | ---- |
| | | lithium, total | 7439-93-2 | E420 | 0.0010 | mg/L | <0.0010 | <0.0010 | 0 | Diff <2x LOR | ---- |
| | | magnesium, total | 7439-95-4 | E420 | 0.0050 | mg/L | 2.01 | 2.04 | 1.44% | 20% | ---- |

Sub-Matrix: **Water**

| | | | | | Laboratory Duplicate (DUP) Report | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *Laboratory sample ID* | *Client sample ID* | *Analyte* | *CAS Number* | *Method* | *LOR* | *Unit* | *Original Result* | *Duplicate Result* | *RPD(%) or Difference* | *Duplicate Limits* | *Qualifier* |
| **Total Metals (QC Lot: 472741) - continued** | | | | | | | | | | | |
| VA22A8039-001 | Upstream | manganese, total | 7439-96-5 | E420 | 0.00010 | mg/L | 0.0261 | 0.0266 | 1.71% | 20% | ---- |
| | | molybdenum, total | 7439-98-7 | E420 | 0.000050 | mg/L | 0.000060 | 0.000073 | 0.000013 | Diff <2x LOR | ---- |
| | | nickel, total | 7440-02-0 | E420 | 0.00050 | mg/L | 0.00073 | 0.00070 | 0.00003 | Diff <2x LOR | ---- |
| | | phosphorus, total | 7723-14-0 | E420 | 0.050 | mg/L | <0.050 | <0.050 | 0 | Diff <2x LOR | ---- |
| | | potassium, total | 7440-09-7 | E420 | 0.050 | mg/L | 0.402 | 0.374 | 0.028 | Diff <2x LOR | ---- |
| | | rubidium, total | 7440-17-7 | E420 | 0.00020 | mg/L | 0.00026 | <0.00020 | 0.00006 | Diff <2x LOR | ---- |
| | | selenium, total | 7782-49-2 | E420 | 0.000050 | mg/L | <0.000050 | 0.000062 | 0.000012 | Diff <2x LOR | ---- |
| | | silicon, total | 7440-21-3 | E420 | 0.10 | mg/L | 3.61 | 3.35 | 7.35% | 20% | ---- |
| | | silver, total | 7440-22-4 | E420 | 0.000010 | mg/L | <0.000010 | <0.000010 | 0 | Diff <2x LOR | ---- |
| | | sodium, total | 7440-23-5 | E420 | 0.050 | mg/L | 2.93 | 2.91 | 0.579% | 20% | ---- |
| | | strontium, total | 7440-24-6 | E420 | 0.00020 | mg/L | 0.0794 | 0.0820 | 3.27% | 20% | ---- |
| | | sulfur, total | 7704-34-9 | E420 | 0.50 | mg/L | <0.50 | <0.50 | 0 | Diff <2x LOR | ---- |
| | | tellurium, total | 13494-80-9 | E420 | 0.00020 | mg/L | <0.00020 | <0.00020 | 0 | Diff <2x LOR | ---- |
| | | thallium, total | 7440-28-0 | E420 | 0.000010 | mg/L | <0.000010 | <0.000010 | 0 | Diff <2x LOR | ---- |
| | | thorium, total | 7440-29-1 | E420 | 0.00010 | mg/L | <0.00010 | <0.00010 | 0 | Diff <2x LOR | ---- |
| | | tin, total | 7440-31-5 | E420 | 0.00010 | mg/L | <0.00010 | <0.00010 | 0 | Diff <2x LOR | ---- |
| | | titanium, total | 7440-32-6 | E420 | 0.00030 | mg/L | 0.00476 | 0.00304 | 44.4% | 20% | DUP-H |
| | | tungsten, total | 7440-33-7 | E420 | 0.00010 | mg/L | <0.00010 | <0.00010 | 0 | Diff <2x LOR | ---- |
| | | uranium, total | 7440-61-1 | E420 | 0.000010 | mg/L | <0.000010 | <0.000010 | 0 | Diff <2x LOR | ---- |
| | | vanadium, total | 7440-62-2 | E420 | 0.00050 | mg/L | 0.00097 | 0.00062 | 0.00035 | Diff <2x LOR | ---- |
| | | zinc, total | 7440-66-6 | E420 | 0.0030 | mg/L | <0.0030 | <0.0030 | 0 | Diff <2x LOR | ---- |
| | | zirconium, total | 7440-67-7 | E420 | 0.00020 | mg/L | 0.00048 | 0.00054 | 0.00006 | Diff <2x LOR | ---- |
| **Dissolved Metals (QC Lot: 461415)** | | | | | | | | | | | |
| VA22A8037-020 | Anonymous | mercury, dissolved | 7439-97-6 | E509 | 0.0000050 | mg/L | <0.0000050 | <0.0000050 | 0 | Diff <2x LOR | ---- |
| **Dissolved Metals (QC Lot: 465554)** | | | | | | | | | | | |
| VA22A7804-006 | Anonymous | aluminum, dissolved | 7429-90-5 | E421 | 0.0010 | mg/L | 0.0036 | 0.0029 | 0.0008 | Diff <2x LOR | ---- |
| | | antimony, dissolved | 7440-36-0 | E421 | 0.00010 | mg/L | <0.00010 | <0.00010 | 0 | Diff <2x LOR | ---- |
| | | arsenic, dissolved | 7440-38-2 | E421 | 0.00010 | mg/L | 0.00056 | 0.00059 | 0.00003 | Diff <2x LOR | ---- |
| | | barium, dissolved | 7440-39-3 | E421 | 0.00010 | mg/L | 0.0579 | 0.0620 | 6.72% | 20% | ---- |
| | | beryllium, dissolved | 7440-41-7 | E421 | 0.000100 | mg/L | <0.000100 | <0.000100 | 0 | Diff <2x LOR | ---- |
| | | bismuth, dissolved | 7440-69-9 | E421 | 0.000050 | mg/L | <0.000050 | <0.000050 | 0 | Diff <2x LOR | ---- |
| | | boron, dissolved | 7440-42-8 | E421 | 0.010 | mg/L | 0.053 | 0.054 | 0.0006 | Diff <2x LOR | ---- |
| | | cadmium, dissolved | 7440-43-9 | E421 | 0.0000050 | mg/L | <0.0000050 | <0.0000050 | 0 | Diff <2x LOR | ---- |
| | | calcium, dissolved | 7440-70-2 | E421 | 0.050 | mg/L | 39.2 | 40.7 | 3.77% | 20% | ---- |
| | | cesium, dissolved | 7440-46-2 | E421 | 0.000010 | mg/L | <0.000010 | <0.000010 | 0 | Diff <2x LOR | ---- |

Sub-Matrix: **Water**

| | | | | | Laboratory Duplicate (DUP) Report | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *Laboratory sample ID* | *Client sample ID* | *Analyte* | *CAS Number* | *Method* | *LOR* | *Unit* | *Original Result* | *Duplicate Result* | *RPD(%) or Difference* | *Duplicate Limits* | *Qualifier* |
| **Dissolved Metals (QC Lot: 465554) - continued** | | | | | | | | | | | |
| VA22A7804-006 | Anonymous | chromium, dissolved | 7440-47-3 | E421 | 0.00050 | mg/L | <0.00050 | <0.00050 | 0 | Diff <2x LOR | ---- |
| | | cobalt, dissolved | 7440-48-4 | E421 | 0.00010 | mg/L | 0.00030 | 0.00031 | 0.00001 | Diff <2x LOR | ---- |
| | | copper, dissolved | 7440-50-8 | E421 | 0.00020 | mg/L | <0.00020 | <0.00020 | 0 | Diff <2x LOR | ---- |
| | | iron, dissolved | 7439-89-6 | E421 | 0.010 | mg/L | 0.022 | 0.023 | 0.0007 | Diff <2x LOR | ---- |
| | | lead, dissolved | 7439-92-1 | E421 | 0.000050 | mg/L | <0.000050 | <0.000050 | 0 | Diff <2x LOR | ---- |
| | | lithium, dissolved | 7439-93-2 | E421 | 0.0010 | mg/L | 0.0030 | 0.0030 | 0.00006 | Diff <2x LOR | ---- |
| | | magnesium, dissolved | 7439-95-4 | E421 | 0.0050 | mg/L | 11.4 | 11.7 | 2.29% | 20% | ---- |
| | | manganese, dissolved | 7439-96-5 | E421 | 0.00010 | mg/L | 0.316 | 0.327 | 3.28% | 20% | ---- |
| | | molybdenum, dissolved | 7439-98-7 | E421 | 0.000050 | mg/L | 0.0158 | 0.0158 | 0.136% | 20% | ---- |
| | | nickel, dissolved | 7440-02-0 | E421 | 0.00050 | mg/L | 0.00066 | 0.00067 | 0.00001 | Diff <2x LOR | ---- |
| | | phosphorus, dissolved | 7723-14-0 | E421 | 0.050 | mg/L | 0.093 | 0.101 | 0.008 | Diff <2x LOR | ---- |
| | | potassium, dissolved | 7440-09-7 | E421 | 0.050 | mg/L | 1.98 | 2.10 | 5.55% | 20% | ---- |
| | | rubidium, dissolved | 7440-17-7 | E421 | 0.00020 | mg/L | 0.00024 | 0.00025 | 0.00001 | Diff <2x LOR | ---- |
| | | selenium, dissolved | 7782-49-2 | E421 | 0.000050 | mg/L | 0.000088 | 0.000092 | 0.000005 | Diff <2x LOR | ---- |
| | | silicon, dissolved | 7440-21-3 | E421 | 0.050 | mg/L | 4.51 | 4.50 | 0.301% | 20% | ---- |
| | | silver, dissolved | 7440-22-4 | E421 | 0.000010 | mg/L | <0.000010 | <0.000010 | 0 | Diff <2x LOR | ---- |
| | | sodium, dissolved | 7440-23-5 | E421 | 0.050 | mg/L | 53.4 | 54.3 | 1.67% | 20% | ---- |
| | | strontium, dissolved | 7440-24-6 | E421 | 0.00020 | mg/L | 0.501 | 0.507 | 1.32% | 20% | ---- |
| | | sulfur, dissolved | 7704-34-9 | E421 | 0.50 | mg/L | 19.2 | 19.8 | 3.06% | 20% | ---- |
| | | tellurium, dissolved | 13494-80-9 | E421 | 0.00020 | mg/L | <0.00020 | <0.00020 | 0 | Diff <2x LOR | ---- |
| | | thallium, dissolved | 7440-28-0 | E421 | 0.000010 | mg/L | <0.000010 | <0.000010 | 0 | Diff <2x LOR | ---- |
| | | thorium, dissolved | 7440-29-1 | E421 | 0.00010 | mg/L | <0.00010 | <0.00010 | 0 | Diff <2x LOR | ---- |
| | | tin, dissolved | 7440-31-5 | E421 | 0.00010 | mg/L | <0.00010 | <0.00010 | 0 | Diff <2x LOR | ---- |
| | | titanium, dissolved | 7440-32-6 | E421 | 0.00030 | mg/L | <0.00030 | <0.00030 | 0 | Diff <2x LOR | ---- |
| | | tungsten, dissolved | 7440-33-7 | E421 | 0.00010 | mg/L | <0.00010 | <0.00010 | 0 | Diff <2x LOR | ---- |
| | | uranium, dissolved | 7440-61-1 | E421 | 0.000010 | mg/L | 0.00187 | 0.00193 | 2.98% | 20% | ---- |
| | | vanadium, dissolved | 7440-62-2 | E421 | 0.00050 | mg/L | <0.00050 | <0.00050 | 0 | Diff <2x LOR | ---- |
| | | zinc, dissolved | 7440-66-6 | E421 | 0.0010 | mg/L | <0.0010 | <0.0010 | 0 | Diff <2x LOR | ---- |
| | | zirconium, dissolved | 7440-67-7 | E421 | 0.00020 | mg/L | <0.00020 | <0.00020 | 0 | Diff <2x LOR | ---- |

## Qualifiers

| *Qualifier* | *Description* |
|---|---|
| *DUP-H* | *Duplicate results outside ALS DQO, due to sample heterogeneity.* |

## Method Blank (MB) Report

A Method Blank is an analyte-free matrix that undergoes sample processing identical to that carried out for test samples. Method Blank results are used to monitor and control for potential contamination from the laboratory environment and reagents. For most tests, the DQO for Method Blanks is for the result to be < LOR.

Sub-Matrix: **Water**

| Analyte | CAS Number | Method | LOR | Unit | Result | Qualifier |
|---|---|---|---|---|---|---|
| **Physical Tests (QCLot: 461164)** | | | | | | |
| conductivity | ---- | E100 | 1 | µS/cm | <1.0 | ---- |
| **Anions and Nutrients (QCLot: 473787)** | | | | | | |
| phosphorus, total | 7723-14-0 | E372-U | 0.002 | mg/L | <0.0020 | ---- |
| **Anions and Nutrients (QCLot: 473788)** | | | | | | |
| ammonia, total (as N) | 7664-41-7 | E298 | 0.005 | mg/L | <0.0050 | ---- |
| **Anions and Nutrients (QCLot: 473791)** | | | | | | |
| nitrogen, total | 7727-37-9 | E366 | 0.03 | mg/L | <0.030 | ---- |
| **Organic / Inorganic Carbon (QCLot: 473789)** | | | | | | |
| carbon, dissolved organic [DOC] | ---- | E358-L | 0.5 | mg/L | <0.50 | ---- |
| **Total Metals (QCLot: 464705)** | | | | | | |
| mercury, total | 7439-97-6 | E508 | 0.000005 | mg/L | <0.0000050 | ---- |
| **Total Metals (QCLot: 472741)** | | | | | | |
| aluminum, total | 7429-90-5 | E420 | 0.003 | mg/L | <0.0030 | ---- |
| antimony, total | 7440-36-0 | E420 | 0.0001 | mg/L | <0.00010 | ---- |
| arsenic, total | 7440-38-2 | E420 | 0.0001 | mg/L | <0.00010 | ---- |
| barium, total | 7440-39-3 | E420 | 0.0001 | mg/L | <0.00010 | ---- |
| beryllium, total | 7440-41-7 | E420 | 0.00002 | mg/L | <0.000020 | ---- |
| bismuth, total | 7440-69-9 | E420 | 0.00005 | mg/L | <0.000050 | ---- |
| boron, total | 7440-42-8 | E420 | 0.01 | mg/L | <0.010 | ---- |
| cadmium, total | 7440-43-9 | E420 | 0.000005 | mg/L | <0.0000050 | ---- |
| calcium, total | 7440-70-2 | E420 | 0.05 | mg/L | <0.050 | ---- |
| cesium, total | 7440-46-2 | E420 | 0.00001 | mg/L | <0.000010 | ---- |
| chromium, total | 7440-47-3 | E420 | 0.0005 | mg/L | <0.00050 | ---- |
| cobalt, total | 7440-48-4 | E420 | 0.0001 | mg/L | <0.00010 | ---- |
| copper, total | 7440-50-8 | E420 | 0.0005 | mg/L | <0.00050 | ---- |
| iron, total | 7439-89-6 | E420 | 0.01 | mg/L | <0.010 | ---- |
| lead, total | 7439-92-1 | E420 | 0.00005 | mg/L | <0.000050 | ---- |
| lithium, total | 7439-93-2 | E420 | 0.001 | mg/L | <0.0010 | ---- |
| magnesium, total | 7439-95-4 | E420 | 0.005 | mg/L | <0.0050 | ---- |
| manganese, total | 7439-96-5 | E420 | 0.0001 | mg/L | <0.00010 | ---- |
| molybdenum, total | 7439-98-7 | E420 | 0.00005 | mg/L | <0.000050 | ---- |
| nickel, total | 7440-02-0 | E420 | 0.0005 | mg/L | <0.00050 | ---- |
| phosphorus, total | 7723-14-0 | E420 | 0.05 | mg/L | <0.050 | ---- |

Sub-Matrix: **Water**

| Analyte | CAS Number | Method | LOR | Unit | Result | Qualifier |
|---|---|---|---|---|---|---|
| **Total Metals (QCLot: 472741) - continued** | | | | | | |
| potassium, total | 7440-09-7 | E420 | 0.05 | mg/L | <0.050 | ---- |
| rubidium, total | 7440-17-7 | E420 | 0.0002 | mg/L | <0.00020 | ---- |
| selenium, total | 7782-49-2 | E420 | 0.00005 | mg/L | <0.000050 | ---- |
| silicon, total | 7440-21-3 | E420 | 0.1 | mg/L | <0.10 | ---- |
| silver, total | 7440-22-4 | E420 | 0.00001 | mg/L | <0.000010 | ---- |
| sodium, total | 7440-23-5 | E420 | 0.05 | mg/L | <0.050 | ---- |
| strontium, total | 7440-24-6 | E420 | 0.0002 | mg/L | <0.00020 | ---- |
| sulfur, total | 7704-34-9 | E420 | 0.5 | mg/L | <0.50 | ---- |
| tellurium, total | 13494-80-9 | E420 | 0.0002 | mg/L | <0.00020 | ---- |
| thallium, total | 7440-28-0 | E420 | 0.00001 | mg/L | <0.000010 | ---- |
| thorium, total | 7440-29-1 | E420 | 0.0001 | mg/L | <0.00010 | ---- |
| tin, total | 7440-31-5 | E420 | 0.0001 | mg/L | <0.00010 | ---- |
| titanium, total | 7440-32-6 | E420 | 0.0003 | mg/L | <0.00030 | ---- |
| tungsten, total | 7440-33-7 | E420 | 0.0001 | mg/L | <0.00010 | ---- |
| uranium, total | 7440-61-1 | E420 | 0.00001 | mg/L | <0.000010 | ---- |
| vanadium, total | 7440-62-2 | E420 | 0.0005 | mg/L | <0.00050 | ---- |
| zinc, total | 7440-66-6 | E420 | 0.003 | mg/L | <0.0030 | ---- |
| zirconium, total | 7440-67-7 | E420 | 0.0002 | mg/L | <0.00020 | ---- |
| **Dissolved Metals (QCLot: 461415)** | | | | | | |
| mercury, dissolved | 7439-97-6 | E509 | 0.000005 | mg/L | <0.0000050 | ---- |
| **Dissolved Metals (QCLot: 465554)** | | | | | | |
| aluminum, dissolved | 7429-90-5 | E421 | 0.001 | mg/L | <0.0010 | ---- |
| antimony, dissolved | 7440-36-0 | E421 | 0.0001 | mg/L | <0.00010 | ---- |
| arsenic, dissolved | 7440-38-2 | E421 | 0.0001 | mg/L | <0.00010 | ---- |
| barium, dissolved | 7440-39-3 | E421 | 0.0001 | mg/L | <0.00010 | ---- |
| beryllium, dissolved | 7440-41-7 | E421 | 0.00002 | mg/L | <0.000020 | ---- |
| bismuth, dissolved | 7440-69-9 | E421 | 0.00005 | mg/L | <0.000050 | ---- |
| boron, dissolved | 7440-42-8 | E421 | 0.01 | mg/L | <0.010 | ---- |
| cadmium, dissolved | 7440-43-9 | E421 | 0.000005 | mg/L | <0.0000050 | ---- |
| calcium, dissolved | 7440-70-2 | E421 | 0.05 | mg/L | <0.050 | ---- |
| cesium, dissolved | 7440-46-2 | E421 | 0.00001 | mg/L | <0.000010 | ---- |
| chromium, dissolved | 7440-47-3 | E421 | 0.0005 | mg/L | <0.00050 | ---- |
| cobalt, dissolved | 7440-48-4 | E421 | 0.0001 | mg/L | <0.00010 | ---- |
| copper, dissolved | 7440-50-8 | E421 | 0.0002 | mg/L | <0.00020 | ---- |
| iron, dissolved | 7439-89-6 | E421 | 0.01 | mg/L | <0.010 | ---- |
| lead, dissolved | 7439-92-1 | E421 | 0.00005 | mg/L | <0.000050 | ---- |

Sub-Matrix: **Water**

| Analyte | CAS Number | Method | LOR | Unit | Result | Qualifier |
|---|---|---|---|---|---|---|
| **Dissolved Metals (QCLot: 465554) - continued** | | | | | | |
| lithium, dissolved | 7439-93-2 | E421 | 0.001 | mg/L | <0.0010 | ---- |
| magnesium, dissolved | 7439-95-4 | E421 | 0.005 | mg/L | <0.0050 | ---- |
| manganese, dissolved | 7439-96-5 | E421 | 0.0001 | mg/L | <0.00010 | ---- |
| molybdenum, dissolved | 7439-98-7 | E421 | 0.00005 | mg/L | <0.000050 | ---- |
| nickel, dissolved | 7440-02-0 | E421 | 0.0005 | mg/L | <0.00050 | ---- |
| phosphorus, dissolved | 7723-14-0 | E421 | 0.05 | mg/L | <0.050 | ---- |
| potassium, dissolved | 7440-09-7 | E421 | 0.05 | mg/L | <0.050 | ---- |
| rubidium, dissolved | 7440-17-7 | E421 | 0.0002 | mg/L | <0.00020 | ---- |
| selenium, dissolved | 7782-49-2 | E421 | 0.00005 | mg/L | <0.000050 | ---- |
| silicon, dissolved | 7440-21-3 | E421 | 0.05 | mg/L | <0.050 | ---- |
| silver, dissolved | 7440-22-4 | E421 | 0.00001 | mg/L | <0.000010 | ---- |
| sodium, dissolved | 7440-23-5 | E421 | 0.05 | mg/L | <0.050 | ---- |
| strontium, dissolved | 7440-24-6 | E421 | 0.0002 | mg/L | <0.00020 | ---- |
| sulfur, dissolved | 7704-34-9 | E421 | 0.5 | mg/L | <0.50 | ---- |
| tellurium, dissolved | 13494-80-9 | E421 | 0.0002 | mg/L | <0.00020 | ---- |
| thallium, dissolved | 7440-28-0 | E421 | 0.00001 | mg/L | <0.000010 | ---- |
| thorium, dissolved | 7440-29-1 | E421 | 0.0001 | mg/L | <0.00010 | ---- |
| tin, dissolved | 7440-31-5 | E421 | 0.0001 | mg/L | <0.00010 | ---- |
| titanium, dissolved | 7440-32-6 | E421 | 0.0003 | mg/L | <0.00030 | ---- |
| tungsten, dissolved | 7440-33-7 | E421 | 0.0001 | mg/L | <0.00010 | ---- |
| uranium, dissolved | 7440-61-1 | E421 | 0.00001 | mg/L | <0.000010 | ---- |
| vanadium, dissolved | 7440-62-2 | E421 | 0.0005 | mg/L | <0.00050 | ---- |
| zinc, dissolved | 7440-66-6 | E421 | 0.001 | mg/L | <0.0010 | ---- |
| zirconium, dissolved | 7440-67-7 | E421 | 0.0002 | mg/L | <0.00020 | ---- |
| **Aggregate Organics (QCLot: 460048)** | | | | | | |
| biochemical oxygen demand [BOD] | ---- | E550 | 2 | mg/L | <2.0 | ---- |

## Laboratory Control Sample (LCS) Report

A Laboratory Control Sample (LCS) is an analyte-free matrix that has been fortified (spiked) with test analytes at known concentration and processed in an identical manner to test samples. LCS results are expressed as percent recovery, and are used to monitor and control test method accuracy and precision, independent of test sample matrix.

Sub-Matrix: **Water**

| | | | | | Laboratory Control Sample (LCS) Report | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Spike | Recovery (%) | Recovery Limits (%) | | |
| Analyte | CAS Number | Method | LOR | Unit | Concentration | LCS | Low | High | Qualifier |
| **Physical Tests (QCLot: 461163)** | | | | | | | | | |
| pH | ---- | E108 | ---- | pH units | 7 pH units | 99.7 | 98.0 | 102 | ---- |
| **Physical Tests (QCLot: 461164)** | | | | | | | | | |
| conductivity | ---- | E100 | 1 | µS/cm | 146.9 µS/cm | 99.5 | 90.0 | 110 | ---- |
| **Anions and Nutrients (QCLot: 473787)** | | | | | | | | | |
| phosphorus, total | 7723-14-0 | E372-U | 0.002 | mg/L | 0.05 mg/L | 100 | 80.0 | 120 | ---- |
| **Anions and Nutrients (QCLot: 473788)** | | | | | | | | | |
| ammonia, total (as N) | 7664-41-7 | E298 | 0.005 | mg/L | 0.2 mg/L | 100 | 85.0 | 115 | ---- |
| **Anions and Nutrients (QCLot: 473791)** | | | | | | | | | |
| nitrogen, total | 7727-37-9 | E366 | 0.03 | mg/L | 0.5 mg/L | 103 | 75.0 | 125 | ---- |
| **Organic / Inorganic Carbon (QCLot: 473789)** | | | | | | | | | |
| carbon, dissolved organic [DOC] | ---- | E358-L | 0.5 | mg/L | 8.57 mg/L | 106 | 80.0 | 120 | ---- |
| **Total Metals (QCLot: 464705)** | | | | | | | | | |
| mercury, total | 7439-97-6 | E508 | 0.000005 | mg/L | 0.0001 mg/L | 97.4 | 80.0 | 120 | ---- |
| **Total Metals (QCLot: 472741)** | | | | | | | | | |
| aluminum, total | 7429-90-5 | E420 | 0.003 | mg/L | 2 mg/L | 102 | 80.0 | 120 | ---- |
| antimony, total | 7440-36-0 | E420 | 0.0001 | mg/L | 1 mg/L | 106 | 80.0 | 120 | ---- |
| arsenic, total | 7440-38-2 | E420 | 0.0001 | mg/L | 1 mg/L | 104 | 80.0 | 120 | ---- |
| barium, total | 7440-39-3 | E420 | 0.0001 | mg/L | 0.25 mg/L | 102 | 80.0 | 120 | ---- |
| beryllium, total | 7440-41-7 | E420 | 0.00002 | mg/L | 0.1 mg/L | 101 | 80.0 | 120 | ---- |
| bismuth, total | 7440-69-9 | E420 | 0.00005 | mg/L | 1 mg/L | 104 | 80.0 | 120 | ---- |
| boron, total | 7440-42-8 | E420 | 0.01 | mg/L | 1 mg/L | 100 | 80.0 | 120 | ---- |
| cadmium, total | 7440-43-9 | E420 | 0.000005 | mg/L | 0.1 mg/L | 98.5 | 80.0 | 120 | ---- |
| calcium, total | 7440-70-2 | E420 | 0.05 | mg/L | 50 mg/L | 103 | 80.0 | 120 | ---- |
| cesium, total | 7440-46-2 | E420 | 0.00001 | mg/L | 0.05 mg/L | 99.2 | 80.0 | 120 | ---- |
| chromium, total | 7440-47-3 | E420 | 0.0005 | mg/L | 0.25 mg/L | 98.1 | 80.0 | 120 | ---- |
| cobalt, total | 7440-48-4 | E420 | 0.0001 | mg/L | 0.25 mg/L | 99.4 | 80.0 | 120 | ---- |
| copper, total | 7440-50-8 | E420 | 0.0005 | mg/L | 0.25 mg/L | 100 | 80.0 | 120 | ---- |
| iron, total | 7439-89-6 | E420 | 0.01 | mg/L | 1 mg/L | 100 | 80.0 | 120 | ---- |
| lead, total | 7439-92-1 | E420 | 0.00005 | mg/L | 0.5 mg/L | 102 | 80.0 | 120 | ---- |
| lithium, total | 7439-93-2 | E420 | 0.001 | mg/L | 0.25 mg/L | 103 | 80.0 | 120 | ---- |
| magnesium, total | 7439-95-4 | E420 | 0.005 | mg/L | 50 mg/L | 107 | 80.0 | 120 | ---- |

Sub-Matrix: **Water**

| | | | | | Laboratory Control Sample (LCS) Report | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Spike | Recovery (%) | Recovery Limits (%) | | |
| Analyte | CAS Number | Method | LOR | Unit | Concentration | LCS | Low | High | Qualifier |
| **Total Metals (QCLot: 472741) - continued** | | | | | | | | | |
| manganese, total | 7439-96-5 | E420 | 0.0001 | mg/L | 0.25 mg/L | 103 | 80.0 | 120 | ---- |
| molybdenum, total | 7439-98-7 | E420 | 0.00005 | mg/L | 0.25 mg/L | 101 | 80.0 | 120 | ---- |
| nickel, total | 7440-02-0 | E420 | 0.0005 | mg/L | 0.5 mg/L | 99.4 | 80.0 | 120 | ---- |
| phosphorus, total | 7723-14-0 | E420 | 0.05 | mg/L | 10 mg/L | 101 | 80.0 | 120 | ---- |
| potassium, total | 7440-09-7 | E420 | 0.05 | mg/L | 50 mg/L | 104 | 80.0 | 120 | ---- |
| rubidium, total | 7440-17-7 | E420 | 0.0002 | mg/L | 0.1 mg/L | 104 | 80.0 | 120 | ---- |
| selenium, total | 7782-49-2 | E420 | 0.00005 | mg/L | 1 mg/L | 103 | 80.0 | 120 | ---- |
| silicon, total | 7440-21-3 | E420 | 0.1 | mg/L | 10 mg/L | 103 | 80.0 | 120 | ---- |
| silver, total | 7440-22-4 | E420 | 0.00001 | mg/L | 0.1 mg/L | 95.4 | 80.0 | 120 | ---- |
| sodium, total | 7440-23-5 | E420 | 0.05 | mg/L | 50 mg/L | 103 | 80.0 | 120 | ---- |
| strontium, total | 7440-24-6 | E420 | 0.0002 | mg/L | 0.25 mg/L | 100 | 80.0 | 120 | ---- |
| sulfur, total | 7704-34-9 | E420 | 0.5 | mg/L | 50 mg/L | 92.6 | 80.0 | 120 | ---- |
| tellurium, total | 13494-80-9 | E420 | 0.0002 | mg/L | 0.1 mg/L | 102 | 80.0 | 120 | ---- |
| thallium, total | 7440-28-0 | E420 | 0.00001 | mg/L | 1 mg/L | 106 | 80.0 | 120 | ---- |
| thorium, total | 7440-29-1 | E420 | 0.0001 | mg/L | 0.1 mg/L | 95.3 | 80.0 | 120 | ---- |
| tin, total | 7440-31-5 | E420 | 0.0001 | mg/L | 0.5 mg/L | 101 | 80.0 | 120 | ---- |
| titanium, total | 7440-32-6 | E420 | 0.0003 | mg/L | 0.25 mg/L | 99.9 | 80.0 | 120 | ---- |
| tungsten, total | 7440-33-7 | E420 | 0.0001 | mg/L | 0.1 mg/L | 105 | 80.0 | 120 | ---- |
| uranium, total | 7440-61-1 | E420 | 0.00001 | mg/L | 0.005 mg/L | 97.6 | 80.0 | 120 | ---- |
| vanadium, total | 7440-62-2 | E420 | 0.0005 | mg/L | 0.5 mg/L | 101 | 80.0 | 120 | ---- |
| zinc, total | 7440-66-6 | E420 | 0.003 | mg/L | 0.5 mg/L | 96.6 | 80.0 | 120 | ---- |
| zirconium, total | 7440-67-7 | E420 | 0.0002 | mg/L | 0.1 mg/L | 99.7 | 80.0 | 120 | ---- |
| mercury, dissolved | 7439-97-6 | E509 | 0.000005 | mg/L | 0.0001 mg/L | 105 | 80.0 | 120 | ---- |
| **Dissolved Metals (QCLot: 465554)** | | | | | | | | | |
| aluminum, dissolved | 7429-90-5 | E421 | 0.001 | mg/L | 2 mg/L | 105 | 80.0 | 120 | ---- |
| antimony, dissolved | 7440-36-0 | E421 | 0.0001 | mg/L | 1 mg/L | 101 | 80.0 | 120 | ---- |
| arsenic, dissolved | 7440-38-2 | E421 | 0.0001 | mg/L | 1 mg/L | 104 | 80.0 | 120 | ---- |
| barium, dissolved | 7440-39-3 | E421 | 0.0001 | mg/L | 0.25 mg/L | 102 | 80.0 | 120 | ---- |
| beryllium, dissolved | 7440-41-7 | E421 | 0.00002 | mg/L | 0.1 mg/L | 98.7 | 80.0 | 120 | ---- |
| bismuth, dissolved | 7440-69-9 | E421 | 0.00005 | mg/L | 1 mg/L | 95.1 | 80.0 | 120 | ---- |
| boron, dissolved | 7440-42-8 | E421 | 0.01 | mg/L | 1 mg/L | 94.1 | 80.0 | 120 | ---- |
| cadmium, dissolved | 7440-43-9 | E421 | 0.000005 | mg/L | 0.1 mg/L | 97.4 | 80.0 | 120 | ---- |
| calcium, dissolved | 7440-70-2 | E421 | 0.05 | mg/L | 50 mg/L | 99.9 | 80.0 | 120 | ---- |
| cesium, dissolved | 7440-46-2 | E421 | 0.00001 | mg/L | 0.05 mg/L | 96.8 | 80.0 | 120 | ---- |
| chromium, dissolved | 7440-47-3 | E421 | 0.0005 | mg/L | 0.25 mg/L | 101 | 80.0 | 120 | ---- |
| cobalt, dissolved | 7440-48-4 | E421 | 0.0001 | mg/L | 0.25 mg/L | 100 | 80.0 | 120 | ---- |
| copper, dissolved | 7440-50-8 | E421 | 0.0002 | mg/L | 0.25 mg/L | 99.8 | 80.0 | 120 | ---- |

Sub-Matrix: **Water**

| | | | | | Laboratory Control Sample (LCS) Report | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Spike | Recovery (%) | Recovery Limits (%) | | |
| Analyte | CAS Number | Method | LOR | Unit | Concentration | LCS | Low | High | Qualifier |
| **Dissolved Metals (QCLot: 465554) - continued** | | | | | | | | | |
| iron, dissolved | 7439-89-6 | E421 | 0.01 | mg/L | 1 mg/L | 101 | 80.0 | 120 | ---- |
| lead, dissolved | 7439-92-1 | E421 | 0.00005 | mg/L | 0.5 mg/L | 99.0 | 80.0 | 120 | ---- |
| lithium, dissolved | 7439-93-2 | E421 | 0.001 | mg/L | 0.25 mg/L | 99.1 | 80.0 | 120 | ---- |
| magnesium, dissolved | 7439-95-4 | E421 | 0.005 | mg/L | 50 mg/L | 100 | 80.0 | 120 | ---- |
| manganese, dissolved | 7439-96-5 | E421 | 0.0001 | mg/L | 0.25 mg/L | 100 | 80.0 | 120 | ---- |
| molybdenum, dissolved | 7439-98-7 | E421 | 0.00005 | mg/L | 0.25 mg/L | 99.1 | 80.0 | 120 | ---- |
| nickel, dissolved | 7440-02-0 | E421 | 0.0005 | mg/L | 0.5 mg/L | 99.9 | 80.0 | 120 | ---- |
| phosphorus, dissolved | 7723-14-0 | E421 | 0.05 | mg/L | 10 mg/L | 101 | 80.0 | 120 | ---- |
| potassium, dissolved | 7440-09-7 | E421 | 0.05 | mg/L | 50 mg/L | 105 | 80.0 | 120 | ---- |
| rubidium, dissolved | 7440-17-7 | E421 | 0.0002 | mg/L | 0.1 mg/L | 106 | 80.0 | 120 | ---- |
| selenium, dissolved | 7782-49-2 | E421 | 0.00005 | mg/L | 1 mg/L | 100 | 80.0 | 120 | ---- |
| silicon, dissolved | 7440-21-3 | E421 | 0.05 | mg/L | 10 mg/L | 104 | 80.0 | 120 | ---- |
| silver, dissolved | 7440-22-4 | E421 | 0.00001 | mg/L | 0.1 mg/L | 91.8 | 80.0 | 120 | ---- |
| sodium, dissolved | 7440-23-5 | E421 | 0.05 | mg/L | 50 mg/L | 101 | 80.0 | 120 | ---- |
| strontium, dissolved | 7440-24-6 | E421 | 0.0002 | mg/L | 0.25 mg/L | 104 | 80.0 | 120 | ---- |
| sulfur, dissolved | 7704-34-9 | E421 | 0.5 | mg/L | 50 mg/L | 102 | 80.0 | 120 | ---- |
| tellurium, dissolved | 13494-80-9 | E421 | 0.0002 | mg/L | 0.1 mg/L | 99.6 | 80.0 | 120 | ---- |
| thallium, dissolved | 7440-28-0 | E421 | 0.00001 | mg/L | 1 mg/L | 101 | 80.0 | 120 | ---- |
| thorium, dissolved | 7440-29-1 | E421 | 0.0001 | mg/L | 0.1 mg/L | 90.6 | 80.0 | 120 | ---- |
| tin, dissolved | 7440-31-5 | E421 | 0.0001 | mg/L | 0.5 mg/L | 97.0 | 80.0 | 120 | ---- |
| titanium, dissolved | 7440-32-6 | E421 | 0.0003 | mg/L | 0.25 mg/L | 99.2 | 80.0 | 120 | ---- |
| tungsten, dissolved | 7440-33-7 | E421 | 0.0001 | mg/L | 0.1 mg/L | 94.2 | 80.0 | 120 | ---- |
| uranium, dissolved | 7440-61-1 | E421 | 0.00001 | mg/L | 0.005 mg/L | 98.3 | 80.0 | 120 | ---- |
| vanadium, dissolved | 7440-62-2 | E421 | 0.0005 | mg/L | 0.5 mg/L | 103 | 80.0 | 120 | ---- |
| zinc, dissolved | 7440-66-6 | E421 | 0.001 | mg/L | 0.5 mg/L | 100.0 | 80.0 | 120 | ---- |
| zirconium, dissolved | 7440-67-7 | E421 | 0.0002 | mg/L | 0.1 mg/L | 95.8 | 80.0 | 120 | ---- |
| **Aggregate Organics (QCLot: 460048)** | | | | | | | | | |
| biochemical oxygen demand [BOD] | ---- | E550 | 2 | mg/L | 198 mg/L | 97.3 | 85.0 | 115 | ---- |

## Matrix Spike (MS) Report

A Matrix Spike (MS) is a randomly selected intra-laboratory replicate sample that has been fortified (spiked) with test analytes at known concentration, and processed in an identical manner to test samples. Matrix Spikes provide information regarding analyte recovery and potential matrix effects. MS DQO exceedances due to sample matrix may sometimes be unavoidable; in such cases, test results for the associated sample (or similar samples) may be subject to bias. ND – Recovery not determined, background level >= 1x spike level.

Sub-Matrix: **Water**

| | | | | | Matrix Spike (MS) Report | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Spike | | Recovery (%) | Recovery Limits (%) | | |
| Laboratory sample ID | Client sample ID | Analyte | CAS Number | Method | Concentration | Target | MS | Low | High | Qualifier |
| **Anions and Nutrients (QCLot: 473787)** | | | | | | | | | | |
| KS2201437-002 | Anonymous | phosphorus, total | 7723-14-0 | E372-U | 0.0490 mg/L | 0.05 mg/L | 98.0 | 70.0 | 130 | ---- |
| **Anions and Nutrients (QCLot: 473788)** | | | | | | | | | | |
| KS2201437-002 | Anonymous | ammonia, total (as N) | 7664-41-7 | E298 | 0.101 mg/L | 0.1 mg/L | 101 | 75.0 | 125 | ---- |
| **Anions and Nutrients (QCLot: 473791)** | | | | | | | | | | |
| VA22A8039-002 | Downstream | nitrogen, total | 7727-37-9 | E366 | 0.410 mg/L | 0.4 mg/L | 102 | 70.0 | 130 | ---- |
| **Organic / Inorganic Carbon (QCLot: 473789)** | | | | | | | | | | |
| FJ2201025-002 | Anonymous | carbon, dissolved organic [DOC] | ---- | E358-L | ND mg/L | 5 mg/L | ND | 70.0 | 130 | ---- |
| **Total Metals (QCLot: 464705)** | | | | | | | | | | |
| KS2201251-001 | Anonymous | mercury, total | 7439-97-6 | E508 | 0.0000940 mg/L | 0.0001 mg/L | 94.0 | 70.0 | 130 | ---- |
| **Total Metals (QCLot: 472741)** | | | | | | | | | | |
| VA22A8039-002 | Downstream | aluminum, total | 7429-90-5 | E420 | ND mg/L | 0.2 mg/L | ND | 70.0 | 130 | ---- |
| | | antimony, total | 7440-36-0 | E420 | 0.0203 mg/L | 0.02 mg/L | 102 | 70.0 | 130 | ---- |
| | | arsenic, total | 7440-38-2 | E420 | 0.0202 mg/L | 0.02 mg/L | 101 | 70.0 | 130 | ---- |
| | | barium, total | 7440-39-3 | E420 | ND mg/L | 0.02 mg/L | ND | 70.0 | 130 | ---- |
| | | beryllium, total | 7440-41-7 | E420 | 0.0395 mg/L | 0.04 mg/L | 98.8 | 70.0 | 130 | ---- |
| | | bismuth, total | 7440-69-9 | E420 | 0.00960 mg/L | 0.01 mg/L | 96.0 | 70.0 | 130 | ---- |
| | | boron, total | 7440-42-8 | E420 | 0.100 mg/L | 0.1 mg/L | 100 | 70.0 | 130 | ---- |
| | | cadmium, total | 7440-43-9 | E420 | 0.00410 mg/L | 0.004 mg/L | 102 | 70.0 | 130 | ---- |
| | | calcium, total | 7440-70-2 | E420 | ND mg/L | 4 mg/L | ND | 70.0 | 130 | ---- |
| | | cesium, total | 7440-46-2 | E420 | 0.01000 mg/L | 0.01 mg/L | 100.0 | 70.0 | 130 | ---- |
| | | chromium, total | 7440-47-3 | E420 | 0.0393 mg/L | 0.04 mg/L | 98.3 | 70.0 | 130 | ---- |
| | | cobalt, total | 7440-48-4 | E420 | 0.0196 mg/L | 0.02 mg/L | 98.0 | 70.0 | 130 | ---- |
| | | copper, total | 7440-50-8 | E420 | 0.0196 mg/L | 0.02 mg/L | 97.9 | 70.0 | 130 | ---- |
| | | iron, total | 7439-89-6 | E420 | 1.97 mg/L | 2 mg/L | 98.3 | 70.0 | 130 | ---- |
| | | lead, total | 7439-92-1 | E420 | 0.0196 mg/L | 0.02 mg/L | 97.9 | 70.0 | 130 | ---- |
| | | lithium, total | 7439-93-2 | E420 | 0.0967 mg/L | 0.1 mg/L | 96.7 | 70.0 | 130 | ---- |
| | | magnesium, total | 7439-95-4 | E420 | ND mg/L | 1 mg/L | ND | 70.0 | 130 | ---- |
| | | manganese, total | 7439-96-5 | E420 | ND mg/L | 0.02 mg/L | ND | 70.0 | 130 | ---- |
| | | molybdenum, total | 7439-98-7 | E420 | 0.0200 mg/L | 0.02 mg/L | 99.9 | 70.0 | 130 | ---- |
| | | nickel, total | 7440-02-0 | E420 | 0.0399 mg/L | 0.04 mg/L | 99.7 | 70.0 | 130 | ---- |

Sub-Matrix: **Water**

| | | | | | Matrix Spike (MS) Report | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Spike | | Recovery (%) | Recovery Limits (%) | | |
| Laboratory sample ID | Client sample ID | Analyte | CAS Number | Method | Concentration | Target | MS | Low | High | Qualifier |
| **Total Metals (QCLot: 472741) - continued** | | | | | | | | | | |
| VA22A8039-002 | Downstream | phosphorus, total | 7723-14-0 | E420 | 9.41 mg/L | 10 mg/L | 94.1 | 70.0 | 130 | ---- |
| | | potassium, total | 7440-09-7 | E420 | 3.86 mg/L | 4 mg/L | 96.5 | 70.0 | 130 | ---- |
| | | rubidium, total | 7440-17-7 | E420 | 0.0200 mg/L | 0.02 mg/L | 99.9 | 70.0 | 130 | ---- |
| | | selenium, total | 7782-49-2 | E420 | 0.0415 mg/L | 0.04 mg/L | 104 | 70.0 | 130 | ---- |
| | | silicon, total | 7440-21-3 | E420 | 9.50 mg/L | 10 mg/L | 95.0 | 70.0 | 130 | ---- |
| | | silver, total | 7440-22-4 | E420 | 0.00412 mg/L | 0.004 mg/L | 103 | 70.0 | 130 | ---- |
| | | sodium, total | 7440-23-5 | E420 | ND mg/L | 2 mg/L | ND | 70.0 | 130 | ---- |
| | | strontium, total | 7440-24-6 | E420 | ND mg/L | 0.02 mg/L | ND | 70.0 | 130 | ---- |
| | | sulfur, total | 7704-34-9 | E420 | 19.4 mg/L | 20 mg/L | 97.1 | 70.0 | 130 | ---- |
| | | tellurium, total | 13494-80-9 | E420 | 0.0414 mg/L | 0.04 mg/L | 103 | 70.0 | 130 | ---- |
| | | thallium, total | 7440-28-0 | E420 | 0.00383 mg/L | 0.004 mg/L | 95.7 | 70.0 | 130 | ---- |
| | | thorium, total | 7440-29-1 | E420 | 0.0182 mg/L | 0.02 mg/L | 90.8 | 70.0 | 130 | ---- |
| | | tin, total | 7440-31-5 | E420 | 0.0200 mg/L | 0.02 mg/L | 99.8 | 70.0 | 130 | ---- |
| | | titanium, total | 7440-32-6 | E420 | 0.0385 mg/L | 0.04 mg/L | 96.3 | 70.0 | 130 | ---- |
| | | tungsten, total | 7440-33-7 | E420 | 0.0203 mg/L | 0.02 mg/L | 102 | 70.0 | 130 | ---- |
| | | uranium, total | 7440-61-1 | E420 | 0.00383 mg/L | 0.004 mg/L | 95.7 | 70.0 | 130 | ---- |
| | | vanadium, total | 7440-62-2 | E420 | 0.0984 mg/L | 0.1 mg/L | 98.4 | 70.0 | 130 | ---- |
| | | zinc, total | 7440-66-6 | E420 | 0.390 mg/L | 0.4 mg/L | 97.6 | 70.0 | 130 | ---- |
| | | zirconium, total | 7440-67-7 | E420 | 0.0404 mg/L | 0.04 mg/L | 101 | 70.0 | 130 | ---- |
| **Dissolved Metals (QCLot: 461415)** | | | | | | | | | | |
| VA22A8037-021 | Anonymous | mercury, dissolved | 7439-97-6 | E509 | 0.000100 mg/L | 0.0001 mg/L | 100 | 70.0 | 130 | ---- |
| **Dissolved Metals (QCLot: 465554)** | | | | | | | | | | |
| VA22A7805-001 | Anonymous | aluminum, dissolved | 7429-90-5 | E421 | 0.193 mg/L | 0.2 mg/L | 96.7 | 70.0 | 130 | ---- |
| | | antimony, dissolved | 7440-36-0 | E421 | 0.0192 mg/L | 0.02 mg/L | 96.3 | 70.0 | 130 | ---- |
| | | arsenic, dissolved | 7440-38-2 | E421 | 0.0205 mg/L | 0.02 mg/L | 102 | 70.0 | 130 | ---- |
| | | barium, dissolved | 7440-39-3 | E421 | 0.0190 mg/L | 0.02 mg/L | 94.9 | 70.0 | 130 | ---- |
| | | beryllium, dissolved | 7440-41-7 | E421 | 0.0391 mg/L | 0.04 mg/L | 97.8 | 70.0 | 130 | ---- |
| | | bismuth, dissolved | 7440-69-9 | E421 | 0.00852 mg/L | 0.01 mg/L | 85.2 | 70.0 | 130 | ---- |
| | | boron, dissolved | 7440-42-8 | E421 | 0.094 mg/L | 0.1 mg/L | 94.0 | 70.0 | 130 | ---- |
| | | cadmium, dissolved | 7440-43-9 | E421 | 0.00396 mg/L | 0.004 mg/L | 99.0 | 70.0 | 130 | ---- |
| | | calcium, dissolved | 7440-70-2 | E421 | ND mg/L | 4 mg/L | ND | 70.0 | 130 | ---- |
| | | cesium, dissolved | 7440-46-2 | E421 | 0.00983 mg/L | 0.01 mg/L | 98.3 | 70.0 | 130 | ---- |
| | | chromium, dissolved | 7440-47-3 | E421 | 0.0389 mg/L | 0.04 mg/L | 97.2 | 70.0 | 130 | ---- |
| | | cobalt, dissolved | 7440-48-4 | E421 | 0.0194 mg/L | 0.02 mg/L | 96.8 | 70.0 | 130 | ---- |
| | | copper, dissolved | 7440-50-8 | E421 | 0.0187 mg/L | 0.02 mg/L | 93.5 | 70.0 | 130 | ---- |
| | | iron, dissolved | 7439-89-6 | E421 | 1.94 mg/L | 2 mg/L | 96.9 | 70.0 | 130 | ---- |

Sub-Matrix: **Water**

| | | | | | Matrix Spike (MS) Report | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Spike | | Recovery (%) | Recovery Limits (%) | | |
| Laboratory sample ID | Client sample ID | Analyte | CAS Number | Method | Concentration | Target | MS | Low | High | Qualifier |
| **Dissolved Metals (QCLot: 465554) - continued** | | | | | | | | | | |
| VA22A7805-001 | Anonymous | lead, dissolved | 7439-92-1 | E421 | 0.0192 mg/L | 0.02 mg/L | 96.3 | 70.0 | 130 | ---- |
| | | lithium, dissolved | 7439-93-2 | E421 | 0.0951 mg/L | 0.1 mg/L | 95.1 | 70.0 | 130 | ---- |
| | | magnesium, dissolved | 7439-95-4 | E421 | 0.916 mg/L | 1 mg/L | 91.6 | 70.0 | 130 | ---- |
| | | manganese, dissolved | 7439-96-5 | E421 | ND mg/L | 0.02 mg/L | ND | 70.0 | 130 | ---- |
| | | molybdenum, dissolved | 7439-98-7 | E421 | 0.0192 mg/L | 0.02 mg/L | 96.2 | 70.0 | 130 | ---- |
| | | nickel, dissolved | 7440-02-0 | E421 | 0.0390 mg/L | 0.04 mg/L | 97.5 | 70.0 | 130 | ---- |
| | | phosphorus, dissolved | 7723-14-0 | E421 | 10.1 mg/L | 10 mg/L | 101 | 70.0 | 130 | ---- |
| | | potassium, dissolved | 7440-09-7 | E421 | 4.08 mg/L | 4 mg/L | 102 | 70.0 | 130 | ---- |
| | | rubidium, dissolved | 7440-17-7 | E421 | 0.0201 mg/L | 0.02 mg/L | 101 | 70.0 | 130 | ---- |
| | | selenium, dissolved | 7782-49-2 | E421 | 0.0422 mg/L | 0.04 mg/L | 106 | 70.0 | 130 | ---- |
| | | silicon, dissolved | 7440-21-3 | E421 | 9.70 mg/L | 10 mg/L | 97.0 | 70.0 | 130 | ---- |
| | | silver, dissolved | 7440-22-4 | E421 | 0.00399 mg/L | 0.004 mg/L | 99.7 | 70.0 | 130 | ---- |
| | | sodium, dissolved | 7440-23-5 | E421 | 1.98 mg/L | 2 mg/L | 98.9 | 70.0 | 130 | ---- |
| | | strontium, dissolved | 7440-24-6 | E421 | ND mg/L | 0.02 mg/L | ND | 70.0 | 130 | ---- |
| | | sulfur, dissolved | 7704-34-9 | E421 | 20.4 mg/L | 20 mg/L | 102 | 70.0 | 130 | ---- |
| | | tellurium, dissolved | 13494-80-9 | E421 | 0.0412 mg/L | 0.04 mg/L | 103 | 70.0 | 130 | ---- |
| | | thallium, dissolved | 7440-28-0 | E421 | 0.00367 mg/L | 0.004 mg/L | 91.8 | 70.0 | 130 | ---- |
| | | thorium, dissolved | 7440-29-1 | E421 | 0.0192 mg/L | 0.02 mg/L | 96.3 | 70.0 | 130 | ---- |
| | | tin, dissolved | 7440-31-5 | E421 | 0.0188 mg/L | 0.02 mg/L | 93.8 | 70.0 | 130 | ---- |
| | | titanium, dissolved | 7440-32-6 | E421 | 0.0381 mg/L | 0.04 mg/L | 95.2 | 70.0 | 130 | ---- |
| | | tungsten, dissolved | 7440-33-7 | E421 | 0.0182 mg/L | 0.02 mg/L | 91.0 | 70.0 | 130 | ---- |
| | | uranium, dissolved | 7440-61-1 | E421 | 0.00381 mg/L | 0.004 mg/L | 95.2 | 70.0 | 130 | ---- |
| | | vanadium, dissolved | 7440-62-2 | E421 | 0.0980 mg/L | 0.1 mg/L | 98.0 | 70.0 | 130 | ---- |
| | | zinc, dissolved | 7440-66-6 | E421 | 0.405 mg/L | 0.4 mg/L | 101 | 70.0 | 130 | ---- |
| | | zirconium, dissolved | 7440-67-7 | E421 | 0.0390 mg/L | 0.04 mg/L | 97.5 | 70.0 | 130 | ---- |

# Chain of Custody (COC) / Analytical Request Form

ALS Environmental

www.alsglobal.com

Canada Toll Free: 1 800 668 9878

Affix ALS barcode label here (lab use only)

COC Number: 17 -

Page of

| Report To | Contact and company name below will appear on the final report |
|---|---|
| Company: | Regional District of Kitimat-Stikine |
| Contact: | Hannah Shinton |
| Phone: | 250-641-4141 |
| | Company address below will appear on the final report |
| Street: | 4545 Lazelle Avenue |
| City/Province: | Terrace/BC |
| Postal Code: | V8G4E1 |
| Invoice To | Same as Report To ☐ YES ☑ NO |
| | Copy of Invoice with Report ☑ YES ☐ NO |
| Company: | Regional District of Kitimat-Stikine |
| Contact: | Nicole Lavoie |

| Report Format / Distribution | |
|---|---|
| Select Report Format: | ☑ PDF ☑ EXCEL ☑ EDD (DIGITAL) |
| Quality Control (QC) Report with Report | ☑ YES ☐ NO |
| ☑ Compare Results to Criteria on Report - provide details below if box checked | |
| Select Distribution: | ☑ EMAIL ☐ MAIL ☐ FAX |
| Email 1 or Fax | hshinton@rdks.bc.ca; eblaney@rdks.bc.ca |
| Email 2 | nlavoie@rdks.bc.ca |
| Email 3 | |

| Invoice Distribution | |
|---|---|
| Select Invoice Distribution: | ☑ EMAIL ☐ MAIL ☐ FAX |
| Email 1 or Fax | anne-maries@rdks.bc.ca |
| Email 2 | nlavoie@rdks.bc.ca |

| Project Information | | Oil and Gas Required Fields (client use) | |
|---|---|---|---|
| ALS Account # / Quote #: | | AFE/Cost Center: | PO# |
| Job #: | Kitwanga Landfill Surface Water | Major/Minor Code: | Routing Code: |
| PO / AFE: | | Requisitioner: | |
| LSD: | | Location: | |

ALS Lab Work Order # (lab use only): A8039

ALS Contact:

Sampler: H. Shinton

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

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

PRIORITY (BUSINESS DAYS): 4 day [P4-20%] ☐ ; 3 day [P3-25%] ☐ ; 2 day [P2-50%] ☐

EMERGENCY: 1 Business day [E1 - 100%] ☐ ; Same Day, Weekend or Statutory holiday [E2 -200% (Laboratory opening fees may apply)] ☐

Date and Time Required for all E&P TATs:

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

Analysis Request

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

| ALS Sample # (lab use only) | Sample Identification and/or Coordinates (This description will appear on the report) | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | BOD (P) | Total Nitrogen (P) | Phosphorus (P) | Ammonia (P) | pH | Total Metals (P) | Dissolved Metals (F/P) | Conductivity | Dissolved Organic Carbon (F/P) | SAMPLES ON HOLD | Sample is hazardous (please provide further detail) | NUMBER OF CONTAINERS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Upstream | 13 APR 22 | 3:35 | Water | R | R | R | R | R | R | R | R | R | | | |
| | Downstream | 13 APR 22 | 5:22 | Water | R | R | R | R | R | R | R | R | R | | | |
| | Field Blank | 13 APR 22 | 6:20 | Water | R | R | R | R | R | R | R | R | | | | |
| | DUP | 13 APR 22 | 12:00 | Water | R | R | R | R | R | R | R | R | R | | | |
| | Travel blank | 13 APR 22 | — | Water | R | | | R | | R | R | | | | | |

Environmental Division
Vancouver
Work Order Reference
VA22A8039

Telephone : +1 604 253 4188

Terrace Shipping
# 1 Coolers
# ___ Carbouys
Ground ☐
Air ☑
SFX ☐

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

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

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

...ria to add on report by clicking on the drop-down list below (electronic COC only)

British Columbia Approved and Working Water Quality Guidelines (MAY, 2015)

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ SIF Observations Yes ☐ No ☐

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

Cooling Initiated ☐

| INITIAL COOLER TEMPERATURES °C | | | | FINAL COOLER TEMPERATURES °C | | | |
|---|---|---|---|---|---|---|---|
| 4.8 | 4.6 | | | 6°C | | | |

| SHIPMENT RELEASE (client use) | | | INITIAL SHIPMENT RECEPTION (lab use only) | | | FINAL SHIPMENT RECEPTION (lab use only) | | |
|---|---|---|---|---|---|---|---|---|
| Released by: Hannah Shinton | Date: 14-APR-22 | Time: | Received by: Chris | Date: 14 Apr 22 | Time: 1315 | Received by: | Date: Apr 14, 2022 | Time: 9:40 |

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

SEPT 2017 FRONT

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

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

ALS Environmental

# CERTIFICATE OF ANALYSIS

| | | | |
|---|---|---|---|
| **Work Order** | : **VA22C3658** | Page | : 1 of 6 |
| Client | : **Regional District of Kitimat-Stikine** | Laboratory | : Vancouver - Environmental |
| Contact | : Hannah Shinton | Account Manager | : Amber Springer |
| Address | : # 300 - 4545 Lazelle Avenue<br>Terrace BC Canada V8G 4E1 | Address | : 8081 Lougheed Highway<br>Burnaby BC Canada V5A 1W9 |
| Telephone | : ---- | Telephone | : +1 604 253 4188 |
| Project | : Kitwanga Landfill Surface Water | Date Samples Received | : 30-Sep-2022 11:55 |
| PO | : ---- | Date Analysis Commenced | : 30-Sep-2022 |
| C-O-C number | : ---- | Issue Date | : 07-Oct-2022 13:37 |
| Sampler | : HS | | |
| Site | : | | |
| Quote number | : Default Water Testing (Q62338) | | |
| No. of samples received | : 4 | | |
| No. of samples analysed | : 4 | | |

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QC Interpretive report to assist with Quality Review and Sample Receipt Notification (SRN).

## *Signatories*

This document has been electronically signed by the authorized signatories below. Electronic signing is conducted in accordance with US FDA 21 CFR Part 11.

| *Signatories* | *Position* | *Laboratory Department* |
|---|---|---|
| Angela Ren | Team Leader - Metals | Metals, Burnaby, British Columbia |
| Angelo Salandanan | Lab Assistant | Metals, Burnaby, British Columbia |
| Benjamin Oke | Lab Assistant | Metals, Burnaby, British Columbia |
| Qammar Almas | Lab Assistant | Metals, Burnaby, British Columbia |
| Tracy Harley | Supervisor - Water Quality Instrumentation | Inorganics, Burnaby, British Columbia |

## General Comments

The analytical methods used by ALS are developed using internationally recognized reference methods (where available), such as those published by US EPA, APHA Standard Methods, ASTM, ISO, Environment Canada, BC MOE, and Ontario MOE. Refer to the ALS Quality Control Interpretive report (QCI) for applicable references and methodology summaries. Reference methods may incorporate modifications to improve performance.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Please refer to Quality Control Interpretive report (QCI) for information regarding Holding Time compliance.

Key : CAS Number: Chemical Abstracts Services number is a unique identifier assigned to discrete substances
LOR: Limit of Reporting (detection limit).

| *Unit* | *Description* |
|---|---|
| - | No Unit |
| µS/cm | Microsiemens per centimetre |
| mg/L | milligrams per litre |
| pH units | pH units |

<: less than.

>: greater than.

Surrogate: An analyte that is similar in behavior to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED on SRN or QCI Report, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

## Qualifiers

| *Qualifier* | *Description* |
|---|---|
| *HTP* | *Sample preparation or preservation hold time was exceeded.* |
| *RRV* | *Reported result verified by repeat analysis.* |

## Analytical Results

Sub-Matrix: **Water**
(Matrix: **Water**)

| Analyte | CAS Number | Method | LOR | Unit | Client sample ID: Upstream | SW-21 | Further Upstream | Travel Blank | ---- |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Client sampling date / time: 27-Sep-2022 09:15 | 27-Sep-2022 12:00 | 27-Sep-2022 14:38 | 27-Sep-2022 | ---- |
| | | | | | VA22C3658-001 | VA22C3658-002 | VA22C3658-003 | VA22C3658-004 | -------- |
| | | | | | Result | Result | Result | Result | ---- |
| **Physical Tests** | | | | | | | | | |
| **conductivity** | ---- | E100 | 2.0 | µS/cm | 184 | 184 | 218 | ---- | ---- |
| **hardness (as CaCO3), dissolved** | ---- | EC100 | 0.60 | mg/L | 92.5 | 88.4 | 103 | ---- | ---- |
| **hardness (as CaCO3), from total Ca/Mg** | ---- | EC100A | 0.60 | mg/L | 90.6 | 90.8 | 106 | <0.60 | ---- |
| **pH** | ---- | E108 | 0.10 | pH units | 7.90 | 7.88 | 8.04 | ---- | ---- |
| **Anions and Nutrients** | | | | | | | | | |
| **ammonia, total (as N)** | 7664-41-7 | E298 | 0.0050 | mg/L | <0.0050 | <0.0050 | 0.109 | 0.0096 RRV | ---- |
| **nitrogen, total** | 7727-37-9 | E366 | 0.030 | mg/L | 0.236 | 0.224 | 0.523 | ---- | ---- |
| **phosphorus, total** | 7723-14-0 | E372-U | 0.0020 | mg/L | 0.0053 | 0.0051 | 0.0051 | ---- | ---- |
| **Organic / Inorganic Carbon** | | | | | | | | | |
| **carbon, dissolved organic [DOC]** | ---- | E358-L | 0.50 | mg/L | 7.31 | 7.61 HTP | 10.4 | ---- | ---- |
| **Total Metals** | | | | | | | | | |
| **aluminum, total** | 7429-90-5 | E420 | 0.0030 | mg/L | 0.0278 | 0.0248 | 0.0250 | <0.0030 | ---- |
| **antimony, total** | 7440-36-0 | E420 | 0.00010 | mg/L | <0.00010 | <0.00010 | <0.00010 | <0.00010 | ---- |
| **arsenic, total** | 7440-38-2 | E420 | 0.00010 | mg/L | 0.00026 | 0.00022 | 0.00092 | <0.00010 | ---- |
| **barium, total** | 7440-39-3 | E420 | 0.00010 | mg/L | 0.0468 | 0.0456 | 0.0582 | <0.00010 | ---- |
| **beryllium, total** | 7440-41-7 | E420 | 0.000100 | mg/L | <0.000100 | <0.000100 | <0.000100 | <0.000100 | ---- |
| **bismuth, total** | 7440-69-9 | E420 | 0.000050 | mg/L | <0.000050 | <0.000050 | <0.000050 | <0.000050 | ---- |
| **boron, total** | 7440-42-8 | E420 | 0.010 | mg/L | <0.010 | <0.010 | <0.010 | <0.010 | ---- |
| **cadmium, total** | 7440-43-9 | E420 | 0.0000050 | mg/L | 0.0000062 | 0.0000069 | <0.0000050 | <0.0000050 | ---- |
| **calcium, total** | 7440-70-2 | E420 | 0.050 | mg/L | 25.0 | 25.1 | 30.2 | <0.050 | ---- |
| **cesium, total** | 7440-46-2 | E420 | 0.000010 | mg/L | <0.000010 | <0.000010 | <0.000010 | <0.000010 | ---- |
| **chromium, total** | 7440-47-3 | E420 | 0.00050 | mg/L | <0.00050 | <0.00050 | <0.00050 | <0.00050 | ---- |
| **cobalt, total** | 7440-48-4 | E420 | 0.00010 | mg/L | <0.00010 | <0.00010 | 0.00047 | <0.00010 | ---- |
| **copper, total** | 7440-50-8 | E420 | 0.00050 | mg/L | 0.00116 | 0.00134 | <0.00050 | <0.00050 | ---- |
| **iron, total** | 7439-89-6 | E420 | 0.010 | mg/L | 0.026 | 0.025 | 0.752 | <0.010 | ---- |
| **lead, total** | 7439-92-1 | E420 | 0.000050 | mg/L | <0.000050 | <0.000050 | <0.000050 | <0.000050 | ---- |
| **lithium, total** | 7439-93-2 | E420 | 0.0010 | mg/L | <0.0010 | <0.0010 | <0.0010 | <0.0010 | ---- |
| **magnesium, total** | 7439-95-4 | E420 | 0.0050 | mg/L | 6.85 | 6.83 | 7.55 | <0.0050 | ---- |
| **manganese, total** | 7439-96-5 | E420 | 0.00010 | mg/L | 0.00672 | 0.00638 | 1.74 | <0.00010 | ---- |
| **mercury, total** | 7439-97-6 | E508 | 0.0000050 | mg/L | <0.0000050 | <0.0000050 | <0.0000050 | <0.0000050 | ---- |

## Analytical Results

Sub-Matrix: **Water**
(Matrix: **Water**)

| Analyte | CAS Number | Method | LOR | Unit | Client sample ID | Upstream | SW-21 | Further Upstream | Travel Blank | ---- |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Client sampling date / time | 27-Sep-2022 09:15 | 27-Sep-2022 12:00 | 27-Sep-2022 14:38 | 27-Sep-2022 | ---- |
| | | | | | | VA22C3658-001 | VA22C3658-002 | VA22C3658-003 | VA22C3658-004 | -------- |
| | | | | | | Result | Result | Result | Result | ---- |
| **Total Metals** | | | | | | | | | | |
| **molybdenum, total** | 7439-98-7 | E420 | 0.000050 | mg/L | | 0.000106 | 0.000105 | 0.000276 | <0.000050 | ---- |
| **nickel, total** | 7440-02-0 | E420 | 0.00050 | mg/L | | 0.00076 | 0.00082 | 0.00128 | <0.00050 | ---- |
| **phosphorus, total** | 7723-14-0 | E420 | 0.050 | mg/L | | <0.050 | <0.050 | <0.050 | <0.050 | ---- |
| **potassium, total** | 7440-09-7 | E420 | 0.050 | mg/L | | 0.711 | 0.688 | 1.03 | <0.050 | ---- |
| **rubidium, total** | 7440-17-7 | E420 | 0.00020 | mg/L | | <0.00020 | <0.00020 | 0.00048 | <0.00020 | ---- |
| **selenium, total** | 7782-49-2 | E420 | 0.000050 | mg/L | | 0.000077 | 0.000085 | 0.000083 | <0.000050 | ---- |
| **silicon, total** | 7440-21-3 | E420 | 0.10 | mg/L | | 3.42 | 3.52 | 4.44 | <0.10 | ---- |
| **silver, total** | 7440-22-4 | E420 | 0.000010 | mg/L | | <0.000010 | <0.000010 | <0.000010 | <0.000010 | ---- |
| **sodium, total** | 7440-23-5 | E420 | 0.050 | mg/L | | 7.40 | 7.35 | 9.16 | <0.050 | ---- |
| **strontium, total** | 7440-24-6 | E420 | 0.00020 | mg/L | | 0.256 | 0.250 | 0.306 | <0.00020 | ---- |
| **sulfur, total** | 7704-34-9 | E420 | 0.50 | mg/L | | <0.50 | <0.50 | <0.50 | <0.50 | ---- |
| **tellurium, total** | 13494-80-9 | E420 | 0.00020 | mg/L | | <0.00020 | <0.00020 | <0.00020 | <0.00020 | ---- |
| **thallium, total** | 7440-28-0 | E420 | 0.000010 | mg/L | | <0.000010 | <0.000010 | <0.000010 | <0.000010 | ---- |
| **thorium, total** | 7440-29-1 | E420 | 0.00010 | mg/L | | <0.00010 | <0.00010 | <0.00010 | <0.00010 | ---- |
| **tin, total** | 7440-31-5 | E420 | 0.00010 | mg/L | | <0.00010 | <0.00010 | <0.00010 | <0.00010 | ---- |
| **titanium, total** | 7440-32-6 | E420 | 0.00030 | mg/L | | 0.00034 | 0.00041 | 0.00040 | <0.00030 | ---- |
| **tungsten, total** | 7440-33-7 | E420 | 0.00010 | mg/L | | <0.00010 | <0.00010 | <0.00010 | <0.00010 | ---- |
| **uranium, total** | 7440-61-1 | E420 | 0.000010 | mg/L | | <0.000010 | <0.000010 | <0.000010 | <0.000010 | ---- |
| **vanadium, total** | 7440-62-2 | E420 | 0.00050 | mg/L | | <0.00050 | <0.00050 | <0.00050 | <0.00050 | ---- |
| **zinc, total** | 7440-66-6 | E420 | 0.0030 | mg/L | | <0.0030 | <0.0030 | <0.0030 | <0.0030 | ---- |
| **zirconium, total** | 7440-67-7 | E420 | 0.00020 | mg/L | | <0.00020 | <0.00020 | <0.00020 | <0.00020 | ---- |
| **Dissolved Metals** | | | | | | | | | | |
| **aluminum, dissolved** | 7429-90-5 | E421 | 0.0010 | mg/L | | 0.0117 | 0.0106 | 0.0070 | ---- | ---- |
| **antimony, dissolved** | 7440-36-0 | E421 | 0.00010 | mg/L | | <0.00010 | <0.00010 | <0.00010 | ---- | ---- |
| **arsenic, dissolved** | 7440-38-2 | E421 | 0.00010 | mg/L | | 0.00026 | 0.00024 | 0.00086 | ---- | ---- |
| **barium, dissolved** | 7440-39-3 | E421 | 0.00010 | mg/L | | 0.0461 | 0.0449 | 0.0553 | ---- | ---- |
| **beryllium, dissolved** | 7440-41-7 | E421 | 0.000100 | mg/L | | <0.000100 | <0.000100 | <0.000100 | ---- | ---- |
| **bismuth, dissolved** | 7440-69-9 | E421 | 0.000050 | mg/L | | <0.000050 | <0.000050 | <0.000050 | ---- | ---- |
| **boron, dissolved** | 7440-42-8 | E421 | 0.010 | mg/L | | <0.010 | <0.010 | <0.010 | ---- | ---- |
| **cadmium, dissolved** | 7440-43-9 | E421 | 0.0000050 | mg/L | | 0.0000052 | <0.0000050 | <0.0000050 | ---- | ---- |
| **calcium, dissolved** | 7440-70-2 | E421 | 0.050 | mg/L | | 26.2 | 24.5 | 29.8 | ---- | ---- |

## Analytical Results

| Sub-Matrix: Water (Matrix: Water) | | | | | Client sample ID | Upstream | SW-21 | Further Upstream | Travel Blank | ---- |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Client sampling date / time | 27-Sep-2022 09:15 | 27-Sep-2022 12:00 | 27-Sep-2022 14:38 | 27-Sep-2022 | ---- |
| Analyte | CAS Number | Method | LOR | Unit | | VA22C3658-001 | VA22C3658-002 | VA22C3658-003 | VA22C3658-004 | -------- |
| | | | | | | Result | Result | Result | Result | ---- |
| **Dissolved Metals** | | | | | | | | | | |
| cesium, dissolved | 7440-46-2 | E421 | 0.000010 | mg/L | | <0.000010 | <0.000010 | <0.000010 | ---- | ---- |
| chromium, dissolved | 7440-47-3 | E421 | 0.00050 | mg/L | | <0.00050 | <0.00050 | <0.00050 | ---- | ---- |
| cobalt, dissolved | 7440-48-4 | E421 | 0.00010 | mg/L | | <0.00010 | <0.00010 | 0.00041 | ---- | ---- |
| copper, dissolved | 7440-50-8 | E421 | 0.00020 | mg/L | | 0.00103 | 0.00110 | 0.00023 | ---- | ---- |
| iron, dissolved | 7439-89-6 | E421 | 0.010 | mg/L | | 0.010 | 0.010 | 0.546 | ---- | ---- |
| lead, dissolved | 7439-92-1 | E421 | 0.000050 | mg/L | | <0.000050 | <0.000050 | <0.000050 | ---- | ---- |
| lithium, dissolved | 7439-93-2 | E421 | 0.0010 | mg/L | | <0.0010 | <0.0010 | <0.0010 | ---- | ---- |
| magnesium, dissolved | 7439-95-4 | E421 | 0.0050 | mg/L | | 6.58 | 6.62 | 6.96 | ---- | ---- |
| manganese, dissolved | 7439-96-5 | E421 | 0.00010 | mg/L | | 0.00434 | 0.00434 | 1.36 | ---- | ---- |
| mercury, dissolved | 7439-97-6 | E509 | 0.0000050 | mg/L | | <0.0000050 | <0.0000050 | <0.0000050 | ---- | ---- |
| molybdenum, dissolved | 7439-98-7 | E421 | 0.000050 | mg/L | | 0.000092 | 0.000094 | 0.000272 | ---- | ---- |
| nickel, dissolved | 7440-02-0 | E421 | 0.00050 | mg/L | | 0.00074 | 0.00076 | 0.00080 | ---- | ---- |
| phosphorus, dissolved | 7723-14-0 | E421 | 0.050 | mg/L | | <0.050 | <0.050 | <0.050 | ---- | ---- |
| potassium, dissolved | 7440-09-7 | E421 | 0.050 | mg/L | | 0.679 | 0.686 | 1.03 | ---- | ---- |
| rubidium, dissolved | 7440-17-7 | E421 | 0.00020 | mg/L | | <0.00020 | <0.00020 | 0.00054 | ---- | ---- |
| selenium, dissolved | 7782-49-2 | E421 | 0.000050 | mg/L | | 0.000056 | 0.000053 | <0.000050 | ---- | ---- |
| silicon, dissolved | 7440-21-3 | E421 | 0.050 | mg/L | | 3.31 | 3.42 | 4.40 | ---- | ---- |
| silver, dissolved | 7440-22-4 | E421 | 0.000010 | mg/L | | <0.000010 | <0.000010 | <0.000010 | ---- | ---- |
| sodium, dissolved | 7440-23-5 | E421 | 0.050 | mg/L | | 7.10 | 7.08 | 8.53 | ---- | ---- |
| strontium, dissolved | 7440-24-6 | E421 | 0.00020 | mg/L | | 0.244 | 0.243 | 0.298 | ---- | ---- |
| sulfur, dissolved | 7704-34-9 | E421 | 0.50 | mg/L | | <0.50 | <0.50 | <0.50 | ---- | ---- |
| tellurium, dissolved | 13494-80-9 | E421 | 0.00020 | mg/L | | <0.00020 | <0.00020 | <0.00020 | ---- | ---- |
| thallium, dissolved | 7440-28-0 | E421 | 0.000010 | mg/L | | <0.000010 | <0.000010 | <0.000010 | ---- | ---- |
| thorium, dissolved | 7440-29-1 | E421 | 0.00010 | mg/L | | <0.00010 | <0.00010 | <0.00010 | ---- | ---- |
| tin, dissolved | 7440-31-5 | E421 | 0.00010 | mg/L | | <0.00010 | <0.00010 | <0.00010 | ---- | ---- |
| titanium, dissolved | 7440-32-6 | E421 | 0.00030 | mg/L | | <0.00030 | <0.00030 | <0.00030 | ---- | ---- |
| tungsten, dissolved | 7440-33-7 | E421 | 0.00010 | mg/L | | <0.00010 | <0.00010 | <0.00010 | ---- | ---- |
| uranium, dissolved | 7440-61-1 | E421 | 0.000010 | mg/L | | <0.000010 | <0.000010 | <0.000010 | ---- | ---- |
| vanadium, dissolved | 7440-62-2 | E421 | 0.00050 | mg/L | | <0.00050 | <0.00050 | <0.00050 | ---- | ---- |
| zinc, dissolved | 7440-66-6 | E421 | 0.0010 | mg/L | | 0.0040 | <0.0010 | <0.0010 | ---- | ---- |
| zirconium, dissolved | 7440-67-7 | E421 | 0.00020 | mg/L | | <0.00020 | <0.00020 | <0.00020 | ---- | ---- |

## Analytical Results

| Sub-Matrix: Water (Matrix: Water) | | | | | Client sample ID | Upstream | SW-21 | Further Upstream | Travel Blank | ---- |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Client sampling date / time | 27-Sep-2022 09:15 | 27-Sep-2022 12:00 | 27-Sep-2022 14:38 | 27-Sep-2022 | ---- |
| Analyte | CAS Number | Method | LOR | Unit | | VA22C3658-001 | VA22C3658-002 | VA22C3658-003 | VA22C3658-004 | -------- |
| | | | | | | Result | Result | Result | Result | ---- |
| **Dissolved Metals** | | | | | | | | | | |
| **dissolved mercury filtration location** | ---- | EP509 | - | - | | Field | Field | Field | ---- | ---- |
| **dissolved metals filtration location** | ---- | EP421 | - | - | | Field | Field | Field | ---- | ---- |
| **Aggregate Organics** | | | | | | | | | | |
| **biochemical oxygen demand [BOD]** | ---- | E550 | 2.0 | mg/L | | <2.0 | <2.0 | <2.0 | <2.0 | ---- |

Please refer to the General Comments section for an explanation of any qualifiers detected.

# QUALITY CONTROL INTERPRETIVE REPORT

| | | | |
|---|---|---|---|
| **Work Order** | : **VA22C3658** | Page | : 1 of 12 |
| Client | : **Regional District of Kitimat-Stikine** | Laboratory | : Vancouver - Environmental |
| Contact | : Hannah Shinton | Account Manager | : Amber Springer |
| Address | : # 300 - 4545 Lazelle Avenue<br>Terrace BC Canada V8G 4E1 | Address | : 8081 Lougheed Highway<br>Burnaby, British Columbia Canada V5A 1W9 |
| Telephone | : ---- | Telephone | : +1 604 253 4188 |
| Project | : Kitwanga Landfill Surface Water | Date Samples Received | : 30-Sep-2022 11:55 |
| PO | : ---- | Issue Date | : 07-Oct-2022 13:37 |
| C-O-C number | : ---- | | |
| Sampler | : HS | | |
| Site | : | | |
| Quote number | : Default Water Testing (Q62338) | | |
| No. of samples received | : 4 | | |
| No. of samples analysed | : 4 | | |

**This report is automatically generated by the ALS LIMS (Laboratory Information Management System) through evaluation of Quality Control (QC) results and other QA parameters associated with this submission, and is intended to facilitate rapid data validation by auditors or reviewers. The report highlights any exceptions and outliers to ALS Data Quality Objectives, provides holding time details and exceptions, summarizes QC sample frequencies, and lists applicable methodology references and summaries.**

**Key**

**Anonymous: Refers to samples which are not part of this work order, but which formed part of the QC process lot.**
**CAS Number: Chemical Abstracts Service number is a unique identifier assigned to discrete substances.**
**DQO: Data Quality Objective.**
**LOR: Limit of Reporting (detection limit).**
**RPD: Relative Percent Difference.**

## Workorder Comments

Holding times are displayed as "---" if no guidance exists from CCME, Canadian provinces, or broadly recognized international references.

## Summary of Outliers

### Outliers : Quality Control Samples

- No Method Blank value outliers occur.
- No Duplicate outliers occur.
- No Laboratory Control Sample (LCS) outliers occur
- No Matrix Spike outliers occur.
- No Test sample Surrogate recovery outliers exist.

### Outliers: Reference Material (RM) Samples

- No Reference Material (RM) Sample outliers occur.

### Outliers : Analysis Holding Time Compliance (Breaches)

- Analysis Holding Time Outliers exist - please see following pages for full details.

### Outliers : Frequency of Quality Control Samples

- No Quality Control Sample Frequency Outliers occur.

## Analysis Holding Time Compliance

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times, which are selected to meet known provincial and /or federal requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by organizations such as CCME, US EPA, APHA Standard Methods, ASTM, or Environment Canada (where available). Dates and holding times reported below represent the first dates of extraction or analysis. If subsequent tests or dilutions exceeded holding times, qualifiers are added (refer to COA).

If samples are identified below as having been analyzed or extracted outside of recommended holding times, measurement uncertainties may be increased, and this should be taken into consideration when interpreting results.

Where actual sampling date is not provided on the chain of custody, the date of receipt with time at 00:00 is used for calculation purposes.

Where only the sample date without time is provided on the chain of custody, the sampling date at 00:00 is used for calculation purposes.

Matrix: **Water**

Evaluation: × = Holding time exceedance ; ✓ = Within Holding Time

| Analyte Group / Container / Client Sample ID(s) | Method | Sampling Date | Extraction / Preparation | | | | Analysis | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Preparation Date | Holding Times Rec | Holding Times Actual | Eval | Analysis Date | Holding Times Rec | Holding Times Actual | Eval |
| **Aggregate Organics : Biochemical Oxygen Demand - 5 day** | | | | | | | | | | |
| **HDPE [BOD HT 3d]** Further Upstream | E550 | 27-Sep-2022 | ---- | ---- | ---- | | 30-Sep-2022 | 3 days | 3 days | ✓ |
| **Aggregate Organics : Biochemical Oxygen Demand - 5 day** | | | | | | | | | | |
| **HDPE [BOD HT 3d]** SW-21 | E550 | 27-Sep-2022 | ---- | ---- | ---- | | 30-Sep-2022 | 3 days | 3 days | ✓ |
| **Aggregate Organics : Biochemical Oxygen Demand - 5 day** | | | | | | | | | | |
| **HDPE [BOD HT 3d]** Travel Blank | E550 | 27-Sep-2022 | ---- | ---- | ---- | | 30-Sep-2022 | 3 days | 3 days | ✓ |
| **Aggregate Organics : Biochemical Oxygen Demand - 5 day** | | | | | | | | | | |
| **HDPE [BOD HT 3d]** Upstream | E550 | 27-Sep-2022 | ---- | ---- | ---- | | 30-Sep-2022 | 3 days | 3 days | ✓ |
| **Anions and Nutrients : Ammonia by Fluorescence** | | | | | | | | | | |
| **Amber glass total (sulfuric acid)** Further Upstream | E298 | 27-Sep-2022 | 04-Oct-2022 | ---- | ---- | | 05-Oct-2022 | 28 days | 8 days | ✓ |
| **Anions and Nutrients : Ammonia by Fluorescence** | | | | | | | | | | |
| **Amber glass total (sulfuric acid)** SW-21 | E298 | 27-Sep-2022 | 04-Oct-2022 | ---- | ---- | | 05-Oct-2022 | 28 days | 8 days | ✓ |
| **Anions and Nutrients : Ammonia by Fluorescence** | | | | | | | | | | |
| **Amber glass total (sulfuric acid)** Travel Blank | E298 | 27-Sep-2022 | 04-Oct-2022 | ---- | ---- | | 05-Oct-2022 | 28 days | 8 days | ✓ |

Matrix: **Water**

Evaluation: × = Holding time exceedance ; ✓ = Within Holding Time

| Analyte Group / Container / Client Sample ID(s) | Method | Sampling Date | Extraction / Preparation | | | | Analysis | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Preparation Date | Holding Times Rec | Holding Times Actual | Eval | Analysis Date | Holding Times Rec | Holding Times Actual | Eval |
| **Anions and Nutrients : Ammonia by Fluorescence** | | | | | | | | | | |
| **Amber glass total (sulfuric acid)** | | | | | | | | | | |
| Upstream | E298 | 27-Sep-2022 | 04-Oct-2022 | ---- | ---- | | 05-Oct-2022 | 28 days | 8 days | ✓ |
| **Anions and Nutrients : Total Nitrogen by Colourimetry** | | | | | | | | | | |
| **Amber glass total (sulfuric acid)** | | | | | | | | | | |
| Further Upstream | E366 | 27-Sep-2022 | 04-Oct-2022 | ---- | ---- | | 05-Oct-2022 | 28 days | 8 days | ✓ |
| **Anions and Nutrients : Total Nitrogen by Colourimetry** | | | | | | | | | | |
| **Amber glass total (sulfuric acid)** | | | | | | | | | | |
| SW-21 | E366 | 27-Sep-2022 | 04-Oct-2022 | ---- | ---- | | 05-Oct-2022 | 28 days | 8 days | ✓ |
| **Anions and Nutrients : Total Nitrogen by Colourimetry** | | | | | | | | | | |
| **Amber glass total (sulfuric acid)** | | | | | | | | | | |
| Upstream | E366 | 27-Sep-2022 | 04-Oct-2022 | ---- | ---- | | 05-Oct-2022 | 28 days | 8 days | ✓ |
| **Anions and Nutrients : Total Phosphorus by Colourimetry (0.002 mg/L)** | | | | | | | | | | |
| **Amber glass total (sulfuric acid)** | | | | | | | | | | |
| Further Upstream | E372-U | 27-Sep-2022 | 04-Oct-2022 | ---- | ---- | | 05-Oct-2022 | 28 days | 8 days | ✓ |
| **Anions and Nutrients : Total Phosphorus by Colourimetry (0.002 mg/L)** | | | | | | | | | | |
| **Amber glass total (sulfuric acid)** | | | | | | | | | | |
| SW-21 | E372-U | 27-Sep-2022 | 04-Oct-2022 | ---- | ---- | | 05-Oct-2022 | 28 days | 8 days | ✓ |
| **Anions and Nutrients : Total Phosphorus by Colourimetry (0.002 mg/L)** | | | | | | | | | | |
| **Amber glass total (sulfuric acid)** | | | | | | | | | | |
| Upstream | E372-U | 27-Sep-2022 | 04-Oct-2022 | ---- | ---- | | 05-Oct-2022 | 28 days | 8 days | ✓ |
| **Dissolved Metals : Dissolved Mercury in Water by CVAAS** | | | | | | | | | | |
| **Glass vial dissolved (hydrochloric acid)** | | | | | | | | | | |
| Further Upstream | E509 | 27-Sep-2022 | 03-Oct-2022 | ---- | ---- | | 03-Oct-2022 | 28 days | 6 days | ✓ |
| **Dissolved Metals : Dissolved Mercury in Water by CVAAS** | | | | | | | | | | |
| **Glass vial dissolved (hydrochloric acid)** | | | | | | | | | | |
| SW-21 | E509 | 27-Sep-2022 | 03-Oct-2022 | ---- | ---- | | 03-Oct-2022 | 28 days | 6 days | ✓ |

Matrix: **Water**

Evaluation: × = Holding time exceedance ; ✓ = Within Holding Time

| Analyte Group / Container / Client Sample ID(s) | Method | Sampling Date | Extraction / Preparation | | | | Analysis | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Preparation Date | Holding Times Rec | Holding Times Actual | Eval | Analysis Date | Holding Times Rec | Holding Times Actual | Eval |
| **Dissolved Metals : Dissolved Mercury in Water by CVAAS** | | | | | | | | | | |
| **Glass vial dissolved (hydrochloric acid)** Upstream | E509 | 27-Sep-2022 | 03-Oct-2022 | ---- | ---- | | 03-Oct-2022 | 28 days | 6 days | ✓ |
| **Dissolved Metals : Dissolved Metals in Water by CRC ICPMS** | | | | | | | | | | |
| **HDPE dissolved (nitric acid)** Further Upstream | E421 | 27-Sep-2022 | 04-Oct-2022 | ---- | ---- | | 04-Oct-2022 | 180 days | 7 days | ✓ |
| **Dissolved Metals : Dissolved Metals in Water by CRC ICPMS** | | | | | | | | | | |
| **HDPE dissolved (nitric acid)** SW-21 | E421 | 27-Sep-2022 | 04-Oct-2022 | ---- | ---- | | 04-Oct-2022 | 180 days | 7 days | ✓ |
| **Dissolved Metals : Dissolved Metals in Water by CRC ICPMS** | | | | | | | | | | |
| **HDPE dissolved (nitric acid)** Upstream | E421 | 27-Sep-2022 | 04-Oct-2022 | ---- | ---- | | 04-Oct-2022 | 180 days | 7 days | ✓ |
| **Organic / Inorganic Carbon : Dissolved Organic Carbon by Combustion (Low Level)** | | | | | | | | | | |
| **Amber glass dissolved (sulfuric acid)** Further Upstream | E358-L | 27-Sep-2022 | 04-Oct-2022 | ---- | ---- | | 04-Oct-2022 | 28 days | 7 days | ✓ |
| **Organic / Inorganic Carbon : Dissolved Organic Carbon by Combustion (Low Level)** | | | | | | | | | | |
| **Amber glass dissolved (sulfuric acid)** SW-21 | E358-L | 27-Sep-2022 | 04-Oct-2022 | ---- | ---- | | 04-Oct-2022 | 28 days | 7 days | ✓ |
| **Organic / Inorganic Carbon : Dissolved Organic Carbon by Combustion (Low Level)** | | | | | | | | | | |
| **Amber glass dissolved (sulfuric acid)** Upstream | E358-L | 27-Sep-2022 | 04-Oct-2022 | ---- | ---- | | 04-Oct-2022 | 28 days | 7 days | ✓ |
| **Physical Tests : Conductivity in Water** | | | | | | | | | | |
| **HDPE** Further Upstream | E100 | 27-Sep-2022 | 04-Oct-2022 | ---- | ---- | | 05-Oct-2022 | 28 days | 8 days | ✓ |
| **Physical Tests : Conductivity in Water** | | | | | | | | | | |
| **HDPE** SW-21 | E100 | 27-Sep-2022 | 04-Oct-2022 | ---- | ---- | | 05-Oct-2022 | 28 days | 8 days | ✓ |

Matrix: **Water**

Evaluation: × = Holding time exceedance ; ✓ = Within Holding Time

| Analyte Group / Container / Client Sample ID(s) | Method | Sampling Date | Extraction / Preparation | | | | Analysis | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Preparation Date | Holding Times Rec | Holding Times Actual | Eval | Analysis Date | Holding Times Rec | Holding Times Actual | Eval |
| **Physical Tests : Conductivity in Water** | | | | | | | | | | |
| **HDPE** Upstream | E100 | 27-Sep-2022 | 04-Oct-2022 | ---- | ---- | | 05-Oct-2022 | 28 days | 8 days | ✓ |
| **Physical Tests : pH by Meter** | | | | | | | | | | |
| **HDPE** Further Upstream | E108 | 27-Sep-2022 | 04-Oct-2022 | ---- | ---- | | 05-Oct-2022 | 0.25 hrs | 18.25 hrs | × EHTR-FM |
| **Physical Tests : pH by Meter** | | | | | | | | | | |
| **HDPE** SW-21 | E108 | 27-Sep-2022 | 04-Oct-2022 | ---- | ---- | | 05-Oct-2022 | 0.25 hrs | 18.25 hrs | × EHTR-FM |
| **Physical Tests : pH by Meter** | | | | | | | | | | |
| **HDPE** Upstream | E108 | 27-Sep-2022 | 04-Oct-2022 | ---- | ---- | | 05-Oct-2022 | 0.25 hrs | 18.25 hrs | × EHTR-FM |
| **Total Metals : Total Mercury in Water by CVAAS** | | | | | | | | | | |
| **Glass vial total (hydrochloric acid)** Further Upstream | E508 | 27-Sep-2022 | 04-Oct-2022 | ---- | ---- | | 04-Oct-2022 | 28 days | 7 days | ✓ |
| **Total Metals : Total Mercury in Water by CVAAS** | | | | | | | | | | |
| **Glass vial total (hydrochloric acid)** SW-21 | E508 | 27-Sep-2022 | 04-Oct-2022 | ---- | ---- | | 04-Oct-2022 | 28 days | 7 days | ✓ |
| **Total Metals : Total Mercury in Water by CVAAS** | | | | | | | | | | |
| **Glass vial total (hydrochloric acid)** Travel Blank | E508 | 27-Sep-2022 | 04-Oct-2022 | ---- | ---- | | 04-Oct-2022 | 28 days | 7 days | ✓ |
| **Total Metals : Total Mercury in Water by CVAAS** | | | | | | | | | | |
| **Glass vial total (hydrochloric acid)** Upstream | E508 | 27-Sep-2022 | 04-Oct-2022 | ---- | ---- | | 04-Oct-2022 | 28 days | 7 days | ✓ |
| **Total Metals : Total metals in Water by CRC ICPMS** | | | | | | | | | | |
| **HDPE total (nitric acid)** Further Upstream | E420 | 27-Sep-2022 | 03-Oct-2022 | ---- | ---- | | 04-Oct-2022 | 180 days | 6 days | ✓ |

Matrix: **Water**

Evaluation: × = Holding time exceedance ; ✓ = Within Holding Time

| Analyte Group / Container / Client Sample ID(s) | Method | Sampling Date | Extraction / Preparation | | | | Analysis | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Preparation Date | Holding Times Rec | Holding Times Actual | Eval | Analysis Date | Holding Times Rec | Holding Times Actual | Eval |
| **Total Metals : Total metals in Water by CRC ICPMS** | | | | | | | | | | |
| **HDPE total (nitric acid)** | | | | | | | | | | |
| SW-21 | E420 | 27-Sep-2022 | 03-Oct-2022 | ---- | ---- | | 04-Oct-2022 | 180 days | 6 days | ✓ |
| **Total Metals : Total metals in Water by CRC ICPMS** | | | | | | | | | | |
| **HDPE total (nitric acid)** | | | | | | | | | | |
| Travel Blank | E420 | 27-Sep-2022 | 03-Oct-2022 | ---- | ---- | | 04-Oct-2022 | 180 days | 6 days | ✓ |
| **Total Metals : Total metals in Water by CRC ICPMS** | | | | | | | | | | |
| **HDPE total (nitric acid)** | | | | | | | | | | |
| Upstream | E420 | 27-Sep-2022 | 03-Oct-2022 | ---- | ---- | | 04-Oct-2022 | 180 days | 7 days | ✓ |

**Legend & Qualifier Definitions**

EHTR-FM: Exceeded ALS recommended hold time prior to sample receipt. Field Measurement recommended

Rec. HT: ALS recommended hold time (see units).

# Quality Control Parameter Frequency Compliance

The following report summarizes the frequency of laboratory QC samples analyzed within the analytical batches (QC lots) in which the submitted samples were processed. The actual frequency should be greater than or equal to the expected frequency.

Matrix: **Water**

Evaluation: × = QC frequency outside specification; ✓ = QC frequency within specification.

| Quality Control Sample Type | | | Count | | Frequency (%) | | |
|---|---|---|---|---|---|---|---|
| *Analytical Methods* | *Method* | *QC Lot #* | *QC* | *Regular* | *Actual* | *Expected* | *Evaluation* |
| **Laboratory Duplicates (DUP)** | | | | | | | |
| Ammonia by Fluorescence | E298 | 679199 | 1 | 19 | 5.2 | 5.0 | ✓ |
| Biochemical Oxygen Demand - 5 day | E550 | 674966 | 1 | 14 | 7.1 | 5.0 | ✓ |
| Conductivity in Water | E100 | 680368 | 1 | 5 | 20.0 | 5.0 | ✓ |
| Dissolved Mercury in Water by CVAAS | E509 | 677568 | 1 | 14 | 7.1 | 5.0 | ✓ |
| Dissolved Metals in Water by CRC ICPMS | E421 | 677966 | 1 | 20 | 5.0 | 5.0 | ✓ |
| Dissolved Organic Carbon by Combustion (Low Level) | E358-L | 679204 | 1 | 3 | 33.3 | 5.0 | ✓ |
| pH by Meter | E108 | 680367 | 1 | 15 | 6.6 | 5.0 | ✓ |
| Total Mercury in Water by CVAAS | E508 | 680215 | 2 | 39 | 5.1 | 5.0 | ✓ |
| Total metals in Water by CRC ICPMS | E420 | 677894 | 1 | 20 | 5.0 | 5.0 | ✓ |
| Total Nitrogen by Colourimetry | E366 | 679202 | 1 | 7 | 14.2 | 5.0 | ✓ |
| Total Phosphorus by Colourimetry (0.002 mg/L) | E372-U | 679203 | 1 | 8 | 12.5 | 5.0 | ✓ |
| **Laboratory Control Samples (LCS)** | | | | | | | |
| Ammonia by Fluorescence | E298 | 679199 | 1 | 19 | 5.2 | 5.0 | ✓ |
| Biochemical Oxygen Demand - 5 day | E550 | 674966 | 1 | 14 | 7.1 | 5.0 | ✓ |
| Conductivity in Water | E100 | 680368 | 1 | 5 | 20.0 | 5.0 | ✓ |
| Dissolved Mercury in Water by CVAAS | E509 | 677568 | 1 | 14 | 7.1 | 5.0 | ✓ |
| Dissolved Metals in Water by CRC ICPMS | E421 | 677966 | 1 | 20 | 5.0 | 5.0 | ✓ |
| Dissolved Organic Carbon by Combustion (Low Level) | E358-L | 679204 | 1 | 3 | 33.3 | 5.0 | ✓ |
| pH by Meter | E108 | 680367 | 1 | 15 | 6.6 | 5.0 | ✓ |
| Total Mercury in Water by CVAAS | E508 | 680215 | 2 | 39 | 5.1 | 5.0 | ✓ |
| Total metals in Water by CRC ICPMS | E420 | 677894 | 1 | 20 | 5.0 | 5.0 | ✓ |
| Total Nitrogen by Colourimetry | E366 | 679202 | 1 | 7 | 14.2 | 5.0 | ✓ |
| Total Phosphorus by Colourimetry (0.002 mg/L) | E372-U | 679203 | 1 | 8 | 12.5 | 5.0 | ✓ |
| **Method Blanks (MB)** | | | | | | | |
| Ammonia by Fluorescence | E298 | 679199 | 1 | 19 | 5.2 | 5.0 | ✓ |
| Biochemical Oxygen Demand - 5 day | E550 | 674966 | 1 | 14 | 7.1 | 5.0 | ✓ |
| Conductivity in Water | E100 | 680368 | 1 | 5 | 20.0 | 5.0 | ✓ |
| Dissolved Mercury in Water by CVAAS | E509 | 677568 | 1 | 14 | 7.1 | 5.0 | ✓ |
| Dissolved Metals in Water by CRC ICPMS | E421 | 677966 | 1 | 20 | 5.0 | 5.0 | ✓ |
| Dissolved Organic Carbon by Combustion (Low Level) | E358-L | 679204 | 1 | 3 | 33.3 | 5.0 | ✓ |
| Total Mercury in Water by CVAAS | E508 | 680215 | 2 | 39 | 5.1 | 5.0 | ✓ |
| Total metals in Water by CRC ICPMS | E420 | 677894 | 1 | 20 | 5.0 | 5.0 | ✓ |
| Total Nitrogen by Colourimetry | E366 | 679202 | 1 | 7 | 14.2 | 5.0 | ✓ |
| Total Phosphorus by Colourimetry (0.002 mg/L) | E372-U | 679203 | 1 | 8 | 12.5 | 5.0 | ✓ |
| **Matrix Spikes (MS)** | | | | | | | |
| Ammonia by Fluorescence | E298 | 679199 | 1 | 19 | 5.2 | 5.0 | ✓ |
| Dissolved Mercury in Water by CVAAS | E509 | 677568 | 1 | 14 | 7.1 | 5.0 | ✓ |

Matrix: **Water**

Evaluation: × = *QC frequency outside specification*; ✓ = *QC frequency within specification.*

| Quality Control Sample Type | | | Count | | Frequency (%) | | |
|---|---|---|---|---|---|---|---|
| *Analytical Methods* | *Method* | *QC Lot #* | *QC* | *Regular* | *Actual* | *Expected* | *Evaluation* |
| Matrix Spikes (MS) - Continued | | | | | | | |
| Dissolved Metals in Water by CRC ICPMS | E421 | 677966 | 1 | 20 | 5.0 | 5.0 | ✓ |
| Dissolved Organic Carbon by Combustion (Low Level) | E358-L | 679204 | 1 | 3 | 33.3 | 5.0 | ✓ |
| Total Mercury in Water by CVAAS | E508 | 680215 | 2 | 39 | 5.1 | 5.0 | ✓ |
| Total metals in Water by CRC ICPMS | E420 | 677894 | 1 | 20 | 5.0 | 5.0 | ✓ |
| Total Nitrogen by Colourimetry | E366 | 679202 | 1 | 7 | 14.2 | 5.0 | ✓ |
| Total Phosphorus by Colourimetry (0.002 mg/L) | E372-U | 679203 | 1 | 8 | 12.5 | 5.0 | ✓ |

## Methodology References and Summaries

The analytical methods used by ALS are developed using internationally recognized reference methods (where available), such as those published by US EPA, APHA Standard Methods, ASTM, ISO, Environment Canada, BC MOE, and Ontario MOE. Reference methods may incorporate modifications to improve performance (indicated by "mod").

| Analytical Methods | Method / Lab | Matrix | Method Reference | Method Descriptions |
|---|---|---|---|---|
| Conductivity in Water | E100<br>Vancouver - Environmental | Water | APHA 2510 (mod) | Conductivity, also known as Electrical Conductivity (EC) or Specific Conductance, is measured by immersion of a conductivity cell with platinum electrodes into a water sample. Conductivity measurements are temperature-compensated to 25°C. |
| pH by Meter | E108<br>Vancouver - Environmental | Water | APHA 4500-H (mod) | pH is determined by potentiometric measurement with a pH electrode, and is conducted at ambient laboratory temperature (normally 20 ± 5°C). For high accuracy test results, pH should be measured in the field within the recommended 15 minute hold time. |
| Ammonia by Fluorescence | E298<br>Vancouver - Environmental | Water | Method Fialab 100, 2018 | Ammonia in water is determined by automated continuous flow analysis with membrane diffusion and fluorescence detection, after reaction with OPA (ortho-phthalaldehyde). This method is approved under US EPA 40 CFR Part 136 (May 2021) |
| Dissolved Organic Carbon by Combustion (Low Level) | E358-L<br>Vancouver - Environmental | Water | APHA 5310 B (mod) | Dissolved Organic Carbon (Non-Purgeable), also known as NPOC (dissolved), is a direct measurement of DOC after a filtered (0.45 micron) sample has been acidified and purged to remove inorganic carbon (IC). Analysis is by high temperature combustion with infrared detection of CO2. NPOC does not include volatile organic species that are purged off with IC. For samples where the majority of DC (dissolved carbon) is comprised of IC (which is common), this method is more accurate and more reliable than the DOC by subtraction method (i.e. DC minus DIC). |
| Total Nitrogen by Colourimetry | E366<br>Vancouver - Environmental | Water | APHA 4500-P J (mod) | Total Nitrogen is determined colourimetrically using a discrete analyzer after heated persulfate digestion of the sample. |
| Total Phosphorus by Colourimetry (0.002 mg/L) | E372-U<br>Vancouver - Environmental | Water | APHA 4500-P E (mod). | Total Phosphorus is determined colourimetrically using a discrete analyzer after heated persulfate digestion of the sample. |
| Total metals in Water by CRC ICPMS | E420<br>Vancouver - Environmental | Water | EPA 200.2/6020B (mod) | Water samples are digested with nitric and hydrochloric acids, and analyzed by Collision/Reaction Cell ICPMS.<br><br>Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. |
| Dissolved Metals in Water by CRC ICPMS | E421<br>Vancouver - Environmental | Water | APHA 3030B/EPA 6020B (mod) | Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by Collision/Reaction Cell ICPMS.<br><br>Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. |
| Total Mercury in Water by CVAAS | E508<br>Vancouver - Environmental | Water | EPA 1631E (mod) | Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS |

| Analytical Methods | Method / Lab | Matrix | Method Reference | Method Descriptions |
|---|---|---|---|---|
| Dissolved Mercury in Water by CVAAS | E509<br>Vancouver - Environmental | Water | APHA 3030B/EPA 1631E (mod) | Water samples are filtered (0.45 um), preserved with HCl, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS. |
| Biochemical Oxygen Demand - 5 day | E550<br>Vancouver - Environmental | Water | APHA 5210 B (mod) | Samples are diluted and incubated for a specified time period, after which the oxygen depletion is measured using a dissolved oxygen meter.<br><br>Free chlorine is a negative interference in the BOD method; please advise ALS when free chlorine is present in samples. |
| Dissolved Hardness (Calculated) | EC100<br>Vancouver - Environmental | Water | APHA 2340B | "Hardness (as CaCO3), dissolved" is calculated from the sum of dissolved Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. "Total Hardness" refers to the sum of Calcium and Magnesium Hardness. Hardness is normally or preferentially calculated from dissolved Calcium and Magnesium concentrations, because it is a property of water due to dissolved divalent cations. |
| Hardness (Calculated) from Total Ca/Mg | EC100A<br>Vancouver - Environmental | Water | APHA 2340B | "Hardness (as CaCO3), from total Ca/Mg" is calculated from the sum of total Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. "Total Hardness" refers to the sum of Calcium and Magnesium Hardness. Hardness is normally or preferentially calculated from dissolved Calcium and Magnesium concentrations, because it is a property of water due to dissolved divalent cations. Hardness from total Ca/Mg is normally comparable to Dissolved Hardness in non-turbid waters. |

| Preparation Methods | Method / Lab | Matrix | Method Reference | Method Descriptions |
|---|---|---|---|---|
| Preparation for Ammonia | EP298<br>Vancouver - Environmental | Water | | Sample preparation for Preserved Nutrients Water Quality Analysis. |
| Preparation for Dissolved Organic Carbon for Combustion | EP358<br>Vancouver - Environmental | Water | APHA 5310 B (mod) | Preparation for Dissolved Organic Carbon |
| Digestion for Total Nitrogen in water | EP366<br>Vancouver - Environmental | Water | APHA 4500-P J (mod) | Samples are heated with a persulfate digestion reagent. |
| Digestion for Total Phosphorus in water | EP372<br>Vancouver - Environmental | Water | APHA 4500-P E (mod). | Samples are heated with a persulfate digestion reagent. |
| Dissolved Metals Water Filtration | EP421<br>Vancouver - Environmental | Water | APHA 3030B | Water samples are filtered (0.45 um), and preserved with HNO3. |
| Dissolved Mercury Water Filtration | EP509<br>Vancouver - Environmental | Water | APHA 3030B | Water samples are filtered (0.45 um), and preserved with HCl. |

# QUALITY CONTROL REPORT

| | | | |
|---|---|---|---|
| **Work Order** | : **VA22C3658** | Page | : 1 of 14 |
| Client | : Regional District of Kitimat-Stikine | Laboratory | : Vancouver - Environmental |
| Contact | : Hannah Shinton | Account Manager | : Amber Springer |
| Address | : # 300 - 4545 Lazelle Avenue<br>Terrace BC Canada V8G 4E1 | Address | : 8081 Lougheed Highway<br>Burnaby, British Columbia Canada V5A 1W9 |
| Telephone | : ---- | Telephone | : +1 604 253 4188 |
| Project | : Kitwanga Landfill Surface Water | Date Samples Received | : 30-Sep-2022 11:55 |
| PO | : ---- | Date Analysis Commenced | : 30-Sep-2022 |
| C-O-C number | : ---- | Issue Date | : 07-Oct-2022 13:37 |
| Sampler | : HS | | |
| Site | : | | |
| Quote number | : Default Water Testing (Q62338) | | |
| No. of samples received | : 4 | | |
| No. of samples analysed | : 4 | | |

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percent Difference (RPD) and Data Quality Objectives
- Matrix Spike (MS) Report; Recovery and Data Quality Objectives
- Method Blank (MB) Report; Recovery and Data Quality Objectives
- Laboratory Control Sample (LCS) Report; Recovery and Data Quality Objectives

## *Signatories*

This document has been electronically signed by the authorized signatories below. Electronic signing is conducted in accordance with US FDA 21 CFR Part 11.

| *Signatories* | *Position* | *Laboratory Department* |
|---|---|---|
| Angela Ren | Team Leader - Metals | Vancouver Metals, Burnaby, British Columbia |
| Angelo Salandanan | Lab Assistant | Vancouver Metals, Burnaby, British Columbia |
| Benjamin Oke | Lab Assistant | Vancouver Metals, Burnaby, British Columbia |
| Qammar Almas | Lab Assistant | Vancouver Metals, Burnaby, British Columbia |
| Tracy Harley | Supervisor - Water Quality Instrumentation | Vancouver Inorganics, Burnaby, British Columbia |

## General Comments

The ALS Quality Control (QC) report is optionally provided to ALS clients upon request. ALS test methods include comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against predetermined Data Quality Objectives (DQOs) to provide confidence in the accuracy of associated test results. This report contains detailed results for all QC results applicable to this sample submission. Please refer to the ALS Quality Control Interpretation report (QCI) for applicable method references and methodology summaries.

Key :

Anonymous = Refers to samples which are not part of this work order, but which formed part of the QC process lot.
CAS Number = Chemical Abstracts Service number is a unique identifier assigned to discrete substances.
DQO = Data Quality Objective.
LOR = Limit of Reporting (detection limit).
RPD = Relative Percent Difference
# = Indicates a QC result that did not meet the ALS DQO.

## Workorder Comments

Holding times are displayed as "---" if no guidance exists from CCME, Canadian provinces, or broadly recognized international references.

## Laboratory Duplicate (DUP) Report

A Laboratory Duplicate (DUP) is a randomly selected intralaboratory replicate sample. Laboratory Duplicates provide information regarding method precision and sample heterogeneity. ALS DQOs for Laboratory Duplicates are expressed as test-specific limits for Relative Percent Difference (RPD), or as an absolute difference limit of 2 times the LOR for low concentration duplicates within ~ 4-10 times the LOR (cut-off is test-specific).

Sub-Matrix: **Water**

| | | | | | Laboratory Duplicate (DUP) Report | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *Laboratory sample ID* | *Client sample ID* | *Analyte* | *CAS Number* | *Method* | *LOR* | *Unit* | *Original Result* | *Duplicate Result* | *RPD(%) or Difference* | *Duplicate Limits* | *Qualifier* |
| **Physical Tests (QC Lot: 680367)** | | | | | | | | | | | |
| VA22C3605-001 | Anonymous | pH | ---- | E108 | 0.10 | pH units | 5.27 | 5.22 | 0.953% | 4% | ---- |
| **Physical Tests (QC Lot: 680368)** | | | | | | | | | | | |
| VA22C3605-001 | Anonymous | conductivity | ---- | E100 | 2.0 | µS/cm | 501 | 496 | 1.00% | 10% | ---- |
| **Anions and Nutrients (QC Lot: 679199)** | | | | | | | | | | | |
| VA22C3425-001 | Anonymous | ammonia, total (as N) | 7664-41-7 | E298 | 0.0050 | mg/L | <0.0050 | <0.0050 | 0 | Diff <2x LOR | ---- |
| **Anions and Nutrients (QC Lot: 679202)** | | | | | | | | | | | |
| VA22C3452-001 | Anonymous | nitrogen, total | 7727-37-9 | E366 | 0.030 | mg/L | 0.148 | 0.149 | 0.001 | Diff <2x LOR | ---- |
| **Anions and Nutrients (QC Lot: 679203)** | | | | | | | | | | | |
| VA22C3452-001 | Anonymous | phosphorus, total | 7723-14-0 | E372-U | 0.0020 | mg/L | 0.0105 | 0.0102 | 0.0003 | Diff <2x LOR | ---- |
| **Organic / Inorganic Carbon (QC Lot: 679204)** | | | | | | | | | | | |
| VA22C3658-001 | Upstream | carbon, dissolved organic [DOC] | ---- | E358-L | 0.50 | mg/L | 7.31 | 7.60 | 3.98% | 20% | ---- |
| **Total Metals (QC Lot: 677894)** | | | | | | | | | | | |
| VA22C3717-003 | Anonymous | aluminum, total | 7429-90-5 | E420 | 0.0030 | mg/L | 0.0121 | 0.0112 | 0.0009 | Diff <2x LOR | ---- |
| | | antimony, total | 7440-36-0 | E420 | 0.00010 | mg/L | 0.00033 | 0.00032 | 0.000006 | Diff <2x LOR | ---- |
| | | arsenic, total | 7440-38-2 | E420 | 0.00010 | mg/L | 0.00014 | 0.00013 | 0.000006 | Diff <2x LOR | ---- |
| | | barium, total | 7440-39-3 | E420 | 0.00010 | mg/L | 0.0414 | 0.0409 | 1.24% | 20% | ---- |
| | | beryllium, total | 7440-41-7 | E420 | 0.000020 | mg/L | <0.000020 | <0.000020 | 0 | Diff <2x LOR | ---- |
| | | bismuth, total | 7440-69-9 | E420 | 0.000050 | mg/L | <0.000050 | <0.000050 | 0 | Diff <2x LOR | ---- |
| | | boron, total | 7440-42-8 | E420 | 0.010 | mg/L | 0.021 | 0.021 | 0.0003 | Diff <2x LOR | ---- |
| | | cadmium, total | 7440-43-9 | E420 | 0.0000050 | mg/L | 0.00135 | 0.00136 | 0.788% | 20% | ---- |
| | | calcium, total | 7440-70-2 | E420 | 0.050 | mg/L | 247 | 243 | 1.62% | 20% | ---- |
| | | cesium, total | 7440-46-2 | E420 | 0.000010 | mg/L | 0.000021 | 0.000020 | 0.000001 | Diff <2x LOR | ---- |
| | | chromium, total | 7440-47-3 | E420 | 0.00050 | mg/L | <0.00050 | <0.00050 | 0 | Diff <2x LOR | ---- |
| | | cobalt, total | 7440-48-4 | E420 | 0.00010 | mg/L | <0.00010 | <0.00010 | 0 | Diff <2x LOR | ---- |
| | | copper, total | 7440-50-8 | E420 | 0.00050 | mg/L | 0.00211 | 0.00211 | 0.0000003 | Diff <2x LOR | ---- |
| | | iron, total | 7439-89-6 | E420 | 0.010 | mg/L | 0.100 | 0.099 | 0.0008 | Diff <2x LOR | ---- |
| | | lead, total | 7439-92-1 | E420 | 0.000050 | mg/L | 0.000103 | 0.000102 | 0.000001 | Diff <2x LOR | ---- |
| | | lithium, total | 7439-93-2 | E420 | 0.0010 | mg/L | 0.0523 | 0.0515 | 1.46% | 20% | ---- |
| | | magnesium, total | 7439-95-4 | E420 | 0.100 | mg/L | 159 | 159 | 0.0398% | 20% | ---- |
| | | manganese, total | 7439-96-5 | E420 | 0.00010 | mg/L | 0.0154 | 0.0152 | 0.962% | 20% | ---- |
| | | molybdenum, total | 7439-98-7 | E420 | 0.000050 | mg/L | 0.00648 | 0.00653 | 0.812% | 20% | ---- |

Sub-Matrix: **Water**

| | | | | | Laboratory Duplicate (DUP) Report | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *Laboratory sample ID* | *Client sample ID* | *Analyte* | *CAS Number* | *Method* | *LOR* | *Unit* | *Original Result* | *Duplicate Result* | *RPD(%) or Difference* | *Duplicate Limits* | *Qualifier* |
| **Total Metals (QC Lot: 677894) - continued** | | | | | | | | | | | |
| VA22C3717-003 | Anonymous | nickel, total | 7440-02-0 | E420 | 0.00050 | mg/L | 0.0149 | 0.0140 | 6.37% | 20% | ---- |
| | | phosphorus, total | 7723-14-0 | E420 | 0.050 | mg/L | 1.01 | 0.988 | 2.58% | 20% | ---- |
| | | potassium, total | 7440-09-7 | E420 | 0.050 | mg/L | 2.66 | 2.64 | 0.792% | 20% | ---- |
| | | rubidium, total | 7440-17-7 | E420 | 0.00020 | mg/L | 0.00206 | 0.00200 | 2.90% | 20% | ---- |
| | | selenium, total | 7782-49-2 | E420 | 0.000050 | mg/L | 43.2 µg/L | 0.0442 | 2.46% | 20% | ---- |
| | | silicon, total | 7440-21-3 | E420 | 0.10 | mg/L | 2.60 | 2.52 | 3.06% | 20% | ---- |
| | | silver, total | 7440-22-4 | E420 | 0.000010 | mg/L | <0.000010 | <0.000010 | 0 | Diff <2x LOR | ---- |
| | | sodium, total | 7440-23-5 | E420 | 0.050 | mg/L | 6.81 | 6.87 | 0.777% | 20% | ---- |
| | | strontium, total | 7440-24-6 | E420 | 0.00020 | mg/L | 0.227 | 0.229 | 0.856% | 20% | ---- |
| | | sulfur, total | 7704-34-9 | E420 | 0.50 | mg/L | 285 | 282 | 0.957% | 20% | ---- |
| | | tellurium, total | 13494-80-9 | E420 | 0.00020 | mg/L | <0.00020 | <0.00020 | 0 | Diff <2x LOR | ---- |
| | | thallium, total | 7440-28-0 | E420 | 0.000010 | mg/L | <0.000010 | <0.000010 | 0 | Diff <2x LOR | ---- |
| | | thorium, total | 7440-29-1 | E420 | 0.00010 | mg/L | <0.00010 | <0.00010 | 0 | Diff <2x LOR | ---- |
| | | tin, total | 7440-31-5 | E420 | 0.00010 | mg/L | <0.00010 | <0.00010 | 0 | Diff <2x LOR | ---- |
| | | titanium, total | 7440-32-6 | E420 | 0.0100 | mg/L | <0.0100 | <0.0100 | 0 | Diff <2x LOR | ---- |
| | | tungsten, total | 7440-33-7 | E420 | 0.00010 | mg/L | <0.00010 | <0.00010 | 0 | Diff <2x LOR | ---- |
| | | uranium, total | 7440-61-1 | E420 | 0.000010 | mg/L | 0.0117 | 0.0118 | 0.485% | 20% | ---- |
| | | vanadium, total | 7440-62-2 | E420 | 0.00050 | mg/L | <0.00050 | <0.00050 | 0 | Diff <2x LOR | ---- |
| | | zinc, total | 7440-66-6 | E420 | 0.0030 | mg/L | 0.0359 | 0.0365 | 1.55% | 20% | ---- |
| | | zirconium, total | 7440-67-7 | E420 | 0.00020 | mg/L | <0.00020 | <0.00020 | 0 | Diff <2x LOR | ---- |
| **Total Metals (QC Lot: 680214)** | | | | | | | | | | | |
| FJ2202796-001 | Anonymous | mercury, total | 7439-97-6 | E508 | 0.0000050 | mg/L | <0.0000050 | <0.0000050 | 0 | Diff <2x LOR | ---- |
| **Total Metals (QC Lot: 680215)** | | | | | | | | | | | |
| VA22C3658-002 | SW-21 | mercury, total | 7439-97-6 | E508 | 0.0000050 | mg/L | <0.0000050 | <0.0000050 | 0 | Diff <2x LOR | ---- |
| **Dissolved Metals (QC Lot: 677568)** | | | | | | | | | | | |
| VA22C3632-007 | Anonymous | mercury, dissolved | 7439-97-6 | E509 | 0.0000050 | mg/L | <0.0000050 | <0.0000050 | 0 | Diff <2x LOR | ---- |
| **Dissolved Metals (QC Lot: 677966)** | | | | | | | | | | | |
| VA22C3452-001 | Anonymous | aluminum, dissolved | 7429-90-5 | E421 | 0.0010 | mg/L | 0.0098 | 0.0106 | 7.85% | 20% | ---- |
| | | antimony, dissolved | 7440-36-0 | E421 | 0.00010 | mg/L | <0.00010 | <0.00010 | 0 | Diff <2x LOR | ---- |
| | | arsenic, dissolved | 7440-38-2 | E421 | 0.00010 | mg/L | <0.00010 | <0.00010 | 0 | Diff <2x LOR | ---- |
| | | barium, dissolved | 7440-39-3 | E421 | 0.00010 | mg/L | 0.00045 | 0.00041 | 0.00004 | Diff <2x LOR | ---- |
| | | beryllium, dissolved | 7440-41-7 | E421 | 0.000020 | mg/L | <0.000020 | <0.000020 | 0 | Diff <2x LOR | ---- |
| | | bismuth, dissolved | 7440-69-9 | E421 | 0.000050 | mg/L | <0.000050 | <0.000050 | 0 | Diff <2x LOR | ---- |
| | | boron, dissolved | 7440-42-8 | E421 | 0.010 | mg/L | <0.010 | <0.010 | 0 | Diff <2x LOR | ---- |
| | | cadmium, dissolved | 7440-43-9 | E421 | 0.0000050 | mg/L | <0.0000050 | <0.0000050 | 0 | Diff <2x LOR | ---- |

Sub-Matrix: **Water**

| | | | | | Laboratory Duplicate (DUP) Report | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *Laboratory sample ID* | *Client sample ID* | *Analyte* | *CAS Number* | *Method* | *LOR* | *Unit* | *Original Result* | *Duplicate Result* | *RPD(%) or Difference* | *Duplicate Limits* | *Qualifier* |
| **Dissolved Metals (QC Lot: 677966) - continued** | | | | | | | | | | | |
| VA22C3452-001 | Anonymous | calcium, dissolved | 7440-70-2 | E421 | 0.050 | mg/L | 0.171 | 0.174 | 0.003 | Diff <2x LOR | ---- |
| | | cesium, dissolved | 7440-46-2 | E421 | 0.000010 | mg/L | <0.000010 | <0.000010 | 0 | Diff <2x LOR | ---- |
| | | chromium, dissolved | 7440-47-3 | E421 | 0.00050 | mg/L | <0.00050 | <0.00050 | 0 | Diff <2x LOR | ---- |
| | | cobalt, dissolved | 7440-48-4 | E421 | 0.00010 | mg/L | <0.00010 | <0.00010 | 0 | Diff <2x LOR | ---- |
| | | copper, dissolved | 7440-50-8 | E421 | 0.00020 | mg/L | <0.00020 | <0.00020 | 0 | Diff <2x LOR | ---- |
| | | iron, dissolved | 7439-89-6 | E421 | 0.010 | mg/L | <0.010 | <0.010 | 0 | Diff <2x LOR | ---- |
| | | lead, dissolved | 7439-92-1 | E421 | 0.000050 | mg/L | <0.000050 | <0.000050 | 0 | Diff <2x LOR | ---- |
| | | lithium, dissolved | 7439-93-2 | E421 | 0.0010 | mg/L | <0.0010 | <0.0010 | 0 | Diff <2x LOR | ---- |
| | | magnesium, dissolved | 7439-95-4 | E421 | 0.0050 | mg/L | 0.0633 | 0.0652 | 2.95% | 20% | ---- |
| | | manganese, dissolved | 7439-96-5 | E421 | 0.00010 | mg/L | 0.00780 | 0.00821 | 5.18% | 20% | ---- |
| | | molybdenum, dissolved | 7439-98-7 | E421 | 0.000050 | mg/L | <0.000050 | <0.000050 | 0 | Diff <2x LOR | ---- |
| | | nickel, dissolved | 7440-02-0 | E421 | 0.00050 | mg/L | <0.00050 | <0.00050 | 0 | Diff <2x LOR | ---- |
| | | phosphorus, dissolved | 7723-14-0 | E421 | 0.050 | mg/L | <0.050 | <0.050 | 0 | Diff <2x LOR | ---- |
| | | potassium, dissolved | 7440-09-7 | E421 | 0.050 | mg/L | 0.245 | 0.261 | 0.016 | Diff <2x LOR | ---- |
| | | rubidium, dissolved | 7440-17-7 | E421 | 0.00020 | mg/L | 0.00050 | 0.00046 | 0.00004 | Diff <2x LOR | ---- |
| | | selenium, dissolved | 7782-49-2 | E421 | 0.000050 | mg/L | <0.000050 | <0.000050 | 0 | Diff <2x LOR | ---- |
| | | silicon, dissolved | 7440-21-3 | E421 | 0.050 | mg/L | <0.050 | <0.050 | 0 | Diff <2x LOR | ---- |
| | | silver, dissolved | 7440-22-4 | E421 | 0.000010 | mg/L | <0.000010 | <0.000010 | 0 | Diff <2x LOR | ---- |
| | | sodium, dissolved | 7440-23-5 | E421 | 0.050 | mg/L | 0.132 | 0.137 | 0.005 | Diff <2x LOR | ---- |
| | | strontium, dissolved | 7440-24-6 | E421 | 0.00020 | mg/L | 0.00147 | 0.00149 | 0.00002 | Diff <2x LOR | ---- |
| | | sulfur, dissolved | 7704-34-9 | E421 | 0.50 | mg/L | <0.50 | <0.50 | 0 | Diff <2x LOR | ---- |
| | | tellurium, dissolved | 13494-80-9 | E421 | 0.00020 | mg/L | <0.00020 | <0.00020 | 0 | Diff <2x LOR | ---- |
| | | thallium, dissolved | 7440-28-0 | E421 | 0.000010 | mg/L | <0.000010 | <0.000010 | 0 | Diff <2x LOR | ---- |
| | | thorium, dissolved | 7440-29-1 | E421 | 0.00010 | mg/L | <0.00010 | <0.00010 | 0 | Diff <2x LOR | ---- |
| | | tin, dissolved | 7440-31-5 | E421 | 0.00010 | mg/L | <0.00010 | <0.00010 | 0 | Diff <2x LOR | ---- |
| | | titanium, dissolved | 7440-32-6 | E421 | 0.00030 | mg/L | <0.00030 | <0.00030 | 0 | Diff <2x LOR | ---- |
| | | tungsten, dissolved | 7440-33-7 | E421 | 0.00010 | mg/L | <0.00010 | <0.00010 | 0 | Diff <2x LOR | ---- |
| | | uranium, dissolved | 7440-61-1 | E421 | 0.000010 | mg/L | <0.000010 | <0.000010 | 0 | Diff <2x LOR | ---- |
| | | vanadium, dissolved | 7440-62-2 | E421 | 0.00050 | mg/L | <0.00050 | <0.00050 | 0 | Diff <2x LOR | ---- |
| | | zinc, dissolved | 7440-66-6 | E421 | 0.0010 | mg/L | 0.0012 | 0.0011 | 0.00010 | Diff <2x LOR | ---- |
| | | zirconium, dissolved | 7440-67-7 | E421 | 0.00030 | mg/L | <0.00030 | <0.00030 | 0 | Diff <2x LOR | ---- |
| **Aggregate Organics (QC Lot: 674966)** | | | | | | | | | | | |
| FJ2202731-001 | Anonymous | biochemical oxygen demand [BOD] | ---- | E550 | 2.0 | mg/L | <2.0 | <2.0 | 0.0% | 30% | ---- |

## Method Blank (MB) Report

A Method Blank is an analyte-free matrix that undergoes sample processing identical to that carried out for test samples. Method Blank results are used to monitor and control for potential contamination from the laboratory environment and reagents. For most tests, the DQO for Method Blanks is for the result to be < LOR.

Sub-Matrix: **Water**

| Analyte | CAS Number | Method | LOR | Unit | Result | Qualifier |
|---|---|---|---|---|---|---|
| **Physical Tests (QCLot: 680368)** | | | | | | |
| conductivity | ---- | E100 | 1 | µS/cm | 1.5 | ---- |
| **Anions and Nutrients (QCLot: 679199)** | | | | | | |
| ammonia, total (as N) | 7664-41-7 | E298 | 0.005 | mg/L | <0.0050 | ---- |
| **Anions and Nutrients (QCLot: 679202)** | | | | | | |
| nitrogen, total | 7727-37-9 | E366 | 0.03 | mg/L | <0.030 | ---- |
| **Anions and Nutrients (QCLot: 679203)** | | | | | | |
| phosphorus, total | 7723-14-0 | E372-U | 0.002 | mg/L | <0.0020 | ---- |
| **Organic / Inorganic Carbon (QCLot: 679204)** | | | | | | |
| carbon, dissolved organic [DOC] | ---- | E358-L | 0.5 | mg/L | <0.50 | ---- |
| **Total Metals (QCLot: 677894)** | | | | | | |
| aluminum, total | 7429-90-5 | E420 | 0.003 | mg/L | <0.0030 | ---- |
| antimony, total | 7440-36-0 | E420 | 0.0001 | mg/L | <0.00010 | ---- |
| arsenic, total | 7440-38-2 | E420 | 0.0001 | mg/L | <0.00010 | ---- |
| barium, total | 7440-39-3 | E420 | 0.0001 | mg/L | <0.00010 | ---- |
| beryllium, total | 7440-41-7 | E420 | 0.00002 | mg/L | <0.000020 | ---- |
| bismuth, total | 7440-69-9 | E420 | 0.00005 | mg/L | <0.000050 | ---- |
| boron, total | 7440-42-8 | E420 | 0.01 | mg/L | <0.010 | ---- |
| cadmium, total | 7440-43-9 | E420 | 0.000005 | mg/L | <0.0000050 | ---- |
| calcium, total | 7440-70-2 | E420 | 0.05 | mg/L | <0.050 | ---- |
| cesium, total | 7440-46-2 | E420 | 0.00001 | mg/L | <0.000010 | ---- |
| chromium, total | 7440-47-3 | E420 | 0.0005 | mg/L | <0.00050 | ---- |
| cobalt, total | 7440-48-4 | E420 | 0.0001 | mg/L | <0.00010 | ---- |
| copper, total | 7440-50-8 | E420 | 0.0005 | mg/L | <0.00050 | ---- |
| iron, total | 7439-89-6 | E420 | 0.01 | mg/L | <0.010 | ---- |
| lead, total | 7439-92-1 | E420 | 0.00005 | mg/L | <0.000050 | ---- |
| lithium, total | 7439-93-2 | E420 | 0.001 | mg/L | <0.0010 | ---- |
| magnesium, total | 7439-95-4 | E420 | 0.005 | mg/L | <0.0050 | ---- |
| manganese, total | 7439-96-5 | E420 | 0.0001 | mg/L | <0.00010 | ---- |
| molybdenum, total | 7439-98-7 | E420 | 0.00005 | mg/L | <0.000050 | ---- |
| nickel, total | 7440-02-0 | E420 | 0.0005 | mg/L | <0.00050 | ---- |
| phosphorus, total | 7723-14-0 | E420 | 0.05 | mg/L | <0.050 | ---- |
| potassium, total | 7440-09-7 | E420 | 0.05 | mg/L | <0.050 | ---- |
| rubidium, total | 7440-17-7 | E420 | 0.0002 | mg/L | <0.00020 | ---- |

Sub-Matrix: **Water**

| Analyte | CAS Number | Method | LOR | Unit | Result | Qualifier |
|---|---|---|---|---|---|---|
| **Total Metals (QCLot: 677894) - continued** | | | | | | |
| selenium, total | 7782-49-2 | E420 | 0.00005 | mg/L | <0.000050 | ---- |
| silicon, total | 7440-21-3 | E420 | 0.1 | mg/L | <0.10 | ---- |
| silver, total | 7440-22-4 | E420 | 0.00001 | mg/L | <0.000010 | ---- |
| sodium, total | 7440-23-5 | E420 | 0.05 | mg/L | <0.050 | ---- |
| strontium, total | 7440-24-6 | E420 | 0.0002 | mg/L | <0.00020 | ---- |
| sulfur, total | 7704-34-9 | E420 | 0.5 | mg/L | <0.50 | ---- |
| tellurium, total | 13494-80-9 | E420 | 0.0002 | mg/L | <0.00020 | ---- |
| thallium, total | 7440-28-0 | E420 | 0.00001 | mg/L | <0.000010 | ---- |
| thorium, total | 7440-29-1 | E420 | 0.0001 | mg/L | <0.00010 | ---- |
| tin, total | 7440-31-5 | E420 | 0.0001 | mg/L | <0.00010 | ---- |
| titanium, total | 7440-32-6 | E420 | 0.0003 | mg/L | <0.00030 | ---- |
| tungsten, total | 7440-33-7 | E420 | 0.0001 | mg/L | <0.00010 | ---- |
| uranium, total | 7440-61-1 | E420 | 0.00001 | mg/L | <0.000010 | ---- |
| vanadium, total | 7440-62-2 | E420 | 0.0005 | mg/L | <0.00050 | ---- |
| zinc, total | 7440-66-6 | E420 | 0.003 | mg/L | <0.0030 | ---- |
| zirconium, total | 7440-67-7 | E420 | 0.0002 | mg/L | <0.00020 | ---- |
| **Total Metals (QCLot: 680214)** | | | | | | |
| mercury, total | 7439-97-6 | E508 | 0.000005 | mg/L | <0.0000050 | ---- |
| **Total Metals (QCLot: 680215)** | | | | | | |
| mercury, total | 7439-97-6 | E508 | 0.000005 | mg/L | <0.0000050 | ---- |
| **Dissolved Metals (QCLot: 677568)** | | | | | | |
| mercury, dissolved | 7439-97-6 | E509 | 0.000005 | mg/L | <0.0000050 | ---- |
| **Dissolved Metals (QCLot: 677966)** | | | | | | |
| aluminum, dissolved | 7429-90-5 | E421 | 0.001 | mg/L | <0.0010 | ---- |
| antimony, dissolved | 7440-36-0 | E421 | 0.0001 | mg/L | <0.00010 | ---- |
| arsenic, dissolved | 7440-38-2 | E421 | 0.0001 | mg/L | <0.00010 | ---- |
| barium, dissolved | 7440-39-3 | E421 | 0.0001 | mg/L | <0.00010 | ---- |
| beryllium, dissolved | 7440-41-7 | E421 | 0.00002 | mg/L | <0.000020 | ---- |
| bismuth, dissolved | 7440-69-9 | E421 | 0.00005 | mg/L | <0.000050 | ---- |
| boron, dissolved | 7440-42-8 | E421 | 0.01 | mg/L | <0.010 | ---- |
| cadmium, dissolved | 7440-43-9 | E421 | 0.000005 | mg/L | <0.0000050 | ---- |
| calcium, dissolved | 7440-70-2 | E421 | 0.05 | mg/L | <0.050 | ---- |
| cesium, dissolved | 7440-46-2 | E421 | 0.00001 | mg/L | <0.000010 | ---- |
| chromium, dissolved | 7440-47-3 | E421 | 0.0005 | mg/L | <0.00050 | ---- |
| cobalt, dissolved | 7440-48-4 | E421 | 0.0001 | mg/L | <0.00010 | ---- |
| copper, dissolved | 7440-50-8 | E421 | 0.0002 | mg/L | <0.00020 | ---- |

Sub-Matrix: **Water**

| Analyte | CAS Number | Method | LOR | Unit | Result | Qualifier |
|---|---|---|---|---|---|---|
| **Dissolved Metals (QCLot: 677966) - continued** | | | | | | |
| iron, dissolved | 7439-89-6 | E421 | 0.01 | mg/L | <0.010 | ---- |
| lead, dissolved | 7439-92-1 | E421 | 0.00005 | mg/L | <0.000050 | ---- |
| lithium, dissolved | 7439-93-2 | E421 | 0.001 | mg/L | <0.0010 | ---- |
| magnesium, dissolved | 7439-95-4 | E421 | 0.005 | mg/L | <0.0050 | ---- |
| manganese, dissolved | 7439-96-5 | E421 | 0.0001 | mg/L | <0.00010 | ---- |
| molybdenum, dissolved | 7439-98-7 | E421 | 0.00005 | mg/L | <0.000050 | ---- |
| nickel, dissolved | 7440-02-0 | E421 | 0.0005 | mg/L | <0.00050 | ---- |
| phosphorus, dissolved | 7723-14-0 | E421 | 0.05 | mg/L | <0.050 | ---- |
| potassium, dissolved | 7440-09-7 | E421 | 0.05 | mg/L | <0.050 | ---- |
| rubidium, dissolved | 7440-17-7 | E421 | 0.0002 | mg/L | <0.00020 | ---- |
| selenium, dissolved | 7782-49-2 | E421 | 0.00005 | mg/L | <0.000050 | ---- |
| silicon, dissolved | 7440-21-3 | E421 | 0.05 | mg/L | <0.050 | ---- |
| silver, dissolved | 7440-22-4 | E421 | 0.00001 | mg/L | <0.000010 | ---- |
| sodium, dissolved | 7440-23-5 | E421 | 0.05 | mg/L | <0.050 | ---- |
| strontium, dissolved | 7440-24-6 | E421 | 0.0002 | mg/L | <0.00020 | ---- |
| sulfur, dissolved | 7704-34-9 | E421 | 0.5 | mg/L | <0.50 | ---- |
| tellurium, dissolved | 13494-80-9 | E421 | 0.0002 | mg/L | <0.00020 | ---- |
| thallium, dissolved | 7440-28-0 | E421 | 0.00001 | mg/L | <0.000010 | ---- |
| thorium, dissolved | 7440-29-1 | E421 | 0.0001 | mg/L | <0.00010 | ---- |
| tin, dissolved | 7440-31-5 | E421 | 0.0001 | mg/L | <0.00010 | ---- |
| titanium, dissolved | 7440-32-6 | E421 | 0.0003 | mg/L | <0.00030 | ---- |
| tungsten, dissolved | 7440-33-7 | E421 | 0.0001 | mg/L | <0.00010 | ---- |
| uranium, dissolved | 7440-61-1 | E421 | 0.00001 | mg/L | <0.000010 | ---- |
| vanadium, dissolved | 7440-62-2 | E421 | 0.0005 | mg/L | <0.00050 | ---- |
| zinc, dissolved | 7440-66-6 | E421 | 0.001 | mg/L | <0.0010 | ---- |
| zirconium, dissolved | 7440-67-7 | E421 | 0.0002 | mg/L | <0.00020 | ---- |
| **Aggregate Organics (QCLot: 674966)** | | | | | | |
| biochemical oxygen demand [BOD] | ---- | E550 | 2 | mg/L | <2.0 | ---- |

## Laboratory Control Sample (LCS) Report

A Laboratory Control Sample (LCS) is an analyte-free matrix that has been fortified (spiked) with test analytes at known concentration and processed in an identical manner to test samples. LCS results are expressed as percent recovery, and are used to monitor and control test method accuracy and precision, independent of test sample matrix.

Sub-Matrix: **Water**

| | | | | | Laboratory Control Sample (LCS) Report | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Spike | Recovery (%) | Recovery Limits (%) | | |
| Analyte | CAS Number | Method | LOR | Unit | Concentration | LCS | Low | High | Qualifier |
| **Physical Tests (QCLot: 680367)** | | | | | | | | | |
| pH | ---- | E108 | ---- | pH units | 7 pH units | 99.1 | 98.0 | 102 | ---- |
| **Physical Tests (QCLot: 680368)** | | | | | | | | | |
| conductivity | ---- | E100 | 1 | µS/cm | 146.9 µS/cm | 95.6 | 90.0 | 110 | ---- |
| **Anions and Nutrients (QCLot: 679199)** | | | | | | | | | |
| ammonia, total (as N) | 7664-41-7 | E298 | 0.005 | mg/L | 0.2 mg/L | 104 | 85.0 | 115 | ---- |
| **Anions and Nutrients (QCLot: 679202)** | | | | | | | | | |
| nitrogen, total | 7727-37-9 | E366 | 0.03 | mg/L | 0.5 mg/L | 104 | 75.0 | 125 | ---- |
| **Anions and Nutrients (QCLot: 679203)** | | | | | | | | | |
| phosphorus, total | 7723-14-0 | E372-U | 0.002 | mg/L | 0.05 mg/L | 88.9 | 80.0 | 120 | ---- |
| **Organic / Inorganic Carbon (QCLot: 679204)** | | | | | | | | | |
| carbon, dissolved organic [DOC] | ---- | E358-L | 0.5 | mg/L | 8.57 mg/L | 111 | 80.0 | 120 | ---- |
| **Total Metals (QCLot: 677894)** | | | | | | | | | |
| aluminum, total | 7429-90-5 | E420 | 0.003 | mg/L | 2 mg/L | 107 | 80.0 | 120 | ---- |
| antimony, total | 7440-36-0 | E420 | 0.0001 | mg/L | 1 mg/L | 113 | 80.0 | 120 | ---- |
| arsenic, total | 7440-38-2 | E420 | 0.0001 | mg/L | 1 mg/L | 109 | 80.0 | 120 | ---- |
| barium, total | 7440-39-3 | E420 | 0.0001 | mg/L | 0.25 mg/L | 104 | 80.0 | 120 | ---- |
| beryllium, total | 7440-41-7 | E420 | 0.00002 | mg/L | 0.1 mg/L | 102 | 80.0 | 120 | ---- |
| bismuth, total | 7440-69-9 | E420 | 0.00005 | mg/L | 1 mg/L | 110 | 80.0 | 120 | ---- |
| boron, total | 7440-42-8 | E420 | 0.01 | mg/L | 1 mg/L | 91.9 | 80.0 | 120 | ---- |
| cadmium, total | 7440-43-9 | E420 | 0.000005 | mg/L | 0.1 mg/L | 104 | 80.0 | 120 | ---- |
| calcium, total | 7440-70-2 | E420 | 0.05 | mg/L | 50 mg/L | 106 | 80.0 | 120 | ---- |
| cesium, total | 7440-46-2 | E420 | 0.00001 | mg/L | 0.05 mg/L | 107 | 80.0 | 120 | ---- |
| chromium, total | 7440-47-3 | E420 | 0.0005 | mg/L | 0.25 mg/L | 106 | 80.0 | 120 | ---- |
| cobalt, total | 7440-48-4 | E420 | 0.0001 | mg/L | 0.25 mg/L | 106 | 80.0 | 120 | ---- |
| copper, total | 7440-50-8 | E420 | 0.0005 | mg/L | 0.25 mg/L | 104 | 80.0 | 120 | ---- |
| iron, total | 7439-89-6 | E420 | 0.01 | mg/L | 1 mg/L | 101 | 80.0 | 120 | ---- |
| lead, total | 7439-92-1 | E420 | 0.00005 | mg/L | 0.5 mg/L | 106 | 80.0 | 120 | ---- |
| lithium, total | 7439-93-2 | E420 | 0.001 | mg/L | 0.25 mg/L | 101 | 80.0 | 120 | ---- |
| magnesium, total | 7439-95-4 | E420 | 0.005 | mg/L | 50 mg/L | 107 | 80.0 | 120 | ---- |
| manganese, total | 7439-96-5 | E420 | 0.0001 | mg/L | 0.25 mg/L | 108 | 80.0 | 120 | ---- |
| molybdenum, total | 7439-98-7 | E420 | 0.00005 | mg/L | 0.25 mg/L | 102 | 80.0 | 120 | ---- |

Sub-Matrix: **Water**

| | | | | | Laboratory Control Sample (LCS) Report | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Spike | Recovery (%) | Recovery Limits (%) | | |
| Analyte | CAS Number | Method | LOR | Unit | Concentration | LCS | Low | High | Qualifier |
| **Total Metals (QCLot: 677894) - continued** | | | | | | | | | |
| nickel, total | 7440-02-0 | E420 | 0.0005 | mg/L | 0.5 mg/L | 101 | 80.0 | 120 | ---- |
| phosphorus, total | 7723-14-0 | E420 | 0.05 | mg/L | 10 mg/L | 99.3 | 80.0 | 120 | ---- |
| potassium, total | 7440-09-7 | E420 | 0.05 | mg/L | 50 mg/L | 106 | 80.0 | 120 | ---- |
| rubidium, total | 7440-17-7 | E420 | 0.0002 | mg/L | 0.1 mg/L | 106 | 80.0 | 120 | ---- |
| selenium, total | 7782-49-2 | E420 | 0.00005 | mg/L | 1 mg/L | 102 | 80.0 | 120 | ---- |
| silicon, total | 7440-21-3 | E420 | 0.1 | mg/L | 10 mg/L | 102 | 80.0 | 120 | ---- |
| silver, total | 7440-22-4 | E420 | 0.00001 | mg/L | 0.1 mg/L | 96.6 | 80.0 | 120 | ---- |
| sodium, total | 7440-23-5 | E420 | 0.05 | mg/L | 50 mg/L | 109 | 80.0 | 120 | ---- |
| strontium, total | 7440-24-6 | E420 | 0.0002 | mg/L | 0.25 mg/L | 106 | 80.0 | 120 | ---- |
| sulfur, total | 7704-34-9 | E420 | 0.5 | mg/L | 50 mg/L | 101 | 80.0 | 120 | ---- |
| tellurium, total | 13494-80-9 | E420 | 0.0002 | mg/L | 0.1 mg/L | 104 | 80.0 | 120 | ---- |
| thallium, total | 7440-28-0 | E420 | 0.00001 | mg/L | 1 mg/L | 105 | 80.0 | 120 | ---- |
| thorium, total | 7440-29-1 | E420 | 0.0001 | mg/L | 0.1 mg/L | 105 | 80.0 | 120 | ---- |
| tin, total | 7440-31-5 | E420 | 0.0001 | mg/L | 0.5 mg/L | 105 | 80.0 | 120 | ---- |
| titanium, total | 7440-32-6 | E420 | 0.0003 | mg/L | 0.25 mg/L | 104 | 80.0 | 120 | ---- |
| tungsten, total | 7440-33-7 | E420 | 0.0001 | mg/L | 0.1 mg/L | 103 | 80.0 | 120 | ---- |
| uranium, total | 7440-61-1 | E420 | 0.00001 | mg/L | 0.005 mg/L | 114 | 80.0 | 120 | ---- |
| vanadium, total | 7440-62-2 | E420 | 0.0005 | mg/L | 0.5 mg/L | 107 | 80.0 | 120 | ---- |
| zinc, total | 7440-66-6 | E420 | 0.003 | mg/L | 0.5 mg/L | 103 | 80.0 | 120 | ---- |
| zirconium, total | 7440-67-7 | E420 | 0.0002 | mg/L | 0.1 mg/L | 98.9 | 80.0 | 120 | ---- |
| **Total Metals (QCLot: 680214)** | | | | | | | | | |
| mercury, total | 7439-97-6 | E508 | 0.000005 | mg/L | 0.0001 mg/L | 96.3 | 80.0 | 120 | ---- |
| **Total Metals (QCLot: 680215)** | | | | | | | | | |
| mercury, total | 7439-97-6 | E508 | 0.000005 | mg/L | 0.0001 mg/L | 95.6 | 80.0 | 120 | ---- |
| mercury, dissolved | 7439-97-6 | E509 | 0.000005 | mg/L | 0.0001 mg/L | 102 | 80.0 | 120 | ---- |
| **Dissolved Metals (QCLot: 677966)** | | | | | | | | | |
| aluminum, dissolved | 7429-90-5 | E421 | 0.001 | mg/L | 2 mg/L | 97.5 | 80.0 | 120 | ---- |
| antimony, dissolved | 7440-36-0 | E421 | 0.0001 | mg/L | 1 mg/L | 94.1 | 80.0 | 120 | ---- |
| arsenic, dissolved | 7440-38-2 | E421 | 0.0001 | mg/L | 1 mg/L | 99.4 | 80.0 | 120 | ---- |
| barium, dissolved | 7440-39-3 | E421 | 0.0001 | mg/L | 0.25 mg/L | 93.4 | 80.0 | 120 | ---- |
| beryllium, dissolved | 7440-41-7 | E421 | 0.00002 | mg/L | 0.1 mg/L | 94.8 | 80.0 | 120 | ---- |
| bismuth, dissolved | 7440-69-9 | E421 | 0.00005 | mg/L | 1 mg/L | 98.9 | 80.0 | 120 | ---- |
| boron, dissolved | 7440-42-8 | E421 | 0.01 | mg/L | 1 mg/L | 86.4 | 80.0 | 120 | ---- |
| cadmium, dissolved | 7440-43-9 | E421 | 0.000005 | mg/L | 0.1 mg/L | 96.9 | 80.0 | 120 | ---- |
| calcium, dissolved | 7440-70-2 | E421 | 0.05 | mg/L | 50 mg/L | 98.2 | 80.0 | 120 | ---- |
| cesium, dissolved | 7440-46-2 | E421 | 0.00001 | mg/L | 0.05 mg/L | 95.4 | 80.0 | 120 | ---- |

Sub-Matrix: **Water**

| Analyte | CAS Number | Method | LOR | Unit | Laboratory Control Sample (LCS) Report | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Spike | Recovery (%) | Recovery Limits (%) | | |
| | | | | | Concentration | LCS | Low | High | Qualifier |
| **Dissolved Metals (QCLot: 677966) - continued** | | | | | | | | | |
| chromium, dissolved | 7440-47-3 | E421 | 0.0005 | mg/L | 0.25 mg/L | 95.6 | 80.0 | 120 | ---- |
| cobalt, dissolved | 7440-48-4 | E421 | 0.0001 | mg/L | 0.25 mg/L | 96.8 | 80.0 | 120 | ---- |
| copper, dissolved | 7440-50-8 | E421 | 0.0002 | mg/L | 0.25 mg/L | 95.8 | 80.0 | 120 | ---- |
| iron, dissolved | 7439-89-6 | E421 | 0.01 | mg/L | 1 mg/L | 98.6 | 80.0 | 120 | ---- |
| lead, dissolved | 7439-92-1 | E421 | 0.00005 | mg/L | 0.5 mg/L | 98.2 | 80.0 | 120 | ---- |
| lithium, dissolved | 7439-93-2 | E421 | 0.001 | mg/L | 0.25 mg/L | 91.0 | 80.0 | 120 | ---- |
| magnesium, dissolved | 7439-95-4 | E421 | 0.005 | mg/L | 50 mg/L | 99.8 | 80.0 | 120 | ---- |
| manganese, dissolved | 7439-96-5 | E421 | 0.0001 | mg/L | 0.25 mg/L | 95.6 | 80.0 | 120 | ---- |
| molybdenum, dissolved | 7439-98-7 | E421 | 0.00005 | mg/L | 0.25 mg/L | 94.1 | 80.0 | 120 | ---- |
| nickel, dissolved | 7440-02-0 | E421 | 0.0005 | mg/L | 0.5 mg/L | 94.4 | 80.0 | 120 | ---- |
| phosphorus, dissolved | 7723-14-0 | E421 | 0.05 | mg/L | 10 mg/L | 108 | 80.0 | 120 | ---- |
| potassium, dissolved | 7440-09-7 | E421 | 0.05 | mg/L | 50 mg/L | 98.4 | 80.0 | 120 | ---- |
| rubidium, dissolved | 7440-17-7 | E421 | 0.0002 | mg/L | 0.1 mg/L | 100 | 80.0 | 120 | ---- |
| selenium, dissolved | 7782-49-2 | E421 | 0.00005 | mg/L | 1 mg/L | 93.1 | 80.0 | 120 | ---- |
| silicon, dissolved | 7440-21-3 | E421 | 0.05 | mg/L | 10 mg/L | 97.1 | 80.0 | 120 | ---- |
| silver, dissolved | 7440-22-4 | E421 | 0.00001 | mg/L | 0.1 mg/L | 87.2 | 80.0 | 120 | ---- |
| sodium, dissolved | 7440-23-5 | E421 | 0.05 | mg/L | 50 mg/L | 103 | 80.0 | 120 | ---- |
| strontium, dissolved | 7440-24-6 | E421 | 0.0002 | mg/L | 0.25 mg/L | 100 | 80.0 | 120 | ---- |
| sulfur, dissolved | 7704-34-9 | E421 | 0.5 | mg/L | 50 mg/L | 95.4 | 80.0 | 120 | ---- |
| tellurium, dissolved | 13494-80-9 | E421 | 0.0002 | mg/L | 0.1 mg/L | 92.2 | 80.0 | 120 | ---- |
| thallium, dissolved | 7440-28-0 | E421 | 0.00001 | mg/L | 1 mg/L | 100 | 80.0 | 120 | ---- |
| thorium, dissolved | 7440-29-1 | E421 | 0.0001 | mg/L | 0.1 mg/L | 94.8 | 80.0 | 120 | ---- |
| tin, dissolved | 7440-31-5 | E421 | 0.0001 | mg/L | 0.5 mg/L | 95.2 | 80.0 | 120 | ---- |
| titanium, dissolved | 7440-32-6 | E421 | 0.0003 | mg/L | 0.25 mg/L | 91.0 | 80.0 | 120 | ---- |
| tungsten, dissolved | 7440-33-7 | E421 | 0.0001 | mg/L | 0.1 mg/L | 97.0 | 80.0 | 120 | ---- |
| uranium, dissolved | 7440-61-1 | E421 | 0.00001 | mg/L | 0.005 mg/L | 104 | 80.0 | 120 | ---- |
| vanadium, dissolved | 7440-62-2 | E421 | 0.0005 | mg/L | 0.5 mg/L | 95.6 | 80.0 | 120 | ---- |
| zinc, dissolved | 7440-66-6 | E421 | 0.001 | mg/L | 0.5 mg/L | 100 | 80.0 | 120 | ---- |
| zirconium, dissolved | 7440-67-7 | E421 | 0.0002 | mg/L | 0.1 mg/L | 93.6 | 80.0 | 120 | ---- |
| **Aggregate Organics (QCLot: 674966)** | | | | | | | | | |
| biochemical oxygen demand [BOD] | ---- | E550 | 2 | mg/L | 198 mg/L | 94.9 | 85.0 | 115 | ---- |

## Matrix Spike (MS) Report

A Matrix Spike (MS) is a randomly selected intra-laboratory replicate sample that has been fortified (spiked) with test analytes at known concentration, and processed in an identical manner to test samples. Matrix Spikes provide information regarding analyte recovery and potential matrix effects. MS DQO exceedances due to sample matrix may sometimes be unavoidable; in such cases, test results for the associated sample (or similar samples) may be subject to bias. ND – Recovery not determined, background level >= 1x spike level.

Sub-Matrix: **Water**

| | | | | | Matrix Spike (MS) Report | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Spike | | Recovery (%) | Recovery Limits (%) | | |
| Laboratory sample ID | Client sample ID | Analyte | CAS Number | Method | Concentration | Target | MS | Low | High | Qualifier |
| **Anions and Nutrients (QCLot: 679199)** | | | | | | | | | | |
| VA22C3429-001 | Anonymous | ammonia, total (as N) | 7664-41-7 | E298 | ND mg/L | 0.1 mg/L | ND | 75.0 | 125 | MS-B |
| **Anions and Nutrients (QCLot: 679202)** | | | | | | | | | | |
| VA22C3452-002 | Anonymous | nitrogen, total | 7727-37-9 | E366 | 0.404 mg/L | 0.4 mg/L | 101 | 70.0 | 130 | ---- |
| **Anions and Nutrients (QCLot: 679203)** | | | | | | | | | | |
| VA22C3452-002 | Anonymous | phosphorus, total | 7723-14-0 | E372-U | 0.0462 mg/L | 0.05 mg/L | 92.3 | 70.0 | 130 | ---- |
| **Organic / Inorganic Carbon (QCLot: 679204)** | | | | | | | | | | |
| VA22C3658-002 | SW-21 | carbon, dissolved organic [DOC] | ---- | E358-L | ND mg/L | 5 mg/L | ND | 70.0 | 130 | ---- |
| **Total Metals (QCLot: 677894)** | | | | | | | | | | |
| VA22C3717-004 | Anonymous | aluminum, total | 7429-90-5 | E420 | 0.201 mg/L | 0.2 mg/L | 101 | 70.0 | 130 | ---- |
| | | antimony, total | 7440-36-0 | E420 | 0.0210 mg/L | 0.02 mg/L | 105 | 70.0 | 130 | ---- |
| | | arsenic, total | 7440-38-2 | E420 | 0.0213 mg/L | 0.02 mg/L | 106 | 70.0 | 130 | ---- |
| | | barium, total | 7440-39-3 | E420 | ND mg/L | 0.02 mg/L | ND | 70.0 | 130 | ---- |
| | | beryllium, total | 7440-41-7 | E420 | 0.0383 mg/L | 0.04 mg/L | 95.7 | 70.0 | 130 | ---- |
| | | bismuth, total | 7440-69-9 | E420 | 0.00948 mg/L | 0.01 mg/L | 94.8 | 70.0 | 130 | ---- |
| | | boron, total | 7440-42-8 | E420 | 0.086 mg/L | 0.1 mg/L | 85.8 | 70.0 | 130 | ---- |
| | | cadmium, total | 7440-43-9 | E420 | 0.00378 mg/L | 0.004 mg/L | 94.5 | 70.0 | 130 | ---- |
| | | calcium, total | 7440-70-2 | E420 | ND mg/L | 4 mg/L | ND | 70.0 | 130 | ---- |
| | | cesium, total | 7440-46-2 | E420 | 0.0105 mg/L | 0.01 mg/L | 105 | 70.0 | 130 | ---- |
| | | chromium, total | 7440-47-3 | E420 | 0.0417 mg/L | 0.04 mg/L | 104 | 70.0 | 130 | ---- |
| | | cobalt, total | 7440-48-4 | E420 | 0.0198 mg/L | 0.02 mg/L | 98.8 | 70.0 | 130 | ---- |
| | | copper, total | 7440-50-8 | E420 | 0.0192 mg/L | 0.02 mg/L | 96.0 | 70.0 | 130 | ---- |
| | | iron, total | 7439-89-6 | E420 | 2.03 mg/L | 2 mg/L | 101 | 70.0 | 130 | ---- |
| | | lead, total | 7439-92-1 | E420 | 0.0185 mg/L | 0.02 mg/L | 92.6 | 70.0 | 130 | ---- |
| | | lithium, total | 7439-93-2 | E420 | 0.0907 mg/L | 0.1 mg/L | 90.7 | 70.0 | 130 | ---- |
| | | magnesium, total | 7439-95-4 | E420 | ND mg/L | 1 mg/L | ND | 70.0 | 130 | ---- |
| | | manganese, total | 7439-96-5 | E420 | 0.0196 mg/L | 0.02 mg/L | 97.9 | 70.0 | 130 | ---- |
| | | molybdenum, total | 7439-98-7 | E420 | 0.0199 mg/L | 0.02 mg/L | 99.3 | 70.0 | 130 | ---- |
| | | nickel, total | 7440-02-0 | E420 | 0.0372 mg/L | 0.04 mg/L | 93.1 | 70.0 | 130 | ---- |
| | | phosphorus, total | 7723-14-0 | E420 | 10.6 mg/L | 10 mg/L | 106 | 70.0 | 130 | ---- |
| | | potassium, total | 7440-09-7 | E420 | 4.11 mg/L | 4 mg/L | 103 | 70.0 | 130 | ---- |
| | | rubidium, total | 7440-17-7 | E420 | 0.0210 mg/L | 0.02 mg/L | 105 | 70.0 | 130 | ---- |

Sub-Matrix: **Water**

| | | | | | Matrix Spike (MS) Report | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Spike | | Recovery (%) | Recovery Limits (%) | | |
| Laboratory sample ID | Client sample ID | Analyte | CAS Number | Method | Concentration | Target | MS | Low | High | Qualifier |
| **Total Metals (QCLot: 677894) - continued** | | | | | | | | | | |
| VA22C3717-004 | Anonymous | selenium, total | 7782-49-2 | E420 | ND mg/L | 0.04 mg/L | ND | 70.0 | 130 | ---- |
| | | silicon, total | 7440-21-3 | E420 | 9.15 mg/L | 10 mg/L | 91.5 | 70.0 | 130 | ---- |
| | | silver, total | 7440-22-4 | E420 | 0.00417 mg/L | 0.004 mg/L | 104 | 70.0 | 130 | ---- |
| | | sodium, total | 7440-23-5 | E420 | ND mg/L | 2 mg/L | ND | 70.0 | 130 | ---- |
| | | strontium, total | 7440-24-6 | E420 | ND mg/L | 0.02 mg/L | ND | 70.0 | 130 | ---- |
| | | sulfur, total | 7704-34-9 | E420 | ND mg/L | 20 mg/L | ND | 70.0 | 130 | ---- |
| | | tellurium, total | 13494-80-9 | E420 | 0.0410 mg/L | 0.04 mg/L | 102 | 70.0 | 130 | ---- |
| | | thallium, total | 7440-28-0 | E420 | 0.00379 mg/L | 0.004 mg/L | 94.7 | 70.0 | 130 | ---- |
| | | thorium, total | 7440-29-1 | E420 | 0.0210 mg/L | 0.02 mg/L | 105 | 70.0 | 130 | ---- |
| | | tin, total | 7440-31-5 | E420 | 0.0200 mg/L | 0.02 mg/L | 99.8 | 70.0 | 130 | ---- |
| | | titanium, total | 7440-32-6 | E420 | 0.0417 mg/L | 0.04 mg/L | 104 | 70.0 | 130 | ---- |
| | | tungsten, total | 7440-33-7 | E420 | 0.0197 mg/L | 0.02 mg/L | 98.5 | 70.0 | 130 | ---- |
| | | uranium, total | 7440-61-1 | E420 | ND mg/L | 0.004 mg/L | ND | 70.0 | 130 | ---- |
| | | vanadium, total | 7440-62-2 | E420 | 0.107 mg/L | 0.1 mg/L | 107 | 70.0 | 130 | ---- |
| | | zinc, total | 7440-66-6 | E420 | 0.378 mg/L | 0.4 mg/L | 94.4 | 70.0 | 130 | ---- |
| | | zirconium, total | 7440-67-7 | E420 | 0.0413 mg/L | 0.04 mg/L | 103 | 70.0 | 130 | ---- |
| **Total Metals (QCLot: 680214)** | | | | | | | | | | |
| FJ2202796-002 | Anonymous | mercury, total | 7439-97-6 | E508 | 0.000101 mg/L | 0.0001 mg/L | 101 | 70.0 | 130 | ---- |
| **Total Metals (QCLot: 680215)** | | | | | | | | | | |
| VA22C3658-003 | Further Upstream | mercury, total | 7439-97-6 | E508 | 0.0000907 mg/L | 0.0001 mg/L | 90.7 | 70.0 | 130 | ---- |
| **Dissolved Metals (QCLot: 677568)** | | | | | | | | | | |
| VA22C3632-008 | Anonymous | mercury, dissolved | 7439-97-6 | E509 | 0.000105 mg/L | 0.0001 mg/L | 105 | 70.0 | 130 | ---- |
| **Dissolved Metals (QCLot: 677966)** | | | | | | | | | | |
| VA22C3452-002 | Anonymous | aluminum, dissolved | 7429-90-5 | E421 | 0.198 mg/L | 0.2 mg/L | 99.0 | 70.0 | 130 | ---- |
| | | antimony, dissolved | 7440-36-0 | E421 | 0.0184 mg/L | 0.02 mg/L | 92.0 | 70.0 | 130 | ---- |
| | | arsenic, dissolved | 7440-38-2 | E421 | 0.0206 mg/L | 0.02 mg/L | 103 | 70.0 | 130 | ---- |
| | | barium, dissolved | 7440-39-3 | E421 | 0.0195 mg/L | 0.02 mg/L | 97.5 | 70.0 | 130 | ---- |
| | | beryllium, dissolved | 7440-41-7 | E421 | 0.0411 mg/L | 0.04 mg/L | 103 | 70.0 | 130 | ---- |
| | | bismuth, dissolved | 7440-69-9 | E421 | 0.00986 mg/L | 0.01 mg/L | 98.6 | 70.0 | 130 | ---- |
| | | boron, dissolved | 7440-42-8 | E421 | 0.088 mg/L | 0.1 mg/L | 88.2 | 70.0 | 130 | ---- |
| | | cadmium, dissolved | 7440-43-9 | E421 | 0.00412 mg/L | 0.004 mg/L | 103 | 70.0 | 130 | ---- |
| | | calcium, dissolved | 7440-70-2 | E421 | 4.08 mg/L | 4 mg/L | 102 | 70.0 | 130 | ---- |
| | | cesium, dissolved | 7440-46-2 | E421 | 0.00962 mg/L | 0.01 mg/L | 96.2 | 70.0 | 130 | ---- |
| | | chromium, dissolved | 7440-47-3 | E421 | 0.0406 mg/L | 0.04 mg/L | 102 | 70.0 | 130 | ---- |
| | | cobalt, dissolved | 7440-48-4 | E421 | 0.0203 mg/L | 0.02 mg/L | 101 | 70.0 | 130 | ---- |

Sub-Matrix: **Water**

| | | | | | Matrix Spike (MS) Report | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Spike | | Recovery (%) | Recovery Limits (%) | | |
| Laboratory sample ID | Client sample ID | Analyte | CAS Number | Method | Concentration | Target | MS | Low | High | Qualifier |
| **Dissolved Metals (QCLot: 677966) - continued** | | | | | | | | | | |
| VA22C3452-002 | Anonymous | copper, dissolved | 7440-50-8 | E421 | 0.0206 mg/L | 0.02 mg/L | 103 | 70.0 | 130 | ---- |
| | | iron, dissolved | 7439-89-6 | E421 | 2.04 mg/L | 2 mg/L | 102 | 70.0 | 130 | ---- |
| | | lead, dissolved | 7439-92-1 | E421 | 0.0194 mg/L | 0.02 mg/L | 97.3 | 70.0 | 130 | ---- |
| | | lithium, dissolved | 7439-93-2 | E421 | 0.0975 mg/L | 0.1 mg/L | 97.5 | 70.0 | 130 | ---- |
| | | magnesium, dissolved | 7439-95-4 | E421 | 1.02 mg/L | 1 mg/L | 102 | 70.0 | 130 | ---- |
| | | manganese, dissolved | 7439-96-5 | E421 | 0.0203 mg/L | 0.02 mg/L | 101 | 70.0 | 130 | ---- |
| | | molybdenum, dissolved | 7439-98-7 | E421 | 0.0180 mg/L | 0.02 mg/L | 90.1 | 70.0 | 130 | ---- |
| | | nickel, dissolved | 7440-02-0 | E421 | 0.0404 mg/L | 0.04 mg/L | 101 | 70.0 | 130 | ---- |
| | | phosphorus, dissolved | 7723-14-0 | E421 | 10.3 mg/L | 10 mg/L | 103 | 70.0 | 130 | ---- |
| | | potassium, dissolved | 7440-09-7 | E421 | 4.06 mg/L | 4 mg/L | 102 | 70.0 | 130 | ---- |
| | | rubidium, dissolved | 7440-17-7 | E421 | 0.0208 mg/L | 0.02 mg/L | 104 | 70.0 | 130 | ---- |
| | | selenium, dissolved | 7782-49-2 | E421 | 0.0384 mg/L | 0.04 mg/L | 95.9 | 70.0 | 130 | ---- |
| | | silicon, dissolved | 7440-21-3 | E421 | 9.30 mg/L | 10 mg/L | 93.0 | 70.0 | 130 | ---- |
| | | silver, dissolved | 7440-22-4 | E421 | 0.00375 mg/L | 0.004 mg/L | 93.8 | 70.0 | 130 | ---- |
| | | sodium, dissolved | 7440-23-5 | E421 | 2.07 mg/L | 2 mg/L | 104 | 70.0 | 130 | ---- |
| | | strontium, dissolved | 7440-24-6 | E421 | 0.0207 mg/L | 0.02 mg/L | 104 | 70.0 | 130 | ---- |
| | | sulfur, dissolved | 7704-34-9 | E421 | 19.8 mg/L | 20 mg/L | 99.2 | 70.0 | 130 | ---- |
| | | tellurium, dissolved | 13494-80-9 | E421 | 0.0371 mg/L | 0.04 mg/L | 92.7 | 70.0 | 130 | ---- |
| | | thallium, dissolved | 7440-28-0 | E421 | 0.00389 mg/L | 0.004 mg/L | 97.4 | 70.0 | 130 | ---- |
| | | thorium, dissolved | 7440-29-1 | E421 | 0.0203 mg/L | 0.02 mg/L | 101 | 70.0 | 130 | ---- |
| | | tin, dissolved | 7440-31-5 | E421 | 0.0186 mg/L | 0.02 mg/L | 93.1 | 70.0 | 130 | ---- |
| | | titanium, dissolved | 7440-32-6 | E421 | 0.0379 mg/L | 0.04 mg/L | 94.8 | 70.0 | 130 | ---- |
| | | tungsten, dissolved | 7440-33-7 | E421 | 0.0187 mg/L | 0.02 mg/L | 93.3 | 70.0 | 130 | ---- |
| | | uranium, dissolved | 7440-61-1 | E421 | 0.00394 mg/L | 0.004 mg/L | 98.6 | 70.0 | 130 | ---- |
| | | vanadium, dissolved | 7440-62-2 | E421 | 0.100 mg/L | 0.1 mg/L | 100 | 70.0 | 130 | ---- |
| | | zinc, dissolved | 7440-66-6 | E421 | 0.429 mg/L | 0.4 mg/L | 107 | 70.0 | 130 | ---- |
| | | zirconium, dissolved | 7440-67-7 | E421 | 0.0379 mg/L | 0.04 mg/L | 94.7 | 70.0 | 130 | ---- |

## Qualifiers

| Qualifier | Description |
|---|---|
| *MS-B* | *Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.* |

ALS Environmental
www.alsglobal.com

# Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

Affix ALS barcode label here
(lab use only)

COC Number: 17 -

Page of

| Report To | Contact and company name below will appear on the final report |
|---|---|
| Company: | Regional District of Kitimat-Stikine |
| Contact: | Hannah Shinton |
| Phone: | 250-615-6100 |
| | Company address below will appear on the final report |
| Street: | 4545 Lazelle Avenue |
| City/Province: | Terrace/BC |
| Postal Code: | V8G4E1 |
| **Invoice To** | Same as Report To ☐ YES ☑ NO |
| | Copy of Invoice with Report ☑ YES ☐ NO |
| Company: | Regional District of Kitimat-Stikine |
| Contact: | Nicole Lavoie |

| Report Format / Distribution | |
|---|---|
| Select Report Format: | ☑ PDF ☑ EXCEL ☑ EDD (DIGITAL) |
| Quality Control (QC) Report with Report | ☑ YES ☐ NO |
| ☑ Compare Results to Criteria on Report - provide details below if box checked | |
| Select Distribution: | ☑ EMAIL ☐ MAIL ☐ FAX |
| Email 1 or Fax | hshinton@rdks.bc.ca |
| Email 2 | enviro.dept@rdks.bc.ca |
| Email 3 | |
| **Invoice Distribution** | |
| Select Invoice Distribution: | ☑ EMAIL ☐ MAIL ☐ FAX |
| Email 1 or Fax | anne-maries@rdks.bc.ca |
| Email 2 | enviro.dept@rdks.bc.ca; hshinton@rdks.bc.ca |

| Project Information | |
|---|---|
| ALS Account # / Quote #: | VA19-RDKS100-001 |
| Job #: | Kitwanga Landfill Surface Water |
| PO / AFE: | |
| LSD: | |
| ALS Lab Work Order # (lab use only): | |

| Oil and Gas Required Fields (client use) | |
|---|---|
| AFE/Cost Center: | PO# |
| Major/Minor Code: | Routing Code: |
| Requisitioner: | |
| Location: | |
| ALS Contact: | Sampler: H. Shinton |

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

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

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

EMERGENCY: 1 Business day [E1 - 100%] ☐ | Same Day, Weekend or Statutory holiday [E2 -200% (Laboratory opening fees may apply)] ☐

Date and Time Required for all E&P TATs:

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

**Analysis Request**

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

| ALS Sample # (lab use only) | Sample Identification and/or Coordinates (This description will appear on the report) | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | BOD (P) | Total Nitrogen (P) | Phosphorus (P) | Ammonia (P) | pH | Total Metals (P) | Dissolved Metals (F/P) | Conductivity | Dissolved Organic Carbon (F/P) | SAMPLES ON HOLD | Sample is hazardous (please provide further detail) | NUMBER OF CONTAINERS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Upstream | 27-Sep-22 | 9:15 | Water | R | R | R | R | R | R | R | R | R | | | |
| | SW-21 | 27-Sep-22 | 12:00 | Water | R | R | R | R | R | R | R | R | R | | | |
| | Further Upstream | 27-Spe-22 | 14:38 | Water | R | R | R | R | R | R | R | R | R | | | |
| | Travel Blank | 27-Sep-22 | - | Water | R | | | R | | R | R | | | | | |

Environmental Division
Vancouver
Work Order Reference
VA22C3658

Telephone : +1 604 253 4188

**Terrace Shipping**
#1 Coolers
#___ Carbouys
Ground ☐
Air ☒
SFX ☐

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

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

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

...port by clicking on the drop-down list below
...OC only)
...Quality Guidelines (MAY, 2015)

**SAMPLE CONDITION AS RECEIVED (lab use only)**

Frozen ☐ | SIF Observations Yes ☐ No ☐

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

Cooling Initiated ☐

| INITIAL COOLER TEMPERATURES °C | | | | FINAL COOLER TEMPERATURES °C | | | |
|---|---|---|---|---|---|---|---|
| 5.3 | | | | 5°C | | | |

| SHIPMENT RELEASE (client use) | | |
|---|---|---|
| Released by: Hannah Shinton | Date: Sept. 28 2022 | Time: |

| INITIAL SHIPMENT RECEPTION (lab use only) | | |
|---|---|---|
| Received by: Chris | Date: 28 Sep 22 | Time: 1600 |

| FINAL SHIPMENT RECEPTION (lab use only) | | |
|---|---|---|
| Received by: PC | Date: 9/30/22 | Time: 11:55 |

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

SEPT 2017 FRONT

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

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

ALS Environmental

www.alsglobal.com

# Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

Affix ALS barcode label here (lab use only)

COC Number: 17 -

Page of

| Report To | Contact and company name below will appear on the final report |
|---|---|
| Company: | Regional District of Kitimat-Stikine |
| Contact: | Hannah Shinton |
| Phone: | 250-615-6100 |
| | Company address below will appear on the final report |
| Street: | 4545 Lazelle Avenue |
| City/Province: | Terrace/BC |
| Postal Code: | V8G4E1 |
| Invoice To | Same as Report To ☐ YES ☑ NO |
| | Copy of Invoice with Report ☑ YES ☐ NO |
| Company: | Regional District of Kitimat-Stikine |
| Contact: | Nicole Lavoie |

| Report Format / Distribution | |
|---|---|
| Select Report Format: | ☑ PDF ☑ EXCEL ☑ EDD (DIGITAL) |
| Quality Control (QC) Report with Report | ☑ YES ☐ NO |
| ☑ Compare Results to Criteria on Report - provide details below if box checked | |
| Select Distribution: | ☑ EMAIL ☐ MAIL ☐ FAX |
| Email 1 or Fax | hshinton@rdks.bc.ca |
| Email 2 | enviro.dept@rdks.bc.ca |
| Email 3 | |
| **Invoice Distribution** | |
| Select Invoice Distribution: | ☑ EMAIL ☐ MAIL ☐ FAX |
| Email 1 or Fax | anne-marles@rdks.bc.ca |
| Email 2 | enviro.dept@rdks.bc.ca; hshinton@rdks.bc.ca |

| Select Service Level Below - Contact your AM to confirm all E&P TATs (surcharges may apply) | |
|---|---|
| Regular [R] | ☑ Standard TAT if received by 3 pm - business days - no surcharges apply |
| PRIORITY (Business Days) | 4 day [P4-20%] ☐ |
| | 3 day [P3-25%] ☐ |
| | 2 day [P2-50%] ☐ |
| EMERGENCY | 1 Business day [E1 - 100%] ☐ |
| | Same Day, Weekend or Statutory holiday [E2 -200% (Laboratory opening fees may apply) ] ☐ |
| Date and Time Required for all E&P TATs: | |
| For tests that can not be performed according to the service level selected, you will be contacted. | |

| Project Information | | Oil and Gas Required Fields (client use) | |
|---|---|---|---|
| ALS Account # / Quote #: | VA19-RDKS100-001 | AFE/Cost Center: | PO# |
| Job #: | Kitwanga Landfill Surface Water | Major/Minor Code: | Routing Code: |
| PO / AFE: | | Requisitioner: | |
| LSD: | | Location: | |
| ALS Lab Work Order # (lab use only): | | ALS Contact: | Sampler: H. Shinton |

Analysis Request

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

| ALS Sample # (lab use only) | Sample Identification and/or Coordinates (This description will appear on the report) | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | BOD | Total Nitrogen | Phosphorus | Ammonia | pH | Total Metals | Dissolved Metals | Conductivity | Dissolved Organic Carbon | SAMPLES ON HOLD | Sample is hazardous (please provide further detail) | NUMBER OF CONTAINERS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | P | P | P | P | | P | F/P | | F/P | | | |
| | Upstream | 27-Sep-22 | 9:15 | Water | R | R | R | R | R | R | R | R | R | | | |
| | SW-21 | 27-Sep-22 | 12:00 | Water | R | R | R | R | R | R | R | R | R | | | |
| | Further Upstream | 27-Spe-22 | 14:38 | Water | R | R | R | R | R | R | R | R | R | | | |
| | Travel Blank | 27-Sep-22 | - | Water | R | | | R | | R | R | | | | | |

Environmental Division
Vancouver
Work Order Reference
VA22C3658

Telephone : +1 604 253 4188

**Terrace Shipping**
#1 Coolers
#___ Carbouys
Ground ☐
Air ☒
SFX ☐

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

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

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

eport by clicking on the drop-down list below
OC only)
uality Guidelines (MAY, 2015)

SAMPLE CONDITION AS RECEIVED (lab use only)

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

| INITIAL COOLER TEMPERATURES °C | | | | FINAL COOLER TEMPERATURES °C | | | |
|---|---|---|---|---|---|---|---|
| 5.3 | | | | 5.0 | | | |

| SHIPMENT RELEASE (client use) | | |
|---|---|---|
| Released by: Hannah Shinton | Date: Sept. 28 2022 | Time: |

| INITIAL SHIPMENT RECEPTION (lab use only) | | |
|---|---|---|
| Received by: Chris | Date: 28 Sep 22 | Time: 1600 |

| FINAL SHIPMENT RECEPTION (lab use only) | | |
|---|---|---|
| Received by: PC | Date: 9/30/22 | Time: 11:55 |

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

SEPT 2017 FRONT

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

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

# Appendix E: Data Summary Tables

**Table E-1**
**Kitwanga Landfill**
Water Quality Results

| Analyte | Unit | Guideline | | | Sampling Location | Downstream | Further Upstream | Upstream | Upstream | RPD | Upstream | Upstream | RPD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Date Sampled | 13-Apr-22 | 27-Sep-22 | 13-Apr-22 | 13-Apr-22 | | 27-Sep-22 | 27-Sep-22 | |
| | | | | | Lab Sample ID | VA22A8039-002 | VA22C3658-003 | VA22A8039-001 | VA22A8039-004 | | VA22C3658-001 | VA22C3658-002 | |
| | | | | | Sample Type | Normal | Normal | Normal | Duplicate | | Normal | Duplicate | |
| | | BCAWQG AL (LT) | BCAWQG AL (ST) | BCWWQG AL | | | | | | | | | |
| **Lab Results** | | | | | | | | | | | | | |
| **Anions and Cations in meq/L unit** | | | | | | | | | | | | | |
| Aluminum (meq/L) (calculated) | meq/L | NG | NG | NG | | 0.0109 | 0.00078 | 0.0138 | 0.0149 | 7.67 | 0.0013 | 0.00118 | 9.68 |
| Barium (meq/L) (calculated) | meq/L | NG | NG | NG | | 0.000243 | 0.000805 | 0.000259 | 0.000259 | 0.00 | 0.000671 | 0.000654 | 2.57 |
| Boron (meq/L) (calculated) | meq/L | NG | NG | NG | | <0.0028 | <0.0028 | <0.0028 | <0.0028 | - | <0.0028 | <0.0028 | - |
| Bromide (meq/L) (calculated) | meq/L | NG | NG | NG | | | | | | - | | | - |
| Calcium (meq/L) (calculated) | meq/L | NG | NG | NG | | 0.378 | 1.49 | 0.364 | 0.371 | 1.90 | 1.31 | 1.22 | 7.11 |
| Calcium (total, meq/L) (calculated) | meq/L | NG | NG | NG | | 0.395 | 1.51 | 0.384 | 0.375 | 2.37 | 1.25 | 1.25 | 0.00 |
| Chloride (meq/L) (calculated) | meq/L | NG | NG | NG | | | | | | - | | | - |
| Chromium (meq/L) (calculated) | meq/L | NG | NG | NG | | <0.000029 | <0.000029 | <0.000029 | <0.000029 | - | <0.000029 | <0.000029 | - |
| Copper (meq/L) (calculated) | meq/L | NG | NG | NG | | 0.0000434 | 0.0000072 | 0.0000463 | 0.0000456 | 1.52 | 0.0000324 | 0.0000346 | 6.57 |
| Fluoride (meq/L) (calculated) | meq/L | NG | NG | NG | | | | | | - | | | - |
| Lead (meq/L) (calculated) | meq/L | NG | NG | NG | | <0.00000048 | <0.00000048 | <0.00000048 | <0.00000048 | - | <0.00000048 | <0.00000048 | - |
| Lithium (meq/L) (calculated) | meq/L | NG | NG | NG | | <0.00014 | <0.00014 | <0.00014 | <0.00014 | - | <0.00014 | <0.00014 | - |
| Magnesium (meq/L) (calculated) | meq/L | NG | NG | NG | | 0.162 | 0.573 | 0.165 | 0.161 | 2.45 | 0.541 | 0.545 | 0.74 |
| Magnesium (total, meq/L) (calculated) | meq/L | NG | NG | NG | | 0.178 | 0.621 | 0.165 | 0.165 | 0.00 | 0.564 | 0.562 | 0.36 |
| Potassium (meq/L) (calculated) | meq/L | NG | NG | NG | | 0.00934 | 0.0263 | 0.00936 | 0.0098 | 4.59 | 0.0174 | 0.0175 | 0.57 |
| Potassium (total, meq/L) (calculated) | meq/L | NG | NG | NG | | 0.0109 | 0.0263 | 0.0103 | 0.00962 | 6.83 | 0.0182 | 0.0176 | 3.35 |
| Sodium (meq/L) (calculated) | meq/L | NG | NG | NG | | 0.135 | 0.371 | 0.132 | 0.131 | 0.76 | 0.309 | 0.308 | 0.32 |
| Sodium (total, meq/L) (calculated) | meq/L | NG | NG | NG | | 0.134 | 0.398 | 0.127 | 0.13 | 2.33 | 0.322 | 0.32 | 0.62 |
| Strontium (meq/L) (calculated) | meq/L | NG | NG | NG | | 0.0018 | 0.0068 | 0.00181 | 0.0018 | 0.55 | 0.00557 | 0.00555 | 0.36 |
| Sulfate (meq/L) (calculated) | meq/L | NG | NG | NG | | | | | | - | | | - |
| Zinc (meq/L) (calculated) | meq/L | NG | NG | NG | | <0.000031 | <0.000031 | <0.000031 | 0.000043 | - | 0.00012 | <0.000031 | - |
| | | | | | | | | | | | | | - |
| **Dissolved Metals** | | | | | | | | | | | | | - |
| Aluminum (dissolved) | µg/L | Calc [1.1] | Calc [2.1] | NG | | 98.3 | 7 | 124 | 134 | 7.75 | 11.7 | 10.6 | 9.87 |
| Antimony (dissolved) | µg/L | NG | NG | 9 [3.1] | | <0.10 | <0.10 | <0.10 | <0.10 | - | <0.10 | <0.10 | - |
| Arsenic (dissolved) | µg/L | 5 [1.2] | NG | NG | | 0.22 | 0.86 | 0.24 | 0.24 | 0.00 | 0.26 | 0.24 | 8.00 |
| Barium (dissolved) | µg/L | NG | NG | 1000 | | 16.7 | 55.3 | 17.8 | 17.8 | 0.00 | 46.1 | 44.9 | 2.64 |
| Beryllium (dissolved) | µg/L | NG | NG | 0.13 | | <0.100 | <0.100 | <0.100 | <0.100 | - | <0.100 | <0.100 | - |
| Bismuth (dissolved) | µg/L | NG | NG | NG | | <0.050 | <0.050 | <0.050 | <0.050 | - | <0.050 | <0.050 | - |
| Boron (dissolved) | µg/L | 1200 [1.3] | NG | NG | | <10 | <10 | <10 | <10 | - | <10 | <10 | - |
| Cadmium (dissolved) | µg/L | Calc [1.4] | Calc [2.2] | NG | | <0.0050 | <0.0050 | <0.0050 | <0.0050 | - | 0.0052 | <0.0050 | - |
| Calcium (dissolved) | mg/L | NG | NG | N [3.2] | | 7.58 | 29.8 | 7.29 | 7.44 | 2.04 | 26.2 | 24.5 | 6.71 |
| Cesium (dissolved) | µg/L | NG | NG | NG | | <0.010 | <0.010 | <0.010 | <0.010 | - | <0.010 | <0.010 | - |
| Chromium (dissolved) | µg/L | NG | NG | 1 [3.3] | | <0.50 | <0.50 | <0.50 | <0.50 | - | <0.50 | <0.50 | - |
| Cobalt (dissolved) | µg/L | 4 [1.5] | 110 [2.3] | NG | | <0.10 | 0.41 | <0.10 | <0.10 | - | <0.10 | <0.10 | - |
| Copper (dissolved) | µg/L | N [1.6] | N [2.4] | NG | | 1.38 | 0.23 | 1.47 | 1.45 | 1.37 | 1.03 | 1.1 | 6.57 |
| Hardness (as CaCO3), dissolved | mg/L | NG | NG | NG | | 27 | 103 | 26.4 | 26.6 | 0.75 | 92.5 | 88.4 | 4.53 |
| Iron (dissolved) | µg/L | NG | 350 [2.5] | NG | | 160 | 546 | 185 | 178 | 3.86 | 10 | 10 | 0.00 |
| Lead (dissolved) | µg/L | Calc [1.7] | Calc [2.6] | NG | | <0.050 | <0.050 | <0.050 | <0.050 | - | <0.050 | <0.050 | - |
| Lithium (dissolved) | µg/L | NG | NG | NG | | <1.0 | <1.0 | <1.0 | <1.0 | #VALUE! | <1.0 | <1.0 | - |
| Magnesium (dissolved) | mg/L | NG | NG | NG | | 1.97 | 6.96 | 2 | 1.96 | 2.02 | 6.58 | 6.62 | 0.61 |
| Manganese (dissolved) | µg/L | Calc [1.8] | Calc [2.7] | NG | | 10.3 | 1360 | 16.7 | 16.5 | 1.20 | 4.34 | 4.34 | 0.00 |
| Mercury (dissolved) | µg/L | 0.02 [1.9] | NG | NG | | 0.0088 | <0.0050 | 0.0155 | 0.0076 | 68.40 | <0.0050 | <0.0050 | - |
| Molybdenum (dissolved) | µg/L | 7600 [1.10] | 46000 [2.8] | NG | | 0.056 | 0.272 | 0.057 | 0.052 | 9.17 | 0.092 | 0.094 | 2.15 |
| Nickel (dissolved) | µg/L | NG | NG | Calc [3.4] | | 0.52 | 0.8 | 0.57 | 0.61 | 6.78 | 0.74 | 0.76 | 2.67 |
| Phosphorus (dissolved, by ICPMS/ICPOES) | µg/L | N [1.11] | NG | NG | | <50 | <50 | <50 | <50 | - | <50 | <50 | - |
| Potassium (dissolved) | µg/L | NG | NG | NG | | 365 | 1030 | 366 | 383 | 4.54 | 679 | 686 | 1.03 |
| Rubidium (dissolved) | µg/L | NG | NG | NG | | <0.20 | 0.54 | <0.20 | <0.20 | - | <0.20 | <0.20 | - |
| Selenium (dissolved) | µg/L | 2 [1.12] | NG | NG | | <0.050 | <0.050 | 0.061 | 0.054 | 12.17 | 0.056 | 0.053 | 5.50 |
| Silicon (dissolved, as Si) | µg/L | NG | NG | NG | | 3320 | 4400 | 3360 | 3390 | 0.89 | 3310 | 3420 | 3.27 |
| Silver (dissolved) | µg/L | Calc [1.13] | Calc [2.9] | NG | | <0.010 | <0.010 | <0.010 | <0.010 | - | <0.010 | <0.010 | - |
| Sodium (dissolved) | mg/L | NG | NG | NG | | 3.1 | 8.53 | 3.03 | 3.02 | 0.33 | 7.1 | 7.08 | 0.28 |
| Strontium (dissolved) | µg/L | NG | NG | NG | | 78.9 | 298 | 79.2 | 79 | 0.25 | 244 | 243 | 0.41 |
| Sulphur (dissolved) | µg/L | NG | NG | NG | | <500 | <500 | <500 | <500 | - | <500 | <500 | - |
| Tellurium (dissolved) | µg/L | NG | NG | NG | | <0.20 | <0.20 | <0.20 | <0.20 | - | <0.20 | <0.20 | - |
| Thallium (dissolved) | µg/L | NG | NG | 0.8 [3.5] | | <0.010 | <0.010 | <0.010 | <0.010 | - | <0.010 | <0.010 | - |
| Thorium (dissolved) | µg/L | NG | NG | NG | | <0.10 | <0.10 | <0.10 | <0.10 | - | <0.10 | <0.10 | - |
| Tin (dissolved) | µg/L | NG | NG | NG | | <0.10 | <0.10 | <0.10 | <0.10 | - | <0.10 | <0.10 | - |
| Titanium (dissolved) | µg/L | NG | NG | NG | | 1.97 | <0.30 | 2.34 | 2.5 | 6.61 | <0.30 | <0.30 | - |
| Tungsten (dissolved) | µg/L | NG | NG | NG | | <0.10 | <0.10 | <0.10 | <0.10 | - | <0.10 | <0.10 | - |
| Uranium (dissolved) | µg/L | NG | NG | 8.5 | | <0.010 | <0.010 | <0.010 | <0.010 | - | <0.010 | <0.010 | - |
| Vanadium (dissolved) | µg/L | NG | NG | NG | | <0.50 | <0.50 | <0.50 | <0.50 | - | <0.50 | <0.50 | - |
| Zinc (dissolved) | µg/L | Calc [1.14] | Calc [2.10] | NG | | <1.0 | <1.0 | <1.0 | 1.4 | - | 4 | <1.0 | - |
| Zirconium (dissolved) | µg/L | NG | NG | NG | | 0.41 | <0.20 | <0.60 | 0.4 | - | <0.20 | <0.20 | - |
| | | | | | | | | | | - | | | - |
| **General and Inorganic Parameters** | | | | | | | | | | - | | | - |
| Alkalinity (total, as CaCO3) | mg/L | NG | NG | N [3.6] | | | | | | - | | | - |
| Ammonia (total, as N) | µg/L | Calc [1.15] | Calc [2.11] | NG | | <5.0 | 109 | <5.0 | 8.6 | - | <5.0 | <5.0 | - |
| Biochemical oxygen demand | mg/L | NG | NG | NG | | <2.0 | <2.0 | <2.0 | <2.0 | - | <2.0 | <2.0 | - |
| Bromide | µg/L | NG | NG | NG | | | | | | - | | | - |
| Dissolved organic carbon | mg/L | N [1.16] | NG | NG | | 12.3 | 10.4 | 12.2 | 12.2 | 0.00 | 7.31 | 7.61 | 4.02 |
| Chemical oxygen demand | µg/L | NG | NG | NG | | | | | | - | | | - |
| Chloride | µg/L | 150000 [1.17] | 600000 [2.12] | NG | | | | | | - | | | - |
| Conductivity | µS/cm | NG | NG | NG | | 62.4 | 218 | 60.5 | 61 | 0.82 | 184 | 184 | 0.00 |
| Fluoride | µg/L | NG | Calc [2.13] | NG | | | | | | - | | | - |
| Nitrate (as N) | mg/L | 3.0 [1.18] | 32.8 [2.14] | NG | | | | | | - | | | - |
| Nitrate + Nitrite (as N) (calculated) | mg/L | NG | NG | NG | | | | | | - | | | - |
| Nitrite (as N) | µg/L | Calc [1.19] | Calc [2.15] | NG | | | | | | - | | | - |
| Nitrogen, total | µg/L | NG | NG | NG | | 282 | 523 | 272 | 264 | 2.99 | 236 | 224 | 5.22 |
| pH | | N [1.20] | NG | NG | | 7.58 | 8.04 | 7.58 | 7.56 | 0.26 | 7.9 | 7.88 | 0.25 |
| Total dissolved solids | mg/L | NG | NG | NG | | | | | | - | | | - |
| Sulphate | mg/L | Calc [1.21] | NG | NG | | | | | | - | | | - |
| | | | | | | | | | | - | | | - |
| **Total Metals** | | | | | | | | | | - | | | - |
| Aluminum (total) | µg/L | NG | NG | NG | | 512 | 25 | 250 | 246 | 1.61 | 27.8 | 24.8 | 11.41 |
| Antimony (total) | µg/L | NG | NG | 9 [3.7] | | <0.10 | <0.10 | <0.10 | <0.10 | - | <0.10 | <0.10 | - |
| Arsenic (total) | µg/L | 5 [1.22] | NG | NG | | 0.41 | 0.92 | 0.33 | 0.32 | 3.08 | 0.26 | 0.22 | 16.67 |
| Barium (total) | µg/L | NG | NG | 1000 | | 22 | 58.2 | 19.7 | 19.1 | 3.09 | 46.8 | 45.6 | 2.60 |
| Beryllium (total) | µg/L | NG | NG | 0.13 | | <0.100 | <0.100 | <0.100 | <0.100 | - | <0.100 | <0.100 | - |
| Bismuth (total) | µg/L | NG | NG | NG | | <0.050 | <0.050 | <0.050 | <0.050 | - | <0.050 | <0.050 | - |
| Boron (total) | µg/L | 1200 [1.23] | NG | NG | | <10 | <10 | <10 | <10 | - | <10 | <10 | - |
| Cadmium (total) | µg/L | NG | NG | NG | | 0.0054 | <0.0050 | 0.0061 | 0.0057 | 6.78 | 0.0062 | 0.0069 | 10.69 |
| Calcium (total) | mg/L | NG | NG | NG | | 7.91 | 30.2 | 7.69 | 7.52 | 2.24 | 25 | 25.1 | 0.40 |
| Cesium (total) | µg/L | NG | NG | NG | | 0.054 | <0.010 | 0.019 | 0.02 | 5.13 | <0.010 | <0.010 | - |
| Chromium (total) | µg/L | NG | NG | 1 [3.8] | | 0.76 | <0.50 | <0.50 | <0.50 | - | <0.50 | <0.50 | - |
| Cobalt (total) | µg/L | 4 [1.24] | 110 [2.16] | NG | | 0.26 | 0.47 | 0.11 | 0.11 | 0.00 | <0.10 | <0.10 | - |
| Copper (total) | µg/L | NG | NG | NG | | 2.11 | <0.50 | 1.63 | 1.72 | 5.37 | 1.16 | 1.34 | 14.40 |
| Hardness (as CaCO3), from total Ca/Mg | mg/L | NG | NG | NG | | 28.6 | 106 | 27.5 | 27 | 1.83 | 90.6 | 90.8 | 0.22 |
| Iron (total) | µg/L | NG | 1000 [2.17] | NG | | 661 | 752 | 328 | 316 | 3.73 | 26 | 25 | 3.92 |
| Lead (total) | µg/L | Calc [1.25] | Calc [2.18] | NG | | 0.154 | <0.050 | 0.055 | 0.068 | 21.14 | <0.050 | <0.050 | - |
| Lithium (total) | µg/L | NG | NG | NG | | <1.0 | <1.0 | <1.0 | <1.0 | - | <1.0 | <1.0 | - |
| Magnesium (total) | mg/L | NG | NG | NG | | 2.16 | 7.55 | 2.01 | 2 | 0.50 | 6.85 | 6.83 | 0.29 |
| Manganese (total) | µg/L | Calc [1.26] | Calc [2.19] | NG | | 31.8 | 1740 | 26.1 | 26.2 | 0.38 | 6.72 | 6.38 | 5.19 |
| Mercury (total) | µg/L | 0.02 [1.27] | NG | NG | | 0.0081 | <0.0050 | 0.0078 | 0.12 | 175.59 | <0.0050 | <0.0050 | - |
| Molybdenum (total) | µg/L | 7600 [1.28] | 46000 [2.20] | NG | | 0.066 | 0.276 | 0.06 | 0.062 | 3.28 | 0.106 | 0.105 | 0.95 |
| Nickel (total) | µg/L | NG | NG | Calc [3.9] | | 1.24 | 1.28 | 0.73 | 0.74 | 1.36 | 0.76 | 0.82 | 7.59 |
| Phosphorus (total, by ICPMS/ICPOES) | µg/L | N [1.29] | NG | NG | | <50 | <50 | <50 | <50 | - | <50 | <50 | - |
| Phosphorus (total, APHA 4500-P) | µg/L | N [1.30] | NG | NG | | 21 | 5.1 | 9.8 | 18.2 | 60.00 | 5.3 | 5.1 | 3.85 |
| Potassium (total) | µg/L | NG | NG | NG | | 427 | 1030 | 402 | 376 | 6.68 | 711 | 688 | 3.29 |
| Rubidium (total) | µg/L | NG | NG | NG | | 0.37 | 0.48 | 0.26 | <0.20 | - | <0.20 | <0.20 | - |
| Selenium (total) | µg/L | 2 [1.31] | NG | NG | | 0.059 | 0.083 | <0.050 | 0.062 | - | 0.077 | 0.085 | 9.88 |
| Silicon (total, as Si) | µg/L | NG | NG | NG | | 3780 | 4440 | 3610 | 3280 | 9.58 | 3420 | 3520 | 2.88 |
| Silver (total) | µg/L | Calc [1.32] | Calc [2.21] | NG | | <0.010 | <0.010 | <0.010 | <0.010 | - | <0.010 | <0.010 | - |
| Sodium (total) | mg/L | NG | NG | NG | | 3.07 | 9.16 | 2.93 | 2.98 | 1.69 | 7.4 | 7.35 | 0.68 |

**Table E-1**
**Kitwanga Landfill**
Water Quality Results

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | **Sampling Location** | Downstream | Further Upstream | Upstream | Upstream | RPD | Upstream | Upstream | RPD |
| | | | | **Date Sampled** | 13-Apr-22 | 27-Sep-22 | 13-Apr-22 | 13-Apr-22 | | 27-Sep-22 | 27-Sep-22 | |
| | | | | **Lab Sample ID** | VA22A8039-002 | VA22C3658-003 | VA22A8039-001 | VA22A8039-004 | | VA22C3658-001 | VA22C3658-002 | |
| | | | | **Sample Type** | Normal | Normal | Normal | Duplicate | | Normal | Duplicate | |
| **Analyte** | **Unit** | **Guideline** | | | | | | | | | | |
| | | BCAWQG AL (LT) | BCAWQG AL (ST) | BCWWQG AL | | | | | | | | |
| Strontium (total) | µg/L | NG | NG | NG | 81.1 | 306 | 79.4 | 76.5 | 3.72 | 256 | 250 | 2.37 |
| Sulphur (total) | µg/L | NG | NG | NG | <500 | <500 | <500 | <500 | - | <500 | <500 | - |
| Tellurium (total) | µg/L | NG | NG | NG | <0.20 | <0.20 | <0.20 | <0.20 | - | <0.20 | <0.20 | - |
| Thallium (total) | µg/L | NG | NG | 0.8 [3.10] | <0.010 | <0.010 | <0.010 | <0.010 | - | <0.010 | <0.010 | - |
| Thorium (total) | µg/L | NG | NG | NG | <0.10 | <0.10 | <0.10 | <0.10 | - | <0.10 | <0.10 | - |
| Tin (total) | µg/L | NG | NG | NG | <0.10 | <0.10 | <0.10 | <0.10 | - | <0.10 | <0.10 | - |
| Titanium (total) | µg/L | NG | NG | NG | <9.60 | 0.4 | 4.76 | 5.02 | 5.32 | 0.34 | 0.41 | 18.67 |
| Tungsten (total) | µg/L | NG | NG | NG | <0.10 | <0.10 | <0.10 | <0.10 | - | <0.10 | <0.10 | - |
| Uranium (total) | µg/L | NG | NG | 8.5 | 0.016 | <0.010 | <0.010 | <0.010 | - | <0.010 | <0.010 | - |
| Vanadium (total) | µg/L | NG | NG | NG | 1.24 | <0.50 | 0.97 | 0.61 | 45.57 | <0.50 | <0.50 | - |
| Zinc (total) | µg/L | Calc [1.33] | Calc [2.22] | NG | <3.0 | <3.0 | <3.0 | <3.0 | - | <3.0 | <3.0 | - |
| Zirconium (total) | µg/L | NG | NG | NG | 0.51 | <0.20 | 0.48 | 0.61 | 23.85 | <0.20 | <0.20 | - |

## Legend for Reports for RDKS Environmental Reporting Water Quality Results

| | |
|---|---|
| < | Less than reported detection limit |
| > | Greater than reported upper detection limit |
| >= | Greater than or equal to |
| A | Absent |
| BC SDWQG MAC | BC Source Drinking Water Quality Guidelines - Maximum Acceptable Concentrations |
| 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) |
| BCWWQG AL | BC Working Water Quality Guidelines for Freshwater Aquatic Life |
| 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. |
| 100 | The maximum guideline/standard value cannot be determined because a result for a dependent analyte is not available for the sample. |
| *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) |
| 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 |

## Guideline Notes for Reports for RDKS Environmental Reporting Water Quality Results

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

**General Notes:**

References: British Columbia Ministry of Environment and Climate Change Strategy. 2021. British Columbia Approved Water Quality Guidelines: Aquatic Life, Wildlife & Agriculture - Guideline Summary; and B.C. Guideline Overview and Technical Reports. / There are two types of water quality guidelines: the short-term acute guideline (i.e. maximum), and the long-term chronic guideline (i.e. average). Only the long-term chronic guidelines are included in this criteria set.

**Note 1.1 for Aluminum (dissolved):**

Freshwater aquatic life long-term chronic guideline: 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 1.2 for Arsenic (dissolved):**

Freshwater aquatic life long-term chronic guideline for total arsenic.

**Note 1.3 for Boron (dissolved):**

Aquatic life long-term chronic guideline for total boron.

**Note 1.4 for Cadmium (dissolved):**

Freshwater aquatic life long-term chronic guideline: 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 1.5 for Cobalt (dissolved):**

Freshwater aquatic life long-term chronic guideline.

**Note 1.6 for Copper (dissolved):**

The freshwater aquatic life long-term chronic 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 1.7 for Lead (dissolved):**

The freshwater aquatic life long-term chronic guideline for total lead in water is: when water hardness exceeds 8 mg/L as CaCO3, the guideline is less than or equal to 3.31 + exp (1.273 ln (mean hardness) - 4.704). In addition, no more than 20% (e.g. 1 in 5) of values in a 30-day period should exceed 1.5 times the long-term chronic guideline.
The guideline applies to water hardness between 8 – 360 mg/L (as CaCO3). If natural levels exceed the guideline, then any allowed increase in total lead above natural levels should be based on site-specific data. When water hardness exceeds highest hardness tested (i.e. upper bound), a site-specific assessment may be required.
For hardness less than or equal to 8 mg/L there is no long-term chronic guideline. The short-term acute guideline of 3.0 µg/L is used for this case.

**Note 1.8 for Manganese (dissolved):**

The freshwater aquatic life long-term chronic guideline for total manganese in mg/L is determined by the following relationship:
0.0044 hardness + 0.605
where water hardness is reported as mg/L of CaCO3.
The guideline applies to water hardness between 37 – 450 mg/L CaCO3. When water hardness is outside hardness range tested (i.e. lower or upper bound), a site-specific assessment may be required.

**Note 1.9 for Mercury (dissolved):**

The aquatic life long-term chronic guideline for total mercury for aquatic life is based on the formula 0.0001 / (MeHg/total Hg), where MeHg is mass (or concentration) of methyl mercury and total Hg is total mass (or concentration) of mercury in a given water volume.
The guideline is 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. Reference: Ambient Water Quality Guidelines for Mercury: Overview Report – First Update (2001).

**Note 1.10 for Molybdenum (dissolved):**

Freshwater aquatic life long-term chronic guideline for total molybdenum.

**Note 1.11 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 1.12 for Selenium (dissolved):**

Aquatic life long-term chronic guideline. 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.

**Note 1.13 for Silver (dissolved):**

The freshwater aquatic life long-term chronic guideline 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 1.14 for Zinc (dissolved):**

The freshwater aquatic life long-term chronic guideline for 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 is less than or equal to 90 mg/L as CaCO3 the guideline is 7.5 µg/L;
When water hardness exceeds 90 mg/L CaCO3, the 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.
The long-term chronic guideline formula applies to water hardness between 90 – 330 mg/L CaCO3.

**Note 1.15 for Ammonia (total, as N):**

The freshwater aquatic life long-term chronic 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 1.16 for Dissolved organic carbon:**

The freshwater aquatic life long-term chronic guideline for dissolved organic carbon (DOC) is 30-day median ± 20% of the median background concentration.
The 30-day median shall be within 20% of seasonally-adjusted median background levels as measured historically or at appropriate reference sites. The 30-day median calculation should be based on a minimum of 5 weekly samples taken over a period of 30 days.

**Note 1.17 for Chloride:**

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. When ambient chloride concentrations exceed guidelines, increases in chloride due to human activities should be avoided.

**Note 1.18 for Nitrate (as N):**

Freshwater aquatic life long-term chronic guideline.

**Note 1.19 for Nitrite (as N):**

The freshwater aquatic life long-term chronic guideline 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 1.20 for pH:**

The freshwater aquatic life long-term chronic guideline is:
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 1.21 for Sulphate:**

The freshwater aquatic life long-term chronic guideline is:
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 1.22 for Arsenic (total):**

Freshwater aquatic life long-term chronic guideline.

**Note 1.23 for Boron (total):**

Aquatic life long-term chronic guideline.

**Note 1.24 for Cobalt (total):**

Freshwater aquatic life long-term chronic guideline.

**Note 1.25 for Lead (total):**

The freshwater aquatic life long-term chronic guideline for total lead in water is: when water hardness exceeds 8 mg/L as CaCO3, the guideline is less than or equal to 3.31 + exp (1.273 ln (mean hardness) - 4.704). In addition, no more than 20% (e.g. 1 in 5) of values in a 30-day period should exceed 1.5 times the long-term chronic guideline.
The guideline applies to water hardness between 8 – 360 mg/L (as CaCO3). If natural levels exceed the guideline, then any allowed increase in total lead above natural levels should be based on site-specific data. When water hardness exceeds highest hardness tested (i.e. upper bound), a site-specific assessment may be required.
For hardness less than or equal to 8 mg/L there is no long-term chronic guideline. The short-term acute guideline of 3.0 µg/L is used for this case.

**Note 1.26 for Manganese (total):**

The freshwater aquatic life long-term chronic guideline for total manganese in mg/L is determined by the following relationship:
0.0044 hardness + 0.605
where water hardness is reported as mg/L of CaCO3.
The guideline applies to water hardness between 37 – 450 mg/L CaCO3. When water hardness is outside hardness range tested (i.e. lower or upper bound), a site-specific assessment may be required.

**Note 1.27 for Mercury (total):**

The aquatic life long-term chronic guideline for total mercury for aquatic life is based on the formula 0.0001 / (MeHg/total Hg), where MeHg is mass (or concentration) of methyl mercury and total Hg is total mass (or concentration) of mercury in a given water volume.
The guideline is 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. Reference: Ambient Water Quality Guidelines for Mercury: Overview Report – First Update (2001).

**Note 1.28 for Molybdenum (total):**

Freshwater aquatic life long-term chronic guideline.

**Note 1.29 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 1.30 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 1.31 for Selenium (total):**

Aquatic life long-term chronic guideline. 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.

**Note 1.32 for Silver (total):**

The freshwater aquatic life long-term chronic guideline 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 1.33 for Zinc (total):**

The freshwater aquatic life long-term chronic guideline for 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 is less than or equal to 90 mg/L as CaCO3 the guideline is 7.5 µg/L;
When water hardness exceeds 90 mg/L CaCO3, the 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.
The long-term chronic guideline formula applies to water hardness between 90 – 330 mg/L CaCO3.

**2. 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.
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. / The standard to protect freshwater aquatic life was used when separate aquatic life standards are provided for freshwater aquatic life and marine aquatic life.

**Note 2.1 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 2.2 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 2.3 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 2.4 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 2.5 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 2.6 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 2.7 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.

**Note 2.8 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 2.9 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 2.10 for Nitrate (as N):**

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

**Note 2.11 for Nitrate + Nitrite (as N) (calculated):**

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

**Note 2.12 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 2.13 for Sulphate:**

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 2.14 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 2.15 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 2.16 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 2.17 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 2.18 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 2.19 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 2.20 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.

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

**General Notes:**

References: British Columbia Ministry of Environment and Climate Change Strategy. 2021. British Columbia Approved Water Quality Guidelines: Aquatic Life, Wildlife & Agriculture - Guideline Summary; and B.C. Guideline Overview and Technical Reports. / There are two types of water quality guidelines: the short-term acute guideline (i.e. maximum), and the long-term chronic guideline (i.e. average). Only the short-term acute guidelines are included in this criteria set.

**Note 3.1 for Aluminum (dissolved):**

Freshwater aquatic life short-term acute guideline: 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 $(pH)^2$)

**Note 3.2 for Cadmium (dissolved):**

Freshwater aquatic life short-term acute guideline: 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 3.3 for Cobalt (dissolved):**

Freshwater aquatic life short-term acute guideline.

**Note 3.4 for Copper (dissolved):**

The freshwater aquatic life short-term acute 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 3.5 for Iron (dissolved):**

Freshwater aquatic life short-term acute guideline.

**Note 3.6 for Lead (dissolved):**

The freshwater aquatic life short-term acute guideline for total lead in water, at a water hardness less than or equal to 8 mg/L as CaCO3 is 3 µg/L. When water hardness exceeds 8 mg/L (as CaCO3) the short-term acute guideline (µg/L) is given by the following equation: exp (1.273 ln(hardness) - 1.460).
The guideline applies to water hardness up to 360 mg/L (as CaCO3). If natural levels exceed the guideline, then any allowed increase in total lead above natural levels should be based on site-specific data. When water hardness exceeds highest hardness tested (i.e. upper bound), a site-specific assessment may be required.

**Note 3.7 for Manganese (dissolved):**

The freshwater aquatic life short-term acute guideline for total manganese in mg/L is determined by the following relationship:
0.01102 hardness + 0.54
where water hardness is reported as mg/L of CaCO3.
The guideline applies to water hardness between 25 – 259 mg/L CaCO3. When water hardness is outside hardness range tested (i.e. lower or upper bound), a site-specific assessment may be required.

**Note 3.8 for Molybdenum (dissolved):**

Freshwater aquatic life short-term acute guideline for total molybdenum.

**Note 3.9 for Silver (dissolved):**

The freshwater aquatic life short-term acute guideline 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.

**Note 3.10 for Zinc (dissolved):**

The freshwater aquatic life short-term acute guideline for total zinc (µg/L) is:
When water hardness is less than or equal to 90 mg/L as CaCO3 the guideline is 33 µg/L;
When water hardness exceeds 90 mg/L CaCO3, the 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.
The short-term acute guideline formula applies to water hardness between 90 – 500 mg/L CaCO3.

**Note 3.11 for Ammonia (total, as N):**

The freshwater aquatic life short-term acute guideline for ammonia varies as a function of pH and temperature. See Table 3 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 3.12 for Chloride:**

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. When ambient chloride concentrations exceed guidelines, increases in chloride due to human activities should be avoided.

**Note 3.13 for Fluoride:**

The freshwater aquatic life short-term acute Interim guideline for total fluoride is as follows:
If hardness is less than or equal to 10 mg/L then the guideline is 0.4 mg/L;
If hardness is greater than 10 mg/L then the guideline (in units mg/L) is based on the equation: WQG = [-51.73 + 92.57 log10 (hardness)] × 0.01.
Hardness is as CaCO3 in units mg/L.
The equation applies to water hardness (as CaCO3) between 10 – 385 mg/L, and is an interim WQG until carefully controlled experiments can determine the appropriate levels of fluoride under various combinations of water temperature and hardness. When water hardness exceeds highest hardness tested (i.e. upper bound), a site-specific assessment may be required.

**Note 3.14 for Nitrate (as N):**

Freshwater aquatic life short-term acute guideline.

**Note 3.15 for Nitrite (as N):**

The freshwater aquatic life short-term acute guideline 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.

**Note 3.16 for Cobalt (total):**

Freshwater aquatic life short-term acute guideline.

**Note 3.17 for Iron (total):**

Freshwater aquatic life short-term acute guideline.

**Note 3.18 for Lead (total):**

The freshwater aquatic life short-term acute guideline for total lead in water, at a water hardness less than or equal to 8 mg/L as CaCO3 is 3 µg/L. When water hardness exceeds 8 mg/L (as CaCO3) the short-term acute guideline (µg/L) is given by the following equation: exp (1.273 ln(hardness) - 1.460).
The guideline applies to water hardness up to 360 mg/L (as CaCO3). If natural levels exceed the guideline, then any allowed increase in total lead above natural levels should be based on site-specific data. When water hardness exceeds highest hardness tested (i.e. upper bound), a site-specific assessment may be required.

**Note 3.19 for Manganese (total):**

The freshwater aquatic life short-term acute guideline for total manganese in mg/L is determined by the following relationship:
0.01102 hardness + 0.54
where water hardness is reported as mg/L of CaCO3.
The guideline applies to water hardness between 25 – 259 mg/L CaCO3. When water hardness is outside hardness range tested (i.e. lower or upper bound), a site-specific assessment may be required.

**Note 3.20 for Molybdenum (total):**

Freshwater aquatic life short-term acute guideline.

**Note 3.21 for Silver (total):**

The freshwater aquatic life short-term acute guideline 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.

**Note 3.22 for Zinc (total):**

The freshwater aquatic life short-term acute guideline for total zinc (µg/L) is:
When water hardness is less than or equal to 90 mg/L as CaCO3 the guideline is 33 µg/L;
When water hardness exceeds 90 mg/L CaCO3, the 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.
The short-term acute guideline formula applies to water hardness between 90 – 500 mg/L CaCO3.

**4. 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 4.1 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 4.2 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 4.3 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 4.4 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 4.5 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 4.6 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 4.7 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 4.8 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.

**Note 4.9 for Chloride:**

Standard to protect against taste and odour concerns.

**Note 4.10 for Nitrate (as N):**

Where nitrate and nitrite are present, total nitrate plus nitrite-nitrogen should not exceed this value.

**Note 4.11 for Nitrate + Nitrite (as N) (calculated):**

Where nitrate and nitrite are present, total nitrate plus nitrite-nitrogen should not exceed this value.

**Note 4.12 for Sulphate:**

Standard to protect against taste and odour concerns.

**Note 4.13 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 4.14 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 4.15 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 4.16 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 4.17 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 4.18 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 4.19 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 4.20 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.

**5. Notes for BC Working Water Quality Guidelines for Freshwater Aquatic Life (BCWWQG AL)**

**General Notes:**

Reference: B.C. Ministry of Environment and Climate Change Strategy. 2021. Working Water Quality Guidelines: Aquatic Life, Wildlife & Agriculture.
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 Antimony (dissolved):**

The guideline is for antimony (III).

**Note 5.2 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 5.3 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 5.4 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 5.5 for Thallium (dissolved):**

30-day average, site-specific objective for the lower Columbia River, BC

**Note 5.6 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 5.7 for Antimony (total):**

The guideline is for antimony (III).

**Note 5.8 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 5.9 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 5.10 for Thallium (total):**

30-day average, site-specific objective for the lower Columbia River, BC

**6. Notes for BC Source Drinking Water Quality Guidelines - Maximum Acceptable Concentrations (BC SDWQG MAC)**

**General Notes:**

Reference: British Columbia Ministry of Environment and Climate Change Strategy. 2020. B.C. Source Drinking Water Quality Guidelines: Guideline Summary.
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 6.1 for Copper (dissolved):**

Includes short-term and long-term exposure.

**Note 6.2 for Copper (total):**

Includes short-term and long-term exposure.

Table E-2 - Kitwanga Landfill
Compiled Surface Water Quality Results

| Kitwanga Water Quality Results | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Upstream Sampling Location | | | | | | | | | | | | Further Upstream Sampling Location | Downstream Sampling Location | | | | | | | | | |
| **Field Observations** | Units | 2014-05-12 | 2015-04-28 | 2016-04-06 | 2018-04-17 | 2019-05-15 | 2019-11-20 | 2020-04-29 | 2020-09-16 | 2021-04-28 | 2021-09-27 | 2022-04-13 | 2022-09-27 | 2022-09-27 | 2014-05-12 | 2015-04-28 | 2016-04-06 | 2018-04-17 | 2019-11-20 | 2020-04-29 | 2020-09-16 | 2021-04-28 | 2021-09-27 | 2022-04-13 | 2022-09-27 |
| Barometer | mmHg | | | | | No Sample | No Sample | 734.5 | 741.4 | 736.1 | 719 | | | | | | | | No Sample | 735.7 | 742.2 | 737.7 | 721.1 | | No sample |
| Conductivity | µs | | | | | Dry | Dry | 40.4 | 76.4 | 38.7 | 103.1 | | | | | | | | Well Dry | 41.7 | 76.7 | 38.8 | 116.5 | 62.4 | Dry |
| Dissolved Oxygen | %I | | | | | - | - | 125 | 92 | 102 | 100 | | | | | | | | - | 153 | 89 | 102 | 93.0 | | |
| Dissolved Oxygen | mg/L | | | | | - | - | 15.2 | 10 | 12.2 | 10.6 | | | | | | | | - | 18.6 | 9.8 | 12.4 | 9.9 | | |
| pH | pH units | | | | | - | - | 7.23 | 7.31 | 7.26 | 7.32 | | | | | | | | - | 7.48 | 7.32 | 7.3 | 7.5 | 7.58 | |
| ORP | mv | | | | | - | - | 361.8 | 308.1 | 249.9 | 260 | | | | | | | | - | 375.7 | 312.5 | 241.2 | 240.6 | | |
| Temperature | °C | | | | | - | - | 5.4 | 9.9 | 6 | 10.4 | | | | | | | | - | 5.3 | 9.9 | 5.7 | 10.3 | | |
| **Analyte** | | | | | | | | | | | | | | | | | | | | | | | | | |
| Conductivity | uS/cm | 82.6 | 70.6 | 77.9 | | - | - | 64.2 | 106 | 61 | 146 | 60.5 | 184 | 218 | 83.2 | 71.2 | 78.2 | | - | 64.3 | 106 | 61.90 | 168.0 | | |
| Hardness (as CaCO3) | mg/L | 35.4 | 29.4 | 35.3 | 30.5 | - | - | 28.5 | 48.8 | 26.8 | 60.2 | 26.4 | 92.5 | 103 | 27.0 | 31.8 | 35.3 | 30.9 | - | 28.5 | 48.3 | 27.60 | 66.5 | 27 | |
| pH | pH | 7.4 | 7.1 | 7.6 | 7.59 | - | - | 7.58 | 7.72 | 7.51 | 7.89 | 7.58 | 7.9 | 8.04 | 7.4 | 7.5 | 7.6 | 7.41 | - | 7.56 | 7.74 | 7.53 | 8.0 | | |
| Total Suspended Solids | mg/L | - | - | - | | - | - | - | - | - | - | | | | - | - | - | | - | - | - | - | - | | |
| Total Dissolved Solids | mg/L | - | - | - | | - | - | - | - | - | - | | | | - | - | - | | - | - | - | - | - | | |
| Acidity | mg/L | - | - | - | | - | - | - | - | - | - | | | | - | - | - | | - | - | - | - | - | | |
| Alkalinity, Total (as CaCO3) | mg/L | - | - | - | | - | - | - | - | - | - | | | | - | - | - | | - | - | - | - | - | | |
| Ammonia, Total (as N) | mg/L | <0.03 | <0.03 | <0.03 | 0.0093 | - | - | 0.0113 | - | <0.0050 | 0.0125 | <0.0050 | <0.0050 | 0.109 | <0.03 | <0.03 | 0.04 | 0.0084 | - | 0.0109 | 0.0054 | 0.0056 | <0.0050 | <0.0050 | |
| Total Nitrogen | mg/L | | | | 0.325 | - | - | 0.351 | 0.358 | 0.334 | 0.534 | | 0.236 | 0.523 | | | | 0.355 | - | 0.355 | 0.353 | 0.407 | 0.414 | 0.282 | |
| Bromide (Br) | mg/L | - | - | - | | - | - | - | - | - | - | | | | - | - | - | | - | - | - | - | - | | |
| Chloride (Cl) | mg/L | 1.7 | 1.3 | 1.6 | | - | - | - | - | - | - | | | | 1.8 | 1.7 | 1.8 | | - | - | - | - | - | | |
| Fluoride (F) | mg/L | <0.1 | <0.10 | <0.10 | | - | - | - | - | - | - | | | | <0.1 | <0.10 | <0.10 | | - | - | - | - | - | | |
| Nitrate (as N) | mg/L | <0.02 | <0.01 | <0.01 | | - | - | - | - | - | - | | | | <0.02 | <0.01 | 0.01 | | - | - | - | - | - | | |
| Total Phosphorus (P) | mg/L | | | | 0.0152 | - | - | | | 0.0105 | 0.0364 | 0.0098 | 0.0053 | 0.0051 | | | | 0.0184 | - | | | 0.0170 | 0.0192 | 0.021 | |
| Sulfate (SO4) | mg/L | <0.5 | <1.0 | <1.0 | | - | - | - | - | - | - | | | | <0.5 | <1.0 | <1.0 | | - | - | - | - | - | | |
| Total Organic Carbon | mg/L | - | - | - | | - | - | - | - | - | - | | | | - | - | - | | - | - | - | - | - | | |
| BOD | mg/L | <4.0 | <4.0 | <4.0 | 3.8 | - | - | <2.0 | <2.0 | <2.0 | <2.0 | <2.0 | <2.0 | <2.0 | <4.0 | <4.0 | <4.0 | 6.1 | - | <2.0 | <2.0 | <2.0 | <2.0 | | |
| COD | mg/L | 30 | 34 | 35 | | - | - | - | - | - | - | | | | 25 | <20 | 36 | | - | - | - | - | - | | |
| **Total Metals** | | | | | | | | | | | | | | | | | | | | | | | | | |
| Aluminum (Al)-Total | mg/L | 0.198 | 0.098 | 0.125 | 0.352 | - | - | 0.239 | 0.209 | 0.221 | 0.330 | 0.25 | 0.0278 | 0.025 | 0.172 | 0.231 | 0.157 | 0.406 | - | 0.250 | 0.216 | 0.350 | 0.359 | 0.512 | |
| Antimony (Sb)-Total | mg/L | 0.00007 | <0.0001 | 0.0001 | <0.00010 | - | - | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | 0.000065 | <0.0001 | 0.0003 | <0.00010 | - | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | |
| Arsenic (As)-Total | mg/L | 0.000513 | <0.0005 | <0.0005 | 0.00032 | - | - | 0.00034 | 0.00068 | 0.00029 | 0.00104 | 0.00033 | 0.00026 | 0.00092 | 0.000401 | <0.0005 | <0.0005 | 0.00035 | - | 0.00035 | 0.00070 | 0.00035 | 0.00073 | 0.00041 | |
| Barium (Ba)-Total | mg/L | 0.0208 | 0.024 | 0.019 | 0.0205 | - | - | 0.0213 | 0.032 | 0.0200 | 0.0352 | 0.0197 | 0.0468 | 0.0582 | 0.0165 | 0.023 | 0.019 | 0.0223 | - | 0.0213 | 0.0329 | 0.0219 | 0.0406 | 0.022 | |
| Beryllium (Be)-Total | mg/L | <0.00001 | <0.0001 | <0.0001 | <0.00010 | - | - | <0.000100 | <0.000100 | <0.000100 | <0.000100 | <0.000100 | <0.000100 | <0.000100 | <0.00001 | <0.0001 | <0.0001 | <0.00010 | - | <0.000100 | <0.000100 | <0.000100 | <0.000100 | <0.000100 | |
| Bismuth | | | | <0.0001 | <0.000050 | - | - | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | | | <0.0001 | <0.000050 | - | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | |
| Boron (B)-Total | mg/L | <0.05 | 0.014 | 0.007 | <0.010 | - | - | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.05 | 0.012 | 0.007 | <0.010 | - | <0.010 | <0.010 | <0.010 | 0.024 | <0.010 | |
| Cadmium (Cd)-Total | mg/L | 0.000008 | 0.00036 | <0.00001 | 0.0000059 | - | - | 0.0000059 | 0.000008 | <0.0000050 | 0.0000050 | 0.0000061 | 0.0000062 | <0.0000050 | 0.000009 | <0.00001 | 0.00002 | 0.0000053 | - | 0.0000063 | 0.0000080 | 0.0000051 | 0.0000083 | 0.0000054 | |
| Calcium (Ca)-Total | mg/L | 10.0 | 8.2 | 9.8 | 8.44 | - | - | 8.73 | 14.1 | 8.08 | 16.9 | 7.69 | 25 | 30.2 | 7.57 | 8.9 | 9.9 | 8.45 | - | 8.74 | 14.8 | 8.21 | 18.7 | 7.91 | |
| Cesium (Cs) | | | | | 0.000042 | - | - | 0.000018 | 0.000019 | 0.000014 | 0.000034 | 0.000019 | <0.000010 | <0.000010 | | | | 0.00005 | - | 0.000021 | 0.000021 | 0.000026 | 0.000042 | 0.000054 | |
| Chromium (Cr)-Total | mg/L | 0.00064 | <0.0005 | <0.0005 | 0.00056 | - | - | 0.00040 | 0.00029 | <0.00050 | 0.00051 | <0.00050 | <0.00050 | <0.00050 | 0.00058 | <0.0005 | <0.0005 | 0.00056 | - | 0.00047 | 0.00044 | 0.00052 | 0.00052 | 0.00076 | |
| Cobalt (Co)-Total | mg/L | 0.000167 | 0.00013 | 0.00011 | 0.00016 | - | - | 0.00015 | 0.00016 | 0.00010 | 0.00021 | 0.00011 | <0.00010 | 0.00047 | 0.000142 | 0.00015 | 0.00014 | 0.00019 | - | 0.00018 | 0.00016 | 0.00018 | 0.00020 | 0.00026 | |
| Copper (Cu)-Total | mg/L | 0.00199 | 0.0022 | 0.0048 | 0.00173 | - | - | 0.00198 | 0.00142 | 0.00166 | 0.00189 | 0.00163 | 0.00116 | <0.00050 | 0.00152 | 0.0011 | 0.0025 | 0.00192 | - | 0.00202 | 0.00160 | 0.00185 | 0.00206 | 0.00211 | |
| Iron (Fe)-Total | mg/L | 0.459 | 0.27 | 0.36 | 0.503 | - | - | 0.412 | 0.665 | 0.356 | 1.36 | 0.328 | 0.026 | 0.752 | 0.386 | 0.45 | 0.39 | 0.58 | - | 0.454 | 0.705 | 0.483 | 1.02 | 0.661 | |
| Lead (Pb)-Total | mg/L | 0.000093 | <0.0001 | 0.0003 | 0.000088 | - | - | <0.000050 | 0.000063 | <0.000050 | 0.000144 | 0.000055 | <0.000050 | <0.000050 | 0.000072 | 0.0001 | 0.0001 | 0.000109 | - | 0.000074 | 0.000070 | 0.000076 | 0.000164 | 0.000154 | |
| Lithium (Li)-Total | mg/L | <0.0005 | 0.0002 | 0.0001 | <0.0010 | - | - | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0005 | 0.0003 | 0.0001 | <0.0010 | - | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | |
| Magnesium (Mg)-Total | mg/L | 2.50 | 2.17 | 2.63 | 2.24 | - | - | 2.30 | 3.48 | 2.18 | 4.36 | 2.01 | 6.85 | 7.55 | 1.97 | 2.31 | 2.57 | 2.3 | - | 2.32 | 3.83 | 2.33 | 4.95 | 2.16 | |
| Manganese (Mn)-Total | mg/L | 0.0582 | 0.0751 | 0.0538 | 0.0364 | - | - | 0.0400 | 0.066 | 0.0273 | 0.0457 | 0.0261 | 0.00672 | 1.74 | 0.0466 | 0.0508 | 0.0449 | 0.0437 | - | 0.0394 | 0.0618 | 0.0292 | 0.0172 | 0.0318 | |
| Mercury (Hg)-Total | mg/L | <0.00001 | <0.00002 | <0.00002 | 0.0000097 | - | - | 0.0000099 | <0.0000050 | 0.0000116 | 0.0000129 | 0.0000078 | <0.0000050 | <0.0000050 | <0.00001 | <0.00002 | <0.00002 | 0.0000118 | - | 0.0000106 | <0.0000050 | 0.0000115 | <0.0000050 | 0.0000081 | |
| Molybdenum (Mo)-Total | mg/L | 0.00012 | 0.0001 | 0.0001 | 0.000065 | - | - | <0.000050 | 0.000157 | 0.000050 | 0.000154 | 0.00006 | 0.000106 | 0.000276 | 0.000091 | <0.0001 | 0.0002 | 0.0000067 | - | 0.000065 | 0.000827 | 0.000056 | 0.000108 | 0.000066 | |
| Nickel (Ni)-Total | mg/L | 0.00096 | 0.0008 | 0.0006 | 0.00097 | - | - | 0.00060 | 0.00088 | 0.00056 | 0.00128 | 0.00073 | 0.00076 | 0.00128 | 0.00086 | 0.0008 | 0.0007 | 0.00108 | - | 0.00070 | 0.00088 | 0.00079 | 0.00132 | 0.00124 | |
| Phosphorus - Total | mg/L | | | <0.02 | <0.050 | - | - | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | | | <0.02 | <0.050 | - | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | |
| Potassium (K)-Total | mg/L | 0.50 | 0.46 | 0.43 | 0.411 | - | - | 0.420 | 0.542 | 0.359 | 1.04 | 0.402 | 0.711 | 1.03 | 0.39 | 0.42 | 0.43 | 0.43 | - | 0.404 | 0.593 | 0.425 | 1.02 | 0.427 | |
| Rubidium (Rd) - Total | mg/L | | | | 0.00029 | - | - | <0.00020 | 0.00035 | <0.00020 | 0.00057 | 0.00026 | <0.00020 | 0.00048 | | | | 0.0003 | - | 0.00020 | 0.00038 | 0.00025 | 0.00048 | 0.00037 | |
| Selenium (Se)-Total | | | | | 0.000098 | - | - | 0.000057 | 0.000101 | 0.000060 | 0.000073 | <0.000050 | 0.000077 | 0.000083 | | | | 0.000055 | - | 0.000056 | 0.000102 | <0.000050 | 0.000089 | 0.000059 | |
| Silicon - Total | mg/L | | | 3.40 | 3.41 | - | - | 3.42 | 4.41 | 3.28 | 3.77 | 3.61 | 3.42 | 4.44 | | | 3.300 | 3.560 | - | 3.35 | 4.55 | 3.55 | 3.92 | 3.78 | |
| Silver (Ag)-Total | mg/L | <0.000005 | <0.00005 | <0.00005 | <0.000010 | - | - | <0.000010 | <0.000010 | <0.000010 | 0.000011 | <0.000010 | <0.000010 | <0.000010 | 0.000008 | <0.00005 | <0.00005 | <0.000010 | - | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | |
| Sodium (Na)-Total | mg/L | 3.96 | 4.05 | 4.32 | 3.3 | - | - | 3.58 | 4.98 | 2.76 | 7.24 | 2.93 | 7.4 | 9.16 | 3.03 | 3.59 | 4.25 | 3.49 | - | 3.51 | 5.32 | 3.02 | 8.21 | 3.07 | |
| Strontium - Total | mg/L | | | 0.095 | 0.0848 | - | - | 0.0886 | 0.15 | 0.0853 | 0.174 | 0.0794 | 0.256 | 0.306 | | | 0.093 | 0.0844 | - | 0.0882 | 0.150 | 0.0846 | 0.184 | 0.0811 | |
| Sulfur - Total | mg/L | | | <1 | <0.50 | - | - | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | | | <1 | <0.50 | - | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | |
| Tellerium - Total | mg/L | | | <0.0002 | <0.00020 | - | - | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | | | <0.0002 | <0.00020 | - | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | |
| Thallium (Tl)-Total | mg/L | <0.000002 | <0.00002 | <0.00002 | <0.000010 | - | - | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | 0.000002 | <0.00002 | <0.00002 | <0.000010 | - | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | |
| Thorium - Total | mg/L | | | <0.0001 | <0.00010 | - | - | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | | | <0.0001 | <0.00010 | - | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | |
| Tin (Sn)-Total | mg/L | <0.0002 | <0.0002 | <0.0002 | <0.00010 | - | - | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.0002 | <0.0002 | <0.0002 | <0.00010 | - | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | |
| Titanium (Ti)-Total | mg/L | <0.005 | <0.005 | <0.005 | 0.00623 | - | - | 0.00422 | 0.00393 | 0.00422 | 0.00594 | 0.00476 | 0.00034 | 0.0004 | <0.005 | <0.005 | <0.005 | 0.00748 | - | 0.00354 | 0.00440 | <0.00630 | 0.00717 | <0.00960 | |
| Tungesten (W) - Total | mg/L | | | | <0.00010 | - | - | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | | | | <0.00010 | - | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | |
| Uranium (U)-Total | mg/L | 0.000006 | <0.00002 | <0.00002 | <0.000010 | - | - | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | 0.000006 | <0.00002 | <0.00002 | <0.000010 | - | <0.000010 | <0.000010 | <0.000010 | 0.000018 | 0.000016 | |
| Vanadium (V)-Total | mg/L | 0.00058 | <0.001 | <0.001 | 0.00078 | - | - | <0.00050 | 0.00061 | 0.00065 | 0.00113 | 0.00097 | <0.00050 | <0.00050 | 0.00057 | 0.001 | <0.001 | 0.00091 | - | 0.00060 | 0.00060 | 0.00095 | 0.00113 | 0.00124 | |
| Zinc (Zn)-Total | mg/L | 0.0049 | 0.006 | <0.004 | <0.0030 | - | - | <0.0030 | <0.0030 | <0.0030 | <0.0030 | <0.0030 | <0.0030 | <0.0030 | 0.0037 | <0.004 | <0.004 | <0.0030 | - | <0.0030 | <0.0030 | <0.0030 | <0.0030 | <0.0030 | |
| Zirconium - Total | mg/L | | | | | - | - | 0.0004 | | 0.00053 | 0.00030 | 0.00048 | <0.00020 | <0.00020 | | | | | - | | 0.00029 | 0.00051 | 0.00029 | 0.00051 | |
| **Dissolved Metals** | | | | | | | | | | | | | | | | | | | | | | | | | |
| Aluminum (Al)-Dissolved | mg/L | | | | 0.15 | - | - | 0.126 | 0.051 | 0.150 | 0.0809 | 0.124 | 0.0117 | 0.007 | | | | 0.15 | - | 0.200 | 0.0505 | 0.128 | 0.0608 | 0.0983 | |
| Antimony (Sb)-Dissolved | mg/L | | | | <0.00010 | - | - | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | | | | <0.00010 | - | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | |
| Arsenic (As)-Dissolved | mg/L | | | | 0.00019 | - | - | 0.00026 | 0.00057 | 0.00026 | 0.00079 | 0.00024 | 0.00026 | 0.00086 | | | | 0.00021 | - | 0.00028 | 0.00051 | 0.00024 | 0.00051 | 0.00022 | |
| Barium (Ba)-Dissolved | mg/L | | | | 0.0203 | - | - | 0.0184 | 0.0276 | 0.0182 | 0.0303 | 0.0178 | 0.0461 | 0.0553 | | | | 0.0195 | - | 0.0203 | 0.0278 | 0.0181 | 0.0340 | 0.0167 | |
| Beryllium (Be)-Dissolved | mg/L | | | | <0.00010 | - | - | <0.000100 | <0.000100 | <0.000100 | <0.000100 | <0.000100 | <0.000100 | <0.000100 | | | | <0.00010 | - | <0.000100 | <0.000100 | <0.000100 | <0.000100 | <0.000100 | |

Table E-2 - Kitwanga Landfill
Compiled Surface Water Quality Results

| Kitwanga Water Quality Results | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Upstream Sampling Location | | | | | | | | | | | | Further Upstream Sampling Location | Downstream Sampling Location | | | | | | | | | |
| **Field Observations** | Units | 2014-05-12 | 2015-04-28 | 2016-04-06 | 2018-04-17 | 2019-05-15 | 2019-11-20 | 2020-04-29 | 2020-09-16 | 2021-04-28 | 2021-09-27 | 2022-04-13 | 2022-09-27 | 2022-09-27 | 2014-05-12 | 2015-04-28 | 2016-04-06 | 2018-04-17 | 2019-11-20 | 2020-04-29 | 2020-09-16 | 2021-04-28 | 2021-09-27 | 2022-04-13 | 2022-09-27 |
| Bisumuth - Dissolved | mg/L | | | | <0.000050 | - | - | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | | | | <0.000050 | - | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | |
| Boron (B)-Dissolved | mg/L | | | | <0.010 | - | - | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | | | | <0.010 | - | <0.010 | <0.010 | <0.010 | 0.021 | <0.010 | |
| Cadmium (Cd)-Dissolved | mg/L | | | | <0.0000050 | - | - | 0.0000180 | <0.0000050 | <0.0000050 | 0.0000052 | <0.0000050 | 0.0000052 | <0.0000050 | | | | <0.0000050 | - | <0.0000050 | <0.0000050 | <0.0000050 | 0.0000058 | <0.0000050 | |
| Calcium (Ca)-Dissolved | mg/L | | | | 8.48 | - | - | 7.90 | 13.7 | 7.47 | 18.0 | 7.29 | 26.2 | 29.8 | | | | 8.39 | - | 7.88 | 13.6 | 7.65 | 18.8 | 7.58 | |
| Cessium (Cs) - Dissolved | mg/L | | | | <0.000010 | - | - | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | | | | <0.000010 | - | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | |
| Chromium (Cr)-Dissolved | mg/L | | | | 0.00023 | - | - | 0.00023 | 0.00017 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | | | | 0.00014 | - | 0.00033 | 0.00016 | <0.00050 | <0.00050 | <0.00050 | |
| Cobalt (Co)-Dissolved | mg/L | | | | <0.00010 | - | - | <0.00010 | <0.00010 | <0.00010 | 0.00010 | <0.00010 | <0.00010 | 0.00041 | | | | <0.00010 | - | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | |
| Copper (Cu)-Dissolved | mg/L | | | | 0.0015 | - | - | 0.00181 | 0.00118 | 0.00145 | 0.00143 | 0.00147 | 0.00103 | 0.00023 | | | | 0.00151 | - | 0.00174 | 0.00121 | 0.00142 | 0.00156 | 0.00138 | |
| Iron (Fe)-Dissolved | mg/L | | | | 0.201 | - | - | 0.205 | 0.372 | 0.247 | 0.850 | 0.185 | 0.01 | 0.546 | | | | 0.201 | - | 0.286 | 0.337 | 0.218 | 0.573 | 0.16 | |
| Lead (Pb)-Dissolved | mg/L | | | | <0.000050 | - | - | <0.000050 | <0.000050 | <0.000050 | 0.000139 | <0.000050 | <0.000050 | <0.000050 | | | | <0.000050 | - | <0.000050 | <0.000050 | <0.000050 | 0.000074 | <0.000050 | |
| Lithium (Li)-Dissolved | mg/L | | | | <0.0010 | - | - | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | | | | <0.0010 | - | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | |
| Magnesium (Mg)-Dissolved | mg/L | | | | 2.26 | - | - | 2.13 | 3.55 | 1.99 | 4.17 | 2 | 6.58 | 6.96 | | | | 2.41 | - | 2.14 | 3.45 | 2.07 | 4.74 | 1.97 | |
| Manganese (Mn)-Dissolved | mg/L | | | | 0.0156 | - | - | 0.0128 | 0.0107 | 0.0134 | 0.0205 | 0.0167 | 0.00434 | 1.36 | | | | 0.0137 | - | 0.0138 | 0.00570 | 0.0100 | 0.00403 | 0.0103 | |
| Mercury (Hg)-Dissolved | mg/L | | | | 0.0000122 | - | - | 0.0000102 | <0.0000050 | 0.0000092 | <0.0000050 | 0.0000155 | <0.0000050 | <0.0000050 | | | | 0.0000111 | - | 0.0000094 | <0.0000050 | 0.0000099 | <0.0000050 | 0.0000088 | |
| Molybdenum (Mo)-Dissolved | mg/L | | | | <0.000050 | - | - | 0.000061 | 0.000776 | 0.000076 | 0.000155 | 0.000057 | 0.000092 | 0.000272 | | | | <0.000050 | - | 0.000060 | 0.000168 | 0.000050 | 0.000112 | 0.000056 | |
| Nickel (Ni)-Dissolved | mg/L | | | | <0.00050 | - | - | 0.00060 | <0.00050 | 0.00062 | 0.00094 | 0.00057 | 0.00074 | 0.0008 | | | | <0.00050 | - | 0.00068 | 0.00051 | 0.00059 | 0.00089 | 0.00052 | |
| Phosphorus - Dissolved | mg/L | | | | <0.050 | - | - | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | | | | <0.050 | - | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | |
| Potassium (K)-Dissolved | mg/L | | | | 0.391 | - | - | 0.363 | 0.562 | 0.360 | 0.980 | 0.366 | 0.679 | 1.03 | | | | 0.41 | - | 0.373 | 0.549 | 0.380 | 0.935 | 0.365 | |
| Rubidium (Rb) -Dissolved | mg/L | | | | <0.00020 | - | - | <0.00020 | 0.00023 | <0.00020 | 0.00041 | <0.00020 | <0.00020 | 0.00054 | | | | <0.00020 | - | <0.00020 | 0.00022 | <0.00020 | 0.00024 | <0.00020 | |
| Selenium (Se)-Dissolved | mg/L | | | | 0.000053 | - | - | 0.000054 | 0.000098 | 0.000052 | 0.000082 | 0.000061 | 0.000056 | <0.000050 | | | | <0.000050 | - | 0.000075 | 0.000066 | 0.000065 | 0.000091 | <0.000050 | |
| Silicon - Dissolved | mg/L | | | | 3.07 | - | - | 3.07 | 3.98 | 2.96 | 3.60 | 3.36 | 3.31 | 4.4 | | | | 3.03 | - | 3.18 | 3.92 | 3.01 | 3.55 | 3.32 | |
| Silver (Ag)-Dissolved | mg/L | | | | <0.000010 | - | - | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | | | | <0.000010 | - | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | |
| Sodium (Na)-Dissolved | mg/L | | | | 3.45 | - | - | 3.26 | 5.09 | 2.80 | 6.94 | 3.03 | 7.1 | 8.53 | | | | 3.57 | - | 3.32 | 5.17 | 2.88 | 8.04 | 3.1 | |
| Strontium - Dissolved | mg/L | | | | 0.0828 | - | - | 0.0846 | 0.151 | 0.0843 | 0.166 | 0.0792 | 0.244 | 0.298 | | | | 0.0825 | - | 0.0861 | 0.151 | 0.0845 | 0.181 | 0.0789 | |
| Sulfur- Dissolved | mg/L | | | | <0.50 | - | - | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | | | | <0.50 | - | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | |
| Tellurium - Dissolved | mg/L | | | | <0.00020 | - | - | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | | | | <0.00020 | - | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | |
| Thallium (Tl)-Dissolved | mg/L | | | | <0.000010 | - | - | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | | | | <0.000010 | - | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | |
| Thorium - Dissovled | mg/L | | | | <0.00010 | - | - | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | | | | <0.00010 | - | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | |
| Tin (Sn)-Dissolved | mg/L | | | | <0.00010 | - | - | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | | | | <0.00010 | - | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | |
| Titanium (Ti)-Dissolved | mg/L | | | | 0.00263 | - | - | 0.00273 | 0.00121 | 0.00346 | 0.00485 | 0.00234 | <0.00030 | <0.00030 | | | | 0.00296 | - | 0.00539 | 0.00131 | 0.00303 | 0.00260 | 0.00197 | |
| Tungsten (W) - Dissolved | mg/L | | | | <0.00010 | - | - | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | | | | <0.00010 | - | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | |
| Uranium (U)-Dissolved | mg/L | | | | <0.000010 | - | - | <0.000010 | <0.000010 | 0.000015 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | | | | <0.000010 | - | <0.000010 | <0.000010 | <0.000010 | 0.000015 | <0.000010 | |
| Vanadium (V)-Dissolved | mg/L | | | | <0.00050 | - | - | <0.00050 | <0.00050 | <0.00050 | 0.00052 | <0.00050 | <0.00050 | <0.00050 | | | | <0.00050 | - | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | |
| Zinc (Zn)-Dissolved | mg/L | | | | <0.0010 | - | - | <0.0010 | <0.0010 | 0.0011 | 0.0015 | <0.0010 | 0.004 | <0.0010 | | | | <0.0010 | - | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | |
| Zirconium - Dissolved | mg/L | | | | 0.000365 | - | - | 0.00053 | 0.00031 | 0.00055 | 0.00043 | <0.00060 | <0.00020 | <0.00020 | | | | 0.000354 | - | 0.00062 | 0.00029 | 0.00051 | 0.00028 | 0.00041 | |

**Table E-3 - Kitwanga Landfill - QAQC Blanks**

Water Quality Results

| Analyte | Unit | Guideline | Sampling Location | Field Blank | Field Blank | Travel Blank | Travel Blank |
|---|---|---|---|---|---|---|---|
| | | | Date Sampled | 13-Apr-22 | 27-Sep-22 | 13-Apr-22 | 27-Sep-22 |
| | | | Lab Sample ID | VA22A8039-003 | VA22C3713-003 | VA22A8039-005 | VA22C3658-004 |
| | | | Sample Type | Normal | Field Blank | Normal | Normal |
| | | No Guideline | | | | | |
| **Lab Results** | | | | | | | |
| **Anions and Cations in meq/L unit** | | | | | | | |
| Aluminum (meq/L) (calculated) | meq/L | NG | | <0.00011 | 0.00014 | <0.00011 | |
| Barium (meq/L) (calculated) | meq/L | NG | | <0.0000015 | <0.0000015 | <0.0000015 | |
| Boron (meq/L) (calculated) | meq/L | NG | | <0.0028 | <0.0028 | <0.0028 | |
| Calcium (meq/L) (calculated) | meq/L | NG | | <0.0025 | <0.0025 | <0.0025 | |
| Calcium (total, meq/L) (calculated) | meq/L | NG | | <0.0025 | | <0.0025 | <0.0025 |
| Chromium (meq/L) (calculated) | meq/L | NG | | <0.000029 | <0.000029 | <0.000029 | |
| Copper (meq/L) (calculated) | meq/L | NG | | <0.0000063 | <0.0000063 | <0.0000063 | |
| Lead (meq/L) (calculated) | meq/L | NG | | <0.00000048 | <0.00000048 | <0.00000048 | |
| Lithium (meq/L) (calculated) | meq/L | NG | | <0.00014 | <0.00014 | <0.00014 | |
| Magnesium (meq/L) (calculated) | meq/L | NG | | <0.00041 | <0.00041 | <0.00041 | |
| Magnesium (total, meq/L) (calculated) | meq/L | NG | | <0.00041 | | <0.00041 | <0.00041 |
| Potassium (meq/L) (calculated) | meq/L | NG | | <0.0013 | <0.0013 | <0.0013 | |
| Potassium (total, meq/L) (calculated) | meq/L | NG | | <0.0013 | | <0.0013 | <0.0013 |
| Sodium (meq/L) (calculated) | meq/L | NG | | <0.0022 | <0.0022 | <0.0022 | |
| Sodium (total, meq/L) (calculated) | meq/L | NG | | <0.0022 | | <0.0022 | <0.0022 |
| Strontium (meq/L) (calculated) | meq/L | NG | | <0.0000046 | <0.0000046 | <0.0000046 | |
| Zinc (meq/L) (calculated) | meq/L | NG | | <0.000031 | <0.000031 | <0.000031 | |
| | | | | | | | |
| **Dissolved Metals** | | | | | | | |
| Aluminum (dissolved) | µg/L | NG | | <1.0 | 1.3 | <1.0 | |
| Antimony (dissolved) | µg/L | NG | | <0.10 | <0.10 | <0.10 | |
| Arsenic (dissolved) | µg/L | NG | | <0.10 | <0.10 | <0.10 | |
| Barium (dissolved) | µg/L | NG | | <0.10 | <0.10 | <0.10 | |
| Beryllium (dissolved) | µg/L | NG | | <0.100 | <0.100 | <0.100 | |
| Bismuth (dissolved) | µg/L | NG | | <0.050 | <0.050 | <0.050 | |
| Boron (dissolved) | µg/L | NG | | <10 | <10 | <10 | |
| Cadmium (dissolved) | µg/L | NG | | <0.0050 | <0.0050 | <0.0050 | |
| Calcium (dissolved) | mg/L | NG | | <0.050 | <0.050 | <0.050 | |
| Cesium (dissolved) | µg/L | NG | | <0.010 | <0.010 | <0.010 | |
| Chromium (dissolved) | µg/L | NG | | <0.50 | <0.50 | <0.50 | |
| Cobalt (dissolved) | µg/L | NG | | <0.10 | <0.10 | <0.10 | |
| Copper (dissolved) | µg/L | NG | | <0.20 | <0.20 | <0.20 | |
| Hardness (as CaCO3), dissolved | mg/L | NG | | <0.60 | <0.60 | <0.60 | |
| Iron (dissolved) | µg/L | NG | | <10 | <10 | <10 | |
| Lead (dissolved) | µg/L | NG | | <0.050 | <0.050 | <0.050 | |
| Lithium (dissolved) | µg/L | NG | | <1.0 | <1.0 | <1.0 | |
| Magnesium (dissolved) | mg/L | NG | | <0.0050 | <0.0050 | <0.0050 | |
| Manganese (dissolved) | µg/L | NG | | <0.10 | <0.10 | <0.10 | |
| Mercury (dissolved) | µg/L | NG | | <0.0050 | <0.0050 | <0.0050 | |
| Molybdenum (dissolved) | µg/L | NG | | <0.050 | <0.050 | <0.050 | |
| Nickel (dissolved) | µg/L | NG | | <0.50 | <0.50 | <0.50 | |
| Phosphorus (dissolved, by ICPMS/ICPOES) | µg/L | NG | | <50 | <50 | <50 | |
| Potassium (dissolved) | µg/L | NG | | <50 | <50 | <50 | |
| Rubidium (dissolved) | µg/L | NG | | <0.20 | <0.20 | <0.20 | |
| Selenium (dissolved) | µg/L | NG | | <0.050 | <0.050 | <0.050 | |
| Silicon (dissolved, as Si) | µg/L | NG | | <50 | <50 | <50 | |
| Silver (dissolved) | µg/L | NG | | <0.010 | <0.010 | <0.010 | |
| Sodium (dissolved) | mg/L | NG | | <0.050 | <0.050 | <0.050 | |
| Strontium (dissolved) | µg/L | NG | | <0.20 | <0.20 | <0.20 | |
| Sulphur (dissolved) | µg/L | NG | | <500 | <500 | <500 | |
| Tellurium (dissolved) | µg/L | NG | | <0.20 | <0.20 | <0.20 | |
| Thallium (dissolved) | µg/L | NG | | <0.010 | <0.010 | <0.010 | |
| Thorium (dissolved) | µg/L | NG | | <0.10 | <0.10 | <0.10 | |
| Tin (dissolved) | µg/L | NG | | <0.10 | <0.10 | <0.10 | |
| Titanium (dissolved) | µg/L | NG | | <0.30 | <0.30 | <0.30 | |
| Tungsten (dissolved) | µg/L | NG | | <0.10 | <0.10 | <0.10 | |
| Uranium (dissolved) | µg/L | NG | | <0.010 | <0.010 | <0.010 | |
| Vanadium (dissolved) | µg/L | NG | | <0.50 | <0.50 | <0.50 | |
| Zinc (dissolved) | µg/L | NG | | <1.0 | <1.0 | <1.0 | |
| Zirconium (dissolved) | µg/L | NG | | <0.20 | <0.20 | <0.20 | |
| | | | | | | | |
| **General and Inorganic Parameters** | | | | | | | |
| Alkalinity (total, as CaCO3) | mg/L | NG | | | <2.0 | | |

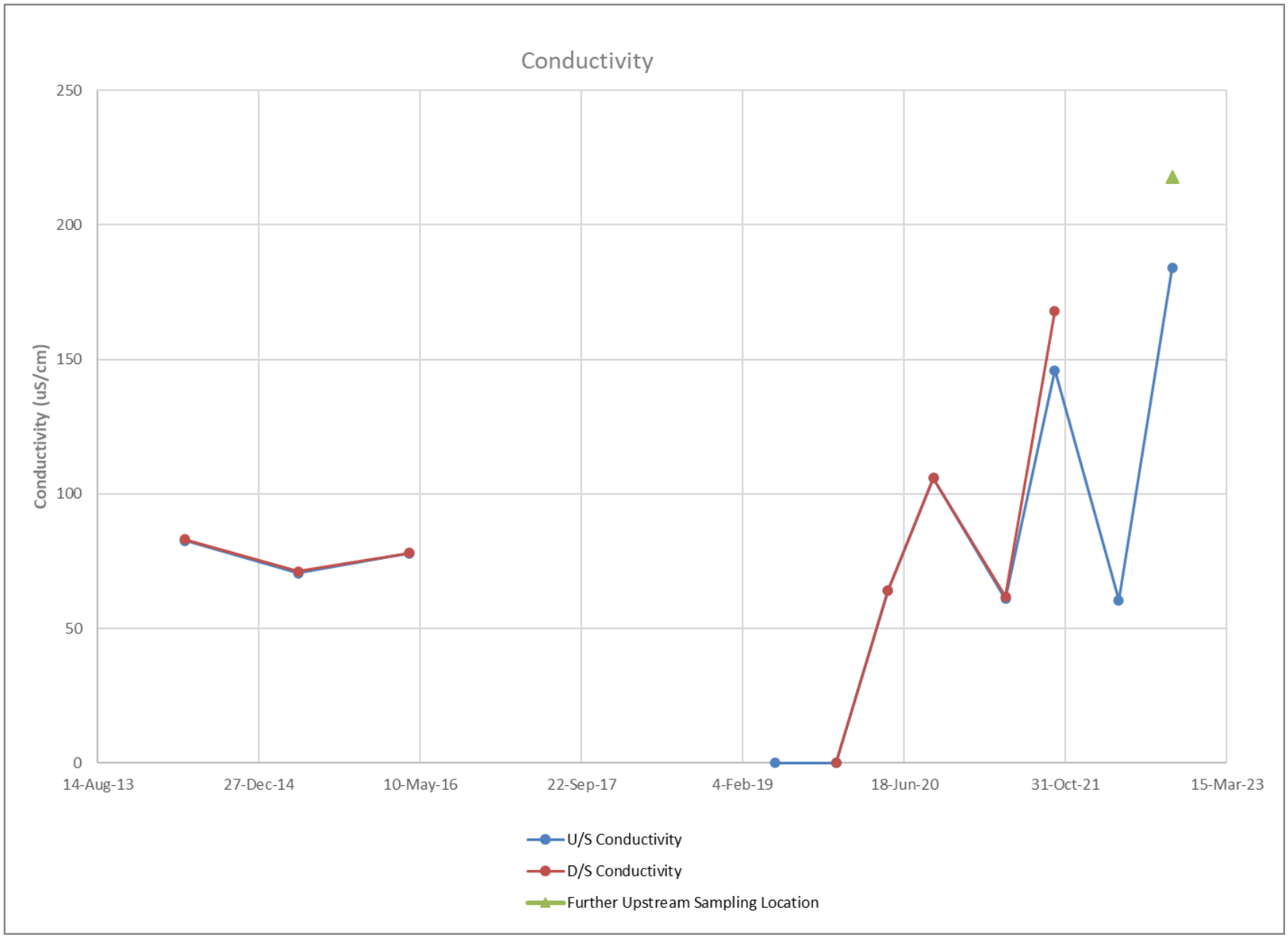
**Table E-3 - Kitwanga Landfill - QAQC Blanks**

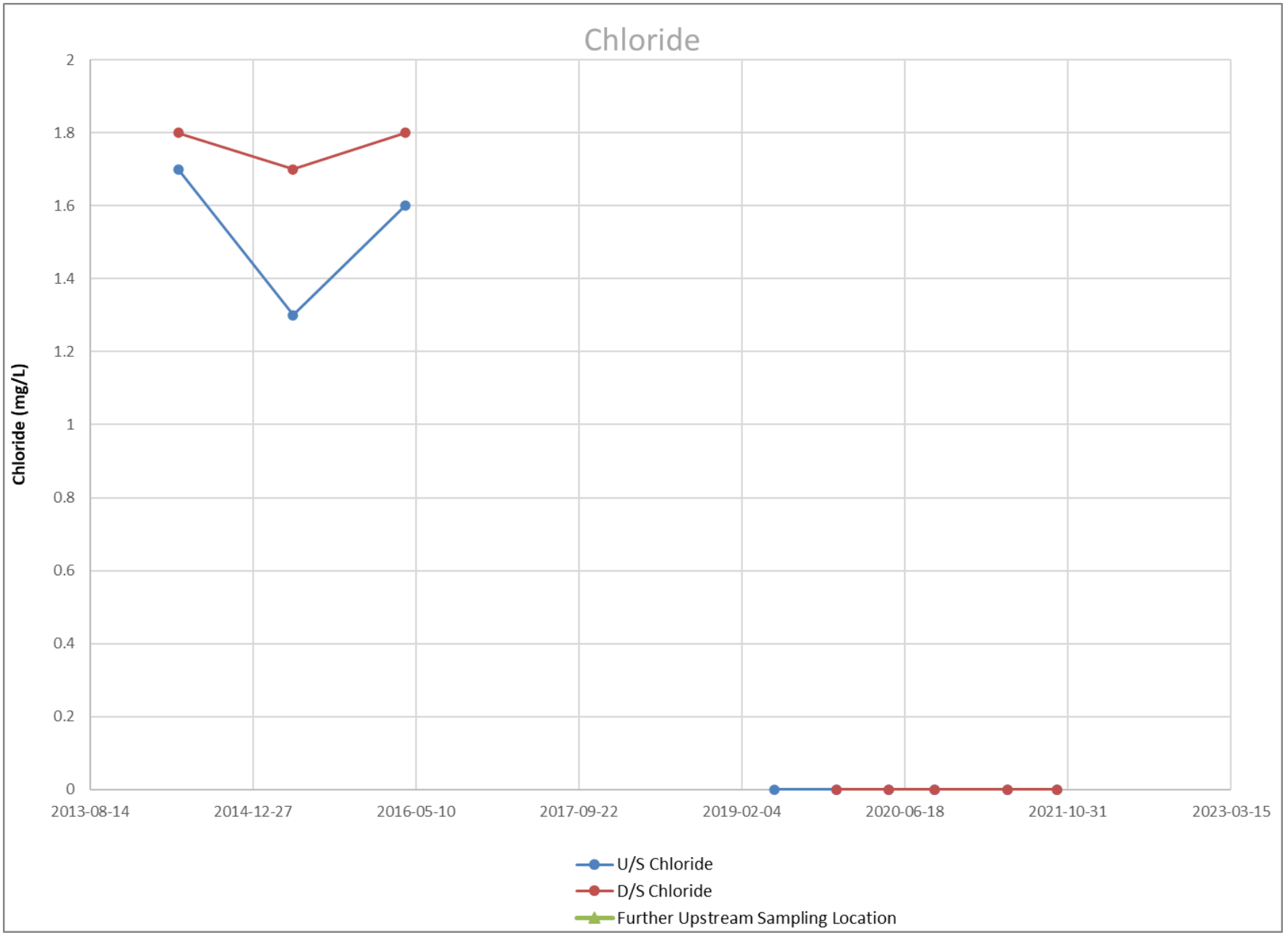
Water Quality Results

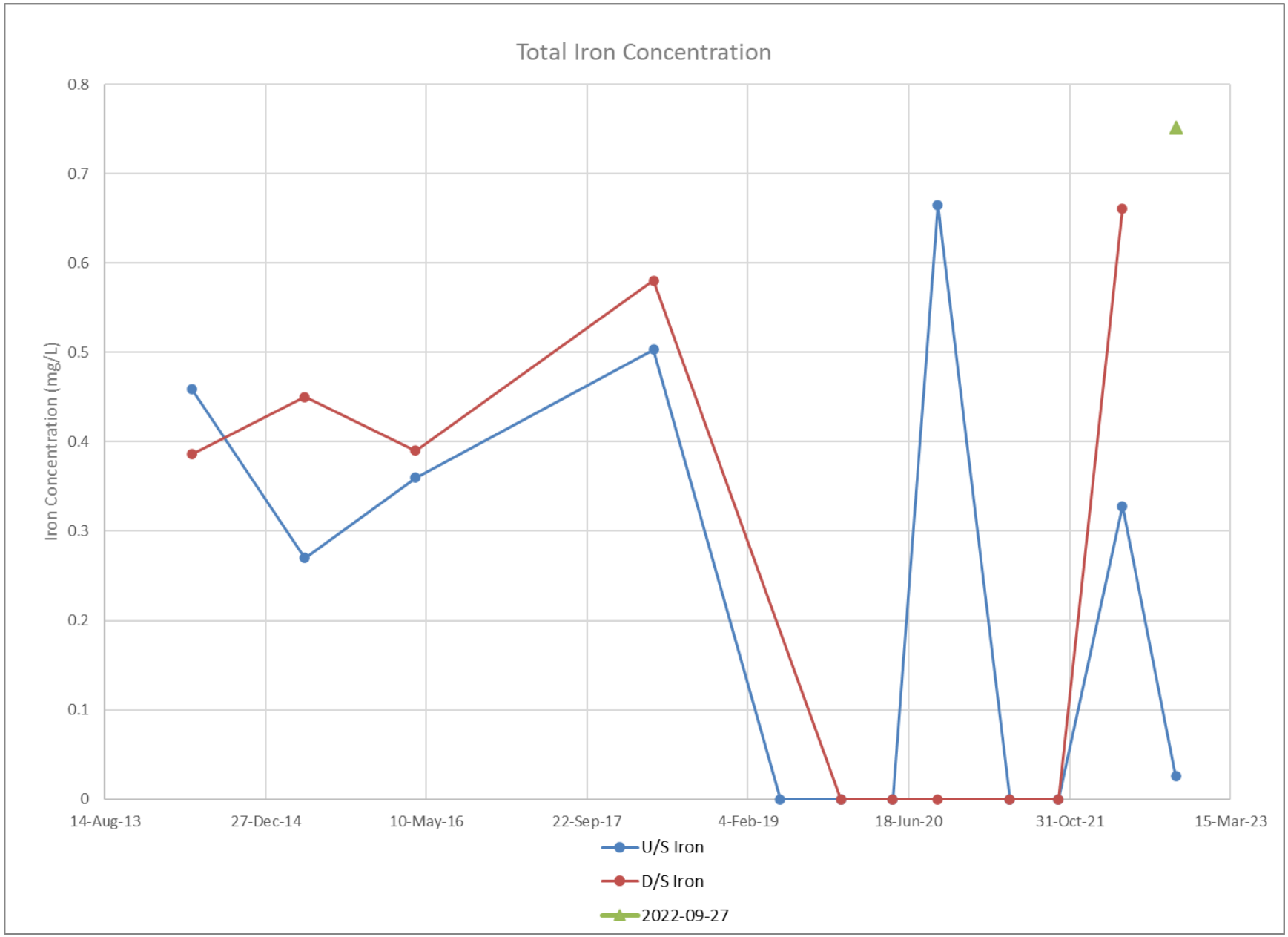
| | | Sampling Location | Field Blank | Field Blank | Travel Blank | Travel Blank |
|---|---|---|---|---|---|---|
| | | Date Sampled | 13-Apr-22 | 27-Sep-22 | 13-Apr-22 | 27-Sep-22 |
| | | Lab Sample ID | VA22A8039-003 | VA22C3713-003 | VA22A8039-005 | VA22C3658-004 |
| | | Sample Type | Normal | Field Blank | Normal | Normal |
| **Analyte** | **Unit** | **Guideline** | | | | |
| | | No Guideline | | | | |
| Ammonia (total, as N) | µg/L | NG | <5.0 | <5.0 | <5.0 | 9.6 |
| Biochemical oxygen demand | mg/L | NG | <2.0 | | <2.0 | <2.0 |
| Conductivity | µS/cm | NG | <2.0 | | | |
| Nitrogen, total | µg/L | NG | <30 | | | |
| pH | | NG | 5.48 | | | |
| | | | | | | |
| **Total Metals** | | | | | | |
| Aluminum (total) | µg/L | NG | <3.0 | | <3.0 | <3.0 |
| Antimony (total) | µg/L | NG | <0.10 | | <0.10 | <0.10 |
| Arsenic (total) | µg/L | NG | <0.10 | | <0.10 | <0.10 |
| Barium (total) | µg/L | NG | <0.10 | | <0.10 | <0.10 |
| Beryllium (total) | µg/L | NG | <0.100 | | <0.100 | <0.100 |
| Bismuth (total) | µg/L | NG | <0.050 | | <0.050 | <0.050 |
| Boron (total) | µg/L | NG | <10 | | <10 | <10 |
| Cadmium (total) | µg/L | NG | <0.0050 | | <0.0050 | <0.0050 |
| Calcium (total) | mg/L | NG | <0.050 | | <0.050 | <0.050 |
| Cesium (total) | µg/L | NG | <0.010 | | <0.010 | <0.010 |
| Chromium (total) | µg/L | NG | <0.50 | | <0.50 | <0.50 |
| Cobalt (total) | µg/L | NG | <0.10 | | <0.10 | <0.10 |
| Copper (total) | µg/L | NG | <0.50 | | <0.50 | <0.50 |
| Hardness (as CaCO3), from total Ca/Mg | mg/L | NG | <0.60 | | <0.60 | <0.60 |
| Iron (total) | µg/L | NG | <10 | | <10 | <10 |
| Lead (total) | µg/L | NG | <0.050 | | <0.050 | <0.050 |
| Lithium (total) | µg/L | NG | <1.0 | | <1.0 | <1.0 |
| Magnesium (total) | mg/L | NG | <0.0050 | | <0.0050 | <0.0050 |
| Manganese (total) | µg/L | NG | <0.10 | | <0.10 | <0.10 |
| Mercury (total) | µg/L | NG | <0.0050 | | <0.0050 | <0.0050 |
| Molybdenum (total) | µg/L | NG | <0.050 | | <0.050 | <0.050 |
| Nickel (total) | µg/L | NG | <0.50 | | <0.50 | <0.50 |
| Phosphorus (total, by ICPMS/ICPOES) | µg/L | NG | <50 | | <50 | <50 |
| Phosphorus (total, APHA 4500-P) | µg/L | NG | <2.0 | | | |
| Potassium (total) | µg/L | NG | <50 | | <50 | <50 |
| Rubidium (total) | µg/L | NG | <0.20 | | <0.20 | <0.20 |
| Selenium (total) | µg/L | NG | <0.050 | | <0.050 | <0.050 |
| Silicon (total, as Si) | µg/L | NG | <100 | | <100 | <100 |
| Silver (total) | µg/L | NG | <0.010 | | <0.010 | <0.010 |
| Sodium (total) | mg/L | NG | <0.050 | | <0.050 | <0.050 |
| Strontium (total) | µg/L | NG | <0.20 | | <0.20 | <0.20 |
| Sulphur (total) | µg/L | NG | <500 | | <500 | <500 |
| Tellurium (total) | µg/L | NG | <0.20 | | <0.20 | <0.20 |
| Thallium (total) | µg/L | NG | <0.010 | | <0.010 | <0.010 |
| Thorium (total) | µg/L | NG | <0.10 | | <0.10 | <0.10 |
| Tin (total) | µg/L | NG | <0.10 | | <0.10 | <0.10 |
| Titanium (total) | µg/L | NG | <0.30 | | <0.30 | <0.30 |
| Tungsten (total) | µg/L | NG | <0.10 | | <0.10 | <0.10 |
| Uranium (total) | µg/L | NG | <0.010 | | <0.010 | <0.010 |
| Vanadium (total) | µg/L | NG | <0.50 | | <0.50 | <0.50 |
| Zinc (total) | µg/L | NG | <3.0 | | <3.0 | <3.0 |
| Zirconium (total) | µg/L | NG | <0.20 | | <0.20 | <0.20 |

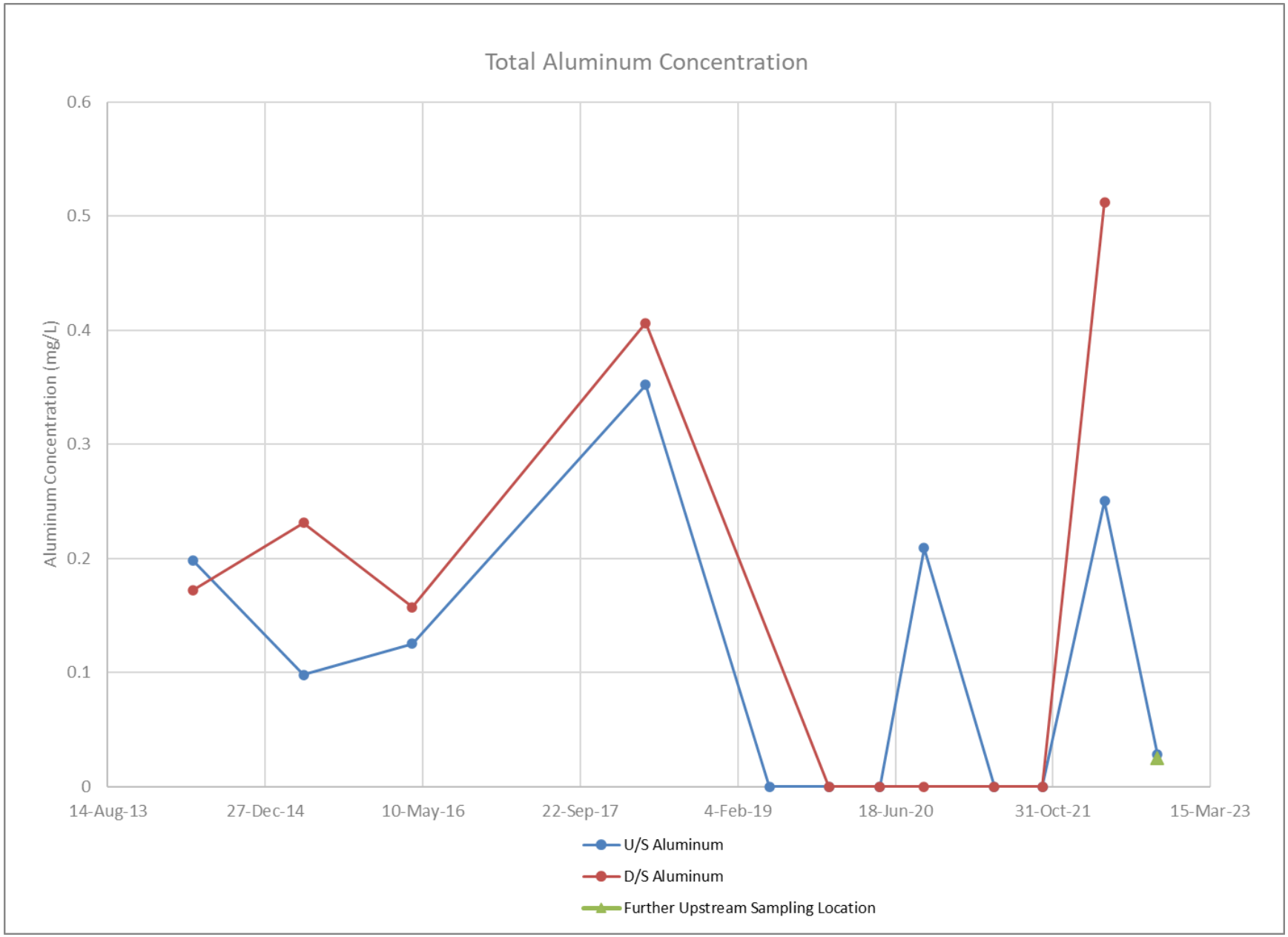
# Appendix F: Sampling and Monitoring Procedures

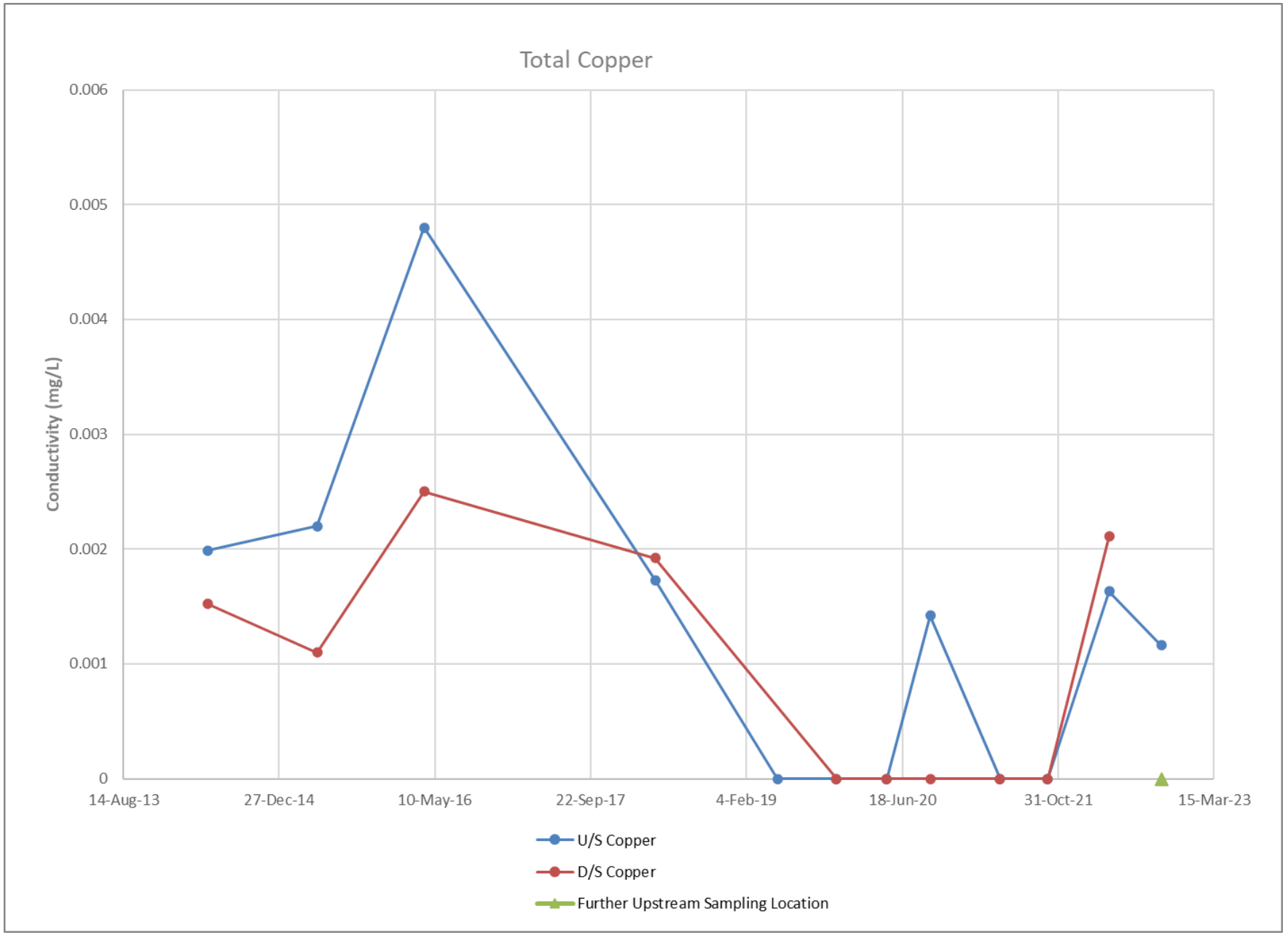
# Appendix G: Water Quality Trending Graphs


Conductivity
250
200
150
100
50
0
Conductivity (uS/cm)
14-Aug-13
27-Dec-14
10-May-16
22-Sep-17
4-Feb-19
18-Jun-20
31-Oct-21
15-Mar-23
U/S Conductivity
D/S Conductivity
Further Upstream Sampling Location


Chloride
Chloride (mg/L)
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
2013-08-14
2014-12-27
2016-05-10
2017-09-22
2019-02-04
2020-06-18
2021-10-31
2023-03-15
U/S Chloride
D/S Chloride
Further Upstream Sampling Location


Total Iron Concentration
Iron Concentration (mg/L)
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
14-Aug-13
27-Dec-14
10-May-16
22-Sep-17
4-Feb-19
18-Jun-20
31-Oct-21
15-Mar-23
U/S Iron
D/S Iron
2022-09-27


Total Aluminum Concentration
Aluminum Concentration (mg/L)
0.6
0.5
0.4
0.3
0.2
0.1
0
14-Aug-13
27-Dec-14
10-May-16
22-Sep-17
4-Feb-19
18-Jun-20
31-Oct-21
15-Mar-23
U/S Aluminum
D/S Aluminum
Further Upstream Sampling Location


Total Copper
0.006
0.005
0.004
0.003
0.002
0.001
0
Conductivity (mg/L)
14-Aug-13
27-Dec-14
10-May-16
22-Sep-17
4-Feb-19
18-Jun-20
31-Oct-21
15-Mar-23
U/S Copper
D/S Copper
Further Upstream Sampling Location

# Appendix C  Ministry Advisory Letter

Report Date: January 06, 2023 File: 5767

Report Number: 195719

Regional District of Kitimat-Stikine
#300-4545 Lazelle Ave
Terrace, BC
V8G 4E1

Dear Regional District of Kitimat-Stikine,

**Re: Non-compliance Advisory Letter, Operational Certificate 5767**

On May 25, 2022, Ministry of Environment and Climate Change Strategy (Ministry) Environmental Protection Officer Julia Coleman (Ministry staff) conducted a planned on-site inspection of the Regional District of Kitimat-Stikine (RDKS) municipal solid waste facility (Facility), located near Kitwanga, BC. The purpose of the inspection was to verify compliance with operational certificate number MR-5767 (OC). The OC authorizes RDKS to store, handle, treat, and discharge municipal solid waste from Kitwanga and the surrounding area to the Kitwanga landfill, subject to the conditions of the OC. The OC was first issued on November 8, 2012, and has not been amended since.

Ministry staff was accompanied by Nicole Lavoie (Environmental Services Coordinator, RDKS), Erin Blaney (Solid Waste Manager, RDKS), and John MacIntyre (Site Supervisor, NBC Contracting).

This Advisory, the alleged violations and the circumstances to which it refers will form part of the compliance history of RDKS, and will be taken into account in the event of future non-compliance.

Please note that this authorization is considered to be out of compliance until such a time as it can be confirmed to meet the authorization requirements.

**Inspection Details:**

This inspection record covered the period from May 25, 2020, to May 25, 2022 (Inspection Period), and the inspection included a review of the following documents:

- Kitwanga Transfer Station and Hazelton Waste Management Facility Health and Safety Plan, undated, prepared by RDKS (H&S Plan);
- Kitwanga Transfer Station Operations & Maintenance Manual, undated, prepared by RDKS (O&M Manual);
- Kitwanga Landfill Closure Plan, dated December 3, 2015, prepared by Sperling Hanson and Associates and UNBC, (2015 Closure Plan);
- 2017 Kitwanga Facility Annual Report, dated June 2018, prepared by RDKS (2017 Annual Report);
- Kitwanga Transfer Station Daily Operational Landfill Inspection Form, dated August 2020 to March 2021, prepared by NBC Contracting (Landfill Inspection Forms);
- Standard Operating Procedures TS-11, Transfer Station Clean Wood Burning, dated January 4, 2019, prepared by RDKS (Clean Wood Burning SOP);
- Kitwanga Transfer Station Weekly Operational Landfill Inspection Form, dated April 2021 to April 2022, prepared by NBC Contracting (Landfill Inspection Forms);

**Ministry of Environment and Climate Change Strategy**
Compliance and Environmental Enforcement Branch
Mailing Address: Bag 5000, 3726 Alfred St, Smithers BC V0J 2N0
Telephone: 250 847 7260
Facsimile: 250 847 7591
Website: www.gov.bc.ca/env

- Closed Kitwanga Landfill 2020 Environmental Monitoring Report, dated April 2021, prepared by Tatersfield Consulting (2020 Environmental Monitoring Report);
- 2020 Closed Kitwanga Landfill Annual Report, dated June 2021, prepared by RDKS, (2020 Annual Report);
- Kitwanga Transfer Station Weekly Operational Site Inspection Form, dated October 17, 2021, prepared by NBC Contracting, (2021 Burn Record);
- Letter report with the subject line Re: Non-Compliance Report for MR-5767 - Surface Water Quality Exceedance, dated November 16, 2021, prepared by RDKS (November 2021 NCR);
- Kitwanga Closed Landfill, 2021 Environmental Monitoring Report, dated 2022, prepared by Tattersfield Consulting (2021 Environmental Monitoring Report);
- Kitwanga Landfill Closure Plan Update, dated May 9, 2022, prepared by Sperling Hansen Associates (2022 Closure Plan), Kitwanga Landfill, 2021 Annual Report, no date, submitted to the Ministry on June 29, 2022, prepared by RDKS (2021 Annual Report) and,
- Letter report with the subject line Re: Non-compliance Report for MR-5767 - Metal Exceedance, dated September 8, 2022, prepared by RDKS (September 2022 NCR).

Below are the OC clauses that were assessed for compliance during this inspection, as well as the associated details/findings and any actions required.

| | |
|---|---|
| Requirement Description: | **1. LOCATION OF LANDFILL PROPERTY**<br>1.: The location of the property where discharges are authorized to occur is District Lot 1335 Cassiar Land District. |
| Details/Findings: | On September 8, 2022, Ministry staff conducted a search of the Ministry's online geographical information database (ParcelMap BC) and confirmed that the Facility is located on District Lot 1335. |
| Compliance: | In |
| Requirement Description: | **2. AUTHORIZED DISCHARGES, 2.1 Discharge of Municipal Solid Waste, 2.1.1**<br>2.1.1: This section applies to the discharge of municipal solid waste to ground at the landfill located approximately as shown on the attached site plan. The site reference number for this discharge is E209210. Refer to Section 5 for the operational requirements associated with this discharge. 2.1.1 Subject to Sections 4.2, 4.3 and 4.4, the characteristics of the discharge shall be typical of municipal solid waste. |
| Details/Findings: | During the on-site inspection, Ministry staff was informed that the Facility stopped landfilling waste around 2017 and that the Facility is in the process of closure. The Solid Waste Manager informed Ministry staff that solid waste collected at the Kitwanga transfer station during the Inspection Period was transported and disposed of at the Hazelton waste management facility in Hazelton, BC. The Hazelton waste management facility is authorized to accept municipal solid waste under the Environmental Management Act (OC 17226).<br><br>Waste was not discharged to the ground at the Facility during the Inspection Period; therefore, compliance with this requirement was not applicable for the Inspection Period. |

| | |
|---|---|
| Compliance: | Not Applicable |
| Actions to be taken: | The Facility is in the process of being closed; therefore, the Ministry recommends that the RDKS contact the Ministry's Authorizations branch to discuss options for amending the OC to reflect a landfill that is no longer accepting waste.<br><br>More information regarding changes to waste discharge authorizations can be found at the following weblink: https://www2.gov.bc.ca/gov/content/environment/waste-management/waste-discharge- |
| Requirement Description: | **2. AUTHORIZED DISCHARGES, 2.1 Discharge of Municipal Solid Waste, 2.1.3**<br>2.1.3: This section applies to the discharge of municipal solid waste to ground at the landfill located approximately as shown on the attached site plan. The site reference number for this discharge is E209210. Refer to Section 5 for the operational requirements associated with this discharge. 2.1.3 The authorized works are a separate municipal solid waste disposal area and related appurtenances located approximately as shown on the attached site plan. |
| Details/Findings: | During the on-site inspection, Ministry staff confirmed that the works are a municipal solid waste disposal area and related appurtenances located approximately as shown on the site plan. |
| Compliance: | In |
| Requirement Description: | **2. AUTHORIZED DISCHARGES, 2.2 Storage and Handling of Wastes for Salvage and Recycling, 2.2.1**<br>2.2.1: This section applies to the storage and handling of municipal solid wastes for salvage and recycling. Refer to Section 7 for the operational requirements associated' with this discharge. 2.2.1 Subject to Section 4.2, the characteristics of the discharge shall be typical of recyclable municipal solid waste. |
| Details/Findings: | During the on-site inspection, Ministry staff observed the recyclable materials (white goods, scrap metal, tires, paper products, and plastics) to be stored separately at the Facility for future transport to the appropriate off-site recycling facility. |
| Compliance: | In |

| | |
|---|---|
| Requirement Description: | **2. AUTHORIZED DISCHARGES, 2.2 Storage and Handling of Wastes for Salvage and Recycling, 2.2.3**<br>2.2.3: This section applies to the storage and handling of municipal solid wastes for salvage and recycling. Refer to Section 7 for the operational requirements associated' with this discharge. 2.2.3 The authorized works are a separate recyclable municipal solid waste storage area and related appurtenances located approximately as shown on the attached site plan. |
| Details/Findings: | During the on-site inspection, Ministry staff observed the recyclable materials storage area located approximately as shown on the Site Plan. However, the site plan has not been updated and does not show the updated features including the transfer station. |
| Compliance: | In |
| Actions to be taken: | The Ministry recommends that the RDKS update the Site Plan during the next OC amendment. |
| Requirement Description: | **2. AUTHORIZED DISCHARGES, 2.3 Discharge of Air Contaminants from Open Burning, 2.3.1**<br>2.3.1: This section applies to the discharge of air contaminants to the atmosphere from the regulated open burning of wood and selected combustibles from a burn pile located approximately as shown on the attached site plan. The site reference number for this discharge is E219223. Refer to Section 8 for the operational requirements associated with this discharge. 2.3.1 The characteristics of the discharge shall be typical of those resulting from the regulated open burning of selected combustibles as per Section 8.3. |
| Details/Findings: | The 2021 Burn Record did not list the types of wastes that were burned on October 14 &15, 2021. However, the 2021 Burn Record directed the operator to inspect the burn pile and to remove non-conforming materials listed in Section 8.3. |
| Compliance: | In |

| | |
|---|---|
| Requirement Description: | **2. AUTHORIZED DISCHARGES, 2.3 Discharge of Air Contaminants from Open Burning, 2.3.3**<br>2.3.3: This section applies to the discharge of air contaminants to the atmosphere from the regulated open burning of wood and selected combustibles from a burn pile located approximately as shown on the attached site plan. The site reference number for this discharge is E219223. Refer to Section 8 for the operational requirements associated with this discharge. 2.3.3 The authorized works are a separate burn area associated with a landfill operation and related appurtenances located approximately as shown on the attached site plan. |
| Details/Findings: | During the on-site inspection, Ministry staff observed a burn area located at the centre of the Facility; not the south end of the landfill footprint as shown on the Site Plan. |
| Compliance: | Not Determined |
| Actions to be taken: | Contact the Ministry and apply to have the Permit amended to include a site plan to that shows the location of all of the authorized works. General inquiries can be made to the Ministry at the following web link: https://www2.gov.bc.ca/gov/content/environment/waste-management/waste- discharge-authorization/change |
| Requirement Description: | **3. LANDFILL DESIGN, 3.1 Design by Qualified Professional(s)**<br>3.1 : The landfill and associated works [including but not limited to the size(s) and location(s) of disposal area(s), maximum allowable slopes of disposal area(s), leachate management system, progressive and final closure details, etc.] shall be designed by qualified professionals [such as engineer(s) and/or geoscientist(s)] registered in the Province of British Columbia who have expertise in the field of landfill design. These details shall be incorporated into a "Design, Operations and Closure Plan" (DOCP) and made available to the Director upon request. Where a design feature prepared by a qualified professional is in conflict with any requirement of this operational certificate, it shall be brought to the attention of the Director who shall determine a resolution to the conflict. |
| Details/Findings: | The landfill is no longer accepting waste; the details of the landfill closure are outlined in the 2022 Closure Plan, which was signed and sealed by qualified professionals (QPs) from Sperling Hanson and Associates (Sperling Hanson).<br><br>However, the closure details have not been incorporated into a DOCP. A DOCP is still required for the Facility because open burning is still occurring which is authorized by the OC. |

| | |
|---|---|
| Compliance: | Out |
| Actions to be taken: | Ensure that a DOCP is prepared that reflects all activities at the Facility in accordance with the requirements of this Section. |
| Requirement Description: | **3. LANDFILL DESIGN, 3.2 Construction**<br>3.2: The landfill and associated works shall be constructed in accordance with the design prepared by qualified professionals, and as documented in the DOCP. |
| Details/Findings: | Drawing number 20087-001 - Existing Site Conditions, within the 2022 Closure Plan, illustrates that the south end of the Facility is lined with a geomembrane cover system. The remaining landfill area is not closed. As closure activities are not yet completed, compliance with the construction design in the 2022 Closure Plan cannot be determined. |
| Compliance: | Not Determined |
| Requirement Description: | **3. LANDFILL DESIGN, 3.3 Engineered Footprint**<br>3.3: The landfill design shall include preparation of an engineered final design footprint delineating the maximum extent of solid waste disposal allowable at the facility horizontally (in plan view). The engineered final design footprint shall be clearly shown on a scaled plan of the site and the plan made available in PDF format (see Section 3.6). These details shall be documented in the DOCP. |
| Details/Findings: | The 2022 Closure Plan includes a drawing that shows the final footprint for the landfill. |
| Compliance: | In |

| | |
|---|---|
| Requirement Description: | **3. LANDFILL DESIGN, 3.4 Engineered Excavation and Final Grade Contours**<br>3.4: The landfill design shall include preparation of engineered excavation grade (if below grade landfilling is to occur) and final grade contours delineating the maximum extent of solid waste disposal allowable at the facility vertically (in cross-sectional view). The engineered excavation and final grade contours shall be clearly shown on scaled drawings ( accompanied with typical cross sections to aid in depicting the landfill profile) and the drawings shall be made available in PDF format (see Section 3.6). These details shall be documented in the DOCP. |
| Details/Findings: | The 2022 Closure Plan includes a drawing that shows the final contours of the landfill. |
| Compliance: | In |
| Requirement Description: | **4. GENERAL REQUIREMENTS, 4.1 Site Identification**<br>4.1 : A sign shall be erected at the main entrance to the landfill which identifies the following: site name, owner, operator, contact phone number and address, hours of operation, tipping fees (if applicable) and prohibition of hazardous wastes. The lettering on the sign shall be such that it is clearly readable by the public upon approach. |
| Details/Findings: | Ministry staff observed the sign posted at the main entrance to the Facility and confirmed it contained the Facility's phone number, address, hours of operation, and a list of prohibited hazardous wastes. |
| Compliance: | In |
| Requirement Description: | **4. GENERAL REQUIREMENTS, 4.2 Prohibited Wastes**<br>4.2: No wastes as defined by the Hazardous Waste Regulation shall be received, stored, treated or disposed of at this site except as authorized by the Director. Lead-acid batteries shall not be landfilled but may be salvaged/recycled provided they are stored, handled and shipped in compliance with the Hazardous Waste Regulation and with Section 8 of this operational certificate. Tires equal to or less than 22" in rim size and autohulks shall not be landfilled. |

| | |
|---|---|
| Details/Findings: | During the on-site inspection, the Solid Waste Manager informed Ministry staff that hazardous wastes were not stored or landfilled at the Facility during the Inspection Period. Ministry staff did not observe hazardous wastes being stored or landfilled at the Facility. |
| Compliance: | In |
| Requirement Description: | **4. GENERAL REQUIREMENTS, 4.3 Waste Asbestos**<br>4.3: Notwithstanding Section 4.2 of this operational certificate, the disposal of waste asbestos under Section 2.1 of this operational certificate and in compliance with the requirements of Section 40 of the Hazardous Waste Regulation is hereby authorized. |
| Details/Findings: | During the on-site inspection, the Solid Waste Manager informed Ministry staff that waste asbestos was not stored or landfilled at the Facility during the Inspection Period, and Ministry staff did not observe asbestos being stored or landfilled at the Facility. |
| Compliance: | Not Applicable |
| Requirement Description: | **4. GENERAL REQUIREMENTS, 4.4 Contaminated Soil**<br>4.4: Soil that contains contaminants in concentrations less than "Hazardous Waste" as defined by the Hazardous Waste Regulation may be disposed at the landfill site. Disposal includes monofilling, co-disposal with other wastes, use as a refuse cell berm material and use as a refuse cell cover material. Disposal must occur within a disposal area as authorized by Section 5 of this operational certificate. Disposal does not include use as final cover material. |
| Details/Findings: | During the on-site inspection, the Solid Waste Manager informed Ministry staff that contaminated soil was not stored or landfilled at the Facility during the inspection period, and Ministry staff did not observe contaminated soil being stored or landfilled at the Facility. Therefore, compliance with this requirement was not applicable during the Inspection Period. |
| Compliance: | Not Applicable |

| | |
|---|---|
| Requirement Description: | **4. GENERAL REQUIREMENTS, 4.5 Waste Measurement**<br>4.5: The quantity of waste material landfilled at the site shall be measured or estimated by means suitable to the Director. The results shall be submitted in accordance with Section 10.5, once per year on or before June 30 for the previous year, expressed in tonnes/yr and/or m3 /yr. |
| Details/Findings: | Ministry staff conducted a search of the Ministry's internal filing system and confirmed that the 2020 and 2021 Annual Reports were submitted to the Ministry before June 30 of the previous year. The 2020 and 2021 Annual Reports confirm that no waste was landfilled at the Facility during the Inspection Period. |
| Compliance: | In |
| Requirement Description: | **4. GENERAL REQUIREMENTS, 4.6 Ozone Depleting Substances**<br>4.6: Release of ozone depleting substances from the storage, handling and transport of used refrigerator equipment, freezers, motor vehicle air conditioners and other air conditioning equipment, fire extinguishers and the like is strictly forbidden as per the requirements of the Ozone Depleting Substances Regulation and Other Halocarbons Regulation. |
| Details/Findings: | During the on-site inspection, Ministry staff observed refrigerators and freezers stored at the Facility. The Solid Waste Manager informed Ministry staff that the ozone depleting substances were removed by Webb Refrigeration of Ltd in Terrace, BC. |
| Compliance: | In |
| Requirement Description: | **4. GENERAL REQUIREMENTS, 4.7 Fire Prevention**<br>4.7: The operational certificate holder shall make all reasonable efforts to prevent unauthorized fires from occurring at the landfill site. As a minimum, a fire break clear of all combustible materials at least 15 metres wide shall surround all disposal, treatment and individual storage areas which have received or are receiving combustible materials. Disposal areas that have had 30 cm of compacted mineral soil cell cover or final cover applied are exempt. Water supply and pumping capabilities and/or soil and earth moving equipment shall be maintained at a sufficient level to extinguish fires. In addition, reasonable efforts shall include, but are not necessarily limited to, the preparation of a Fire Prevention and Response Plan. |

| | |
|---|---|
| Details/Findings: | During the on-site inspection, Ministry staff confirmed that fire breaks were in place around the combustible materials that were stored at the Facility, such as the wood waste pile. The Site Supervisor informed Ministry staff that the landfill and the transfer station operations are inspected on a daily basis and recorded on Landfill Inspection Forms. Section 9.3 - Fire Control, in the Operations and Maintenance Manual, describes the steps to be taken in the event of a fire at the Facility. |
| Compliance: | In |
| Requirement Description: | **4. GENERAL REQUIREMENTS, 4.8 Extinguishment of Fires**<br>4.8: In the event of an unauthorized fire (including any smouldering fire), the operational certificate holder shall immediately make all reasonable efforts to extinguish the fire. The operational certificate holder shall also immediately notify the Provincial Emergency Program (phone: 1-800-663-3456) and any local fire authority of an unauthorized fire. |
| Details/Findings: | During the on-site inspection, the Site Supervisor informed Ministry staff that there were no unauthorized fires during the Inspection Period; therefore, compliance with this requirement was not applicable for the Inspection Period. |
| Compliance: | Not Applicable |
| Requirement Description: | **4. GENERAL REQUIREMENTS, 4.9 Buffer Zone**<br>4.9: No material shall be landfilled within 50 metres of the property boundary. |
| Details/Findings: | The drawings provided in the 2022 Closure Plan do not show the extent of the property boundary, and the property boundary was not identified during the on-site inspection; therefore, compliance with this requirement was not determined. |
| Compliance: | Not Determined |

| | |
|---|---|
| Requirement Description: | **4. GENERAL REQUIREMENTS, 4.10 Litter Control**<br>4.10: The operational certificate holder shall make all reasonable efforts to prevent litter from scattering. Any litter scattered on neighbouring property shall be cleaned up as soon as practicable. |
| Details/Findings: | The Site Supervisor informed Ministry staff that litter scatter is picked up approximately once each month. During the on-site inspection, Ministry staff did not observe litter scatter on neighboring properties. Ministry staff conducted a review of the Ministry's internal filing system and confirmed that there are no complaints of litter scatter on file. |
| Compliance: | In |
| Requirement Description: | **4. GENERAL REQUIREMENTS, 4.12 Surface Water Management**<br>4.12: The distance between a natural body of surface water and any stored or buried materials shall be a minimum of 25 metres. |
| Details/Findings: | The closest natural body of surface water is an unnamed creek located northwest of the landfill; the 2022 Closure Plan describes the distance from landfilled waste to the creek as 76 m from the toe of the landfill. |
| Compliance: | In |
| Requirement Description: | **4. GENERAL REQUIREMENTS, 4.14 Landfill Gas Lower Explosive Limit**<br>4.14: The landfill shall be operated such that combustible gas concentrations do not exceed the lower explosive limit in soils at the property boundary or 25% of the lower explosive limit in any on-site or off-site structure or facility, including any services (water, sewer, electrical, etc.). |
| Details/Findings: | The Landfill Inspection Forms do not include monitoring results for the landfill gas and there is no OC requirement to monitor and record landfill gas. Therefore, compliance with this requirement was not determined. |

| | |
|---|---|
| Compliance: | Not Determined |
| Requirement Description: | **4. GENERAL REQUIREMENTS, 4.15 Water Quality and Protection**<br>4.15: The landfill shall be operated in a manner such that ground or surface water quality does not decrease beyond that specified by the Director, at the landfill property boundary or other specified location. If exceedences of the specified criteria occur as a result of landfill operations, the Director may require that leachate management control measures or works be undertaken. Terms of reference for any leachate management study and/or design work shall be submitted to the Director for approval prior to conducting the work. In addition to requirements specified by the director, groundwater must be managed in accordance with the Contaminated Sites Regulation. |
| Details/Findings: | Surface water and groundwater samples were not collected at the landfill property boundary during the Inspection Period. Therefore, compliance with this requirement was not determined for the Inspection Period. |
| Compliance: | Not Determined |
| Requirement Description: | **4. GENERAL REQUIREMENTS, 4.16 Maintenance of Works and Emergency Procedures**<br>4.16: The operational certificate holder shall inspect the operation regularly and maintain it in good working order. The operational certificate holder shall immediately notify the Director of any circumstance which prevents continuing operation in the approved manner or results in non-compliance with the requirements of this operational certificate. |
| Details/Findings: | The Landfill Inspection Forms confirm that the Facility was inspected daily during the Inspection Period. During the on-site inspection, Ministry staff observed a leachate breakout at the toe of the northwest corner of the landfill (Photo 1). The 2017 Annual Report confirmed that the leachate breakout in the northwest area was first identified in 2016.<br><br>Leachate breakout in the northwest corner of the landfill is considered to be not maintaining the Facility in good working order.<br><br>A review of the Ministry's internal electronic files confirmed there are no non-compliance notifications on file for the leachate breakout. |
| Compliance: | Out |

| | |
|---|---|
| Actions to be taken: | Maintain the Facility in good working order that prevents the breakout of leachate and notify the Ministry of any circumstance which prevents continuing operation in the approved manner of operation, or results in non-compliance with the requirements of this OC. |
| Requirement Description: | **4. GENERAL REQUIREMENTS, 4.17 Electric Fencing, 4.17.1 Design, Construction and Maintenance**<br>4.17.1: Wherever required, electric fencing and gate systems at the landfill shall be designed, constructed, and maintained such that bears are prevented from entering into the landfill through any portion of the fence or gates at any time of the day. |
| Details/Findings: | During the on-site inspection, Ministry staff observed the electric fence to be in place. The Site Supervisor informed Ministry staff that the electric fence is inspected regularly and inspection results are recorded in the Landfill Inspection Forms. The Environmental Coordinator provided the Landfill Inspection Forms to Ministry staff which contained records for any evidence of bear activity. A review of the Landfill Inspection Forms confirmed that there was no bear activity during the Inspection Period, which was confirmed by the Site Supervisor during the on-site inspection. |
| Compliance: | In |
| Requirement Description: | **4. GENERAL REQUIREMENTS, 4.17 Electric Fencing, 4.17.6 Period of Operation**<br>4.17.6: Electric fencing shall be fully operational during the period of April 1 to October 31 inclusive each year and at any other time of year when there is bear activity in the immediate surrounding area. If snow is present during this period, any electrified strands above snow line shall be isolated from the remainder of the system and energized. |
| Details/Findings: | The Landfill Inspection Forms confirm that the electric fence was activated between March 31 and April 11, 2021, that it was deactivated between October 31 and November 7, 2021, and that the electric fence was activated between March 27 and April 3, 2022. |
| Compliance: | In |
| Requirement Description: | **4. GENERAL REQUIREMENTS, 4.17 Electric Fencing, 4.17.7 Minimum Voltage**<br>4.17.7: Electric fencing shall be operated with a minimum voltage of 6,000 volts. |

| | |
|---|---|
| Details/Findings: | The Landfill Inspection Forms confirm that the electric fence, when monitored, was operating with a voltage greater than 6,000 volts during the Inspection Period. |
| Compliance: | In |
| Requirement Description: | **4. GENERAL REQUIREMENTS, 4.17 Electric Fencing, 4.17.9 Fence Inspections**<br>4.17.9: The entire perimeter of the electric fencing shall be inspected at least once every seven days and the voltage of the fencing measured at several points along the fencing and at each gate using a proper electric fence voltmeter matched to the brand of the fence charging unit. The results of voltage testing shall be recorded in a log book. Any results less than the minimum 6,000 volts shall be immediately investigated for the cause of the low voltage (e.g., low battery, litter, vegetation, loose or crossed wires, broken insulators, breaks in the grounding system, etc.). Corrective actions to restore proper voltage shall be immediately undertaken. Signs of digging or other attempts by bears to penetrate electric fencing shall be recorded in a log book. Any penetrations through electric fencing by bears shall be immediately reported to the Conservation Officer Service at 1-877-952-7277 and to the Director at 250-84 7-7260. In cases of low voltage or signs of penetration attempts, inspections shall be increased from once per week to once per day until proper voltage is fully restored and until there are no new signs of penetration attempts, respectively. |
| Details/Findings: | During the on-site inspection, the Site Supervisor informed Ministry staff that the electric fence is checked regularly and recorded in the Landfill Inspection Forms. The Landfill Inspection Forms confirm that the electric fence voltage was:<br>- Monitored at least once per week,<br>- Greater than 6,000 volts when monitored during the Inspection Period, and<br>- Monitored at several points along the fence and at each gate.<br>The Site Supervisor informed Ministry staff during the on-site inspection, that any low voltage reading on the electric fence is immediately investigated and remedied. The Site Supervisor also confirmed that there were no signs of animals penetrating the fence during the Inspection Period. |
| Compliance: | In |

| | |
|---|---|
| Requirement Description: | **5. OPERATIONAL REQUIREMENTS FOR THE DISPOSAL OF SOLID WASTE, 5.1 Location**<br>5.1 : The operational certificate holder shall identify an area for disposal of solid waste (herein referred to as the solid waste disposal area) that is within the authorized municipal solid waste disposal footprint (see Section 2.1.3). Signs which identify the nature of the waste acceptable at the designated solid waste disposal area shall be erected and maintained. The lettering on the sign shall be such that it is clearly readable by the public upon approach. |
| Details/Findings: | During the on-site inspection, Ministry staff confirmed that waste was historically landfilled within the footprint of the solid waste disposal area. However, because there was no solid waste disposal during the Inspection Period, compliance with the operational requirements for solid waste disposal outlined in Sections 5.2, 5.4, 5.5, 5.6.1, 5.6.2, and 5.7 of the OC was not applicable for the Inspection Period. |
| Compliance: | Not Applicable |
| Requirement Description: | **5. OPERATIONAL REQUIREMENTS FOR THE DISPOSAL OF SOLID WASTE, 5.6 Waste Cover, 5.6.3 Final Cover**<br>5.6.3: Cover shall be applied to waste in the solid waste disposal area as specified below. The operational certificate holder shall maintain a log book to record all dates of cover application. Completed portions of the solid waste disposal area shall progressively receive final cover during the active life of the landfill (see Section 11.5). |
| Details/Findings: | During the on-site inspection, Ministry staff observed that the landfill is no longer accepting waste and is no longer actively landfilling. The waste was covered with material; however, the Environmental Service Coordinator informed Ministry staff that approximately 90% of the landfill has not received final cover as required by Section 11.5. Ministry staff observed the landfill to be covered in coarse grained sands and gravels (Photo 2).<br><br>The Environmental Services Coordinator confirmed that the landfill did not receive any cover during the Inspection Period, and therefore, records of the dates cover was applied was not applicable for the Inspection Period. |
| Compliance: | Out |
| Requirement Description: | **6. OPERATIONAL REQUIREMENTS FOR COMPOSTING, 6.1 Composting**<br>6.1 : Composting operations shall comply with the requirements of the Organic Matter Recycling Regulation and any other relevant legislation. |

| | |
|---|---|
| Details/Findings: | During the on-site inspection, the Solid Waste Manager informed Ministry staff that there were no composting operations at the Facility during the Inspection Period and Ministry staff did not observe any compositing activity during the on-site inspection; therefore, compliance with Sections 6.1 and 6.2 was not applicable for the Inspection Period. |
| Compliance: | Not Applicable |
| Requirement Description: | **7. OPERATIONAL REQUIREMENTS FOR STORAGE OF SELECTED WASTES FOR SALVAGE AND RECYCLING, 7.1 Location**<br>7.1 : The operational certificate holder may identify an area for the storage of selected wastes for salvage and recycling (herein referred to as the salvage/recycling area). Any salvage/recycling shall be restricted to the designated salvage/recycling area. This area shall be clearly identified at the landfill site. Signs which identify the nature of the materials acceptable at the designated salvage/recycling area shall be erected and maintained. The lettering on the sign shall be such that it is clearly readable by the public upon approach. |
| Details/Findings: | Ministry staff observed that recycling and salvage were restricted to designated areas at the Facility that were clearly identified with signage. |
| Compliance: | In |
| Requirement Description: | **7. OPERATIONAL REQUIREMENTS FOR STORAGE OF SELECTED WASTES FOR SALVAGE AND RECYCLING, 7.2 Nature of Wastes**<br>7.2: Wastes to be salvaged/recycled may be any items with potential salvage or recycling value such as tires, lead-acid batteries, auto hulks, white goods, furniture, used lumber, used goods and the like, but shall not include any refuse consisting of or containing putrescibles, any liquid wastes, hot ashes or materials otherwise restricted by Section 4.2. |
| Details/Findings: | During the on-site inspection, Ministry staff observed recycling and salvage items including, tires, cardboard and paper products, white goods, scrap metal, and electronics. No items restricted by Section 4.2 were identified during the on-site inspection. |
| Compliance: | In |

| | |
|---|---|
| Requirement Description: | **7. OPERATIONAL REQUIREMENTS FOR STORAGE OF SELECTED WASTES FOR SALVAGE AND RECYCLING, 7.3 Compliance**<br>7.3: Salvage/recycling shall comply with the requirements of the Storage of Recyclable Material Regulation and any other relevant legislation and any additional requirements contained in this operational certificate. |
| Details/Findings: | Compliance with the Storage of Recyclable Materials Regulation was not assessed as part of this inspection. Therefore, compliance was not determined. |
| Compliance: | Not Determined |
| Requirement Description: | **7. OPERATIONAL REQUIREMENTS FOR STORAGE OF SELECTED WASTES FOR SALVAGE AND RECYCLING, 7.4 Contamination**<br>7.4: Contamination of any of the designated salvage/recycling storage piles with putrescible wastes shall be cleaned up immediately. |
| Details/Findings: | During the on-site inspection, Ministry staff did not observe the salvage and recycling areas to be contaminated with putrescible wastes. Household waste and putrescible wastes were managed at the transfer station and were kept separate from the salvage and recycling areas. |
| Compliance: | Not Applicable |
| Requirement Description: | **8. OPERATIONAL REQUIREMENTS FOR REGULATED OPEN BURNING, 8.1 Location**<br>8.1 : The operational certificate holder may identify an area for the use of open burning to dispose of selected combustibles (herein referred to as the open burning area). Any open burning of selected wastes shall be restricted to the designated open burning area. This area shall be clearly identified at the landfill site. Signs which identify the nature of the waste acceptable at the designated open burning area shall be erected and maintained. The lettering on the sign(s) shall be such that it is clearly readable by the public upon approach. |

| | |
|---|---|
| Details/Findings: | During the on-site inspection, Ministry staff observed that the area used for open burning operations during the Inspection Period was confined to a single location.<br><br>There were no signs that identified the nature of the acceptable materials for the designated open burning area installed at the Facility during the on-site inspection. |
| Compliance: | Out |
| Actions to be taken: | Install a sign which identifies the nature of the waste acceptable at the designated open burning area in accordance with OC Section 8.1. |
| Requirement Description: | **8. OPERATIONAL REQUIREMENTS FOR REGULATED OPEN BURNING, 8.2 Quantity, Timing, and Duration of Discharge**<br>8.2: The maximum authorized quantity of wood residue to be open burned during each event is that which has accumulated at the time of burn initiation. The pile(s) shall be constructed so as to ensure a rapid and complete bum. The quantity of air contaminants is indeterminate. The maximum authorized duration of each burn shall be limited to the period between two hours after sunrise on the day of ignition, and sunset on the following day. Each open burn must be completely extinguished at the end of the authorized burn duration. Should a condition arise which prevents the bum pile(s) from being burned within this period, the Director must be notified in accordance with Section 8.10 of this authorization. |
| Details/Findings: | The Environmental Services Coordinator informed Ministry staff that one controlled burn occurred during the Inspection Period and provided the Landfill Inspection Form for October 17, 2021, which contained the 2021 Burn Record. The 2021 Burn Record confirmed the burn volume was 165 m3, and that the burn commenced on Thursday, October 14, 2021, at 4:03 pm, and was completed on October 15, 2021, at 7:10 pm, approximately half an hour following sunset. A review of the Ministry's internal files confirmed that there was no notification submitted to a Director for failing to complete the burn within the approved time period. |
| Compliance: | In |

| | |
|---|---|
| Requirement Description: | **8. OPERATIONAL REQUIREMENTS FOR REGULATED OPEN BURNING, 8.3 Nature of Wastes**<br>8.3: No wastes shall be burned which are unacceptable to the Director. Acceptable materials for burning may only include dry, unpainted, untreated demolition, construction and packing-related wood residue, clean stumps and brush, but must exclude nuisance-causing combustibles such as glue-containing wood, painted and treated wood, sawdust, yard wastes, mulch, wood chips, rubber, plastics, tars, insulation, roofing material, asphalt shingles, etc. |
| Details/Findings: | The 2021 Burn Record directs the operator to inspect the burn pile for any non-conforming material prior to burning, which is the operational practice that was confirmed by the Operator during the on-site inspection.<br><br>During the on-site inspection, Ministry staff observed a pile of woody waste stored in the burn area. The wood waste included cut brush and branches. Ministry staff did not identify any nuisance-causing combustibles in the material stored in the burn area. |
| Compliance: | In |
| Requirement Description: | **8. OPERATIONAL REQUIREMENTS FOR REGULATED OPEN BURNING, 8.4 Favourable Weather for Smoke Dispersion**<br>8.4: Open burning shall not proceed unless weather conditions are such that emissions are dispersed away from populated areas. The operational certificate holder must also obtain a burn registration number from the Ministry of Forests (1-888-797-1717) prior to ignition. Open burning of wood residue must not be initiated or continued if the local air flow will cause the smoke to negatively impact a nearby population or cause pollution. No burning shall occur during periods of fire hazard or when burning is prohibited by other agencies. |
| Details/Findings: | A review of the online BC Wildfire Service Open Fire Tracking System on September 12, 2022, confirmed that the Facility has open burning registration number R01-R1255, with an expiry date of September 19, 2022.<br><br>The Open Burning Form confirmed that the venting index was recorded during the burn times as required by OC Section 8.2. The venting index during the burn was between 29% and 66%.<br><br>A review of the Ministry's internal electronic filing system confirmed that there were no complaints on file for the Inspection Period. However, because the venting index was less than 34 during the burn event, which is considered poor according to the venting index, it cannot be determined if this burn event caused smoke to negatively impact the nearby population or caused pollution. |

| | |
|---|---|
| Compliance: | Not Determined |
| Requirement Description: | **8. OPERATIONAL REQUIREMENTS FOR REGULATED OPEN BURNING, 8.5 Fire Accelerant**<br>8.5: A suitable amount of approved fire accelerant such as diesel fuel or commercial fire starter gel or a flame-thrower shall be used to ensure efficient and rapid ignition of the waste material. |
| Details/Findings: | The Environmental Services Coordinator confirmed in an email on January 4, 2023, that it was unknown if the on-site staff used a fire accelerant for the controlled burn that occurred on October 14th and 15th 2021. |
| Compliance: | Not Determined |
| Requirement Description: | **8. OPERATIONAL REQUIREMENTS FOR REGULATED OPEN BURNING, 8.6 Minimization of Smoke**<br>8.6: The burn shall be tended and fed in a manner that ensures minimization of smoke emissions. Measures to minimize smoke shall include, but not necessarily be limited to: stacking of waste in a manner that eliminates dirt; waiting to burn until wastes are reasonably dry after any significant precipitation event; and using adequate equipment and staff. |
| Details/Findings: | The Environmental Services Coordinator confirmed in an email on January 4, 2023, that the methods used to minimize smoke included stacking the material in a manner that reduced the amount of smoke generation. |
| Compliance: | In |

| | |
|---|---|
| Requirement Description: | **8. OPERATIONAL REQUIREMENTS FOR REGULATED OPEN BURNING, 8.7 Contingency Plan**<br>8.7: Prior to burning, a contingency plan must be in place detailing how the open burn will be extinguished in the event of any of the following occurring: i) Inadequate smoke dispersion in the surrounding environment; ii) wood residue continues to smoulder after the authorized burn period; and, iii) the Director requires that the open burn be extinguished for environmental protection reasons. At a minimum, the plan must detail the actions to be taken to extinguish the open burn should any of the above conditions occur. The plan shall be made available to the Director upon request. |
| Details/Findings: | The H&S Plan includes Section 6.5 Open Burning, which does not include the actions to be taken to extinguish the open burn should any of the events described above occur. |
| Compliance: | Out |
| Actions to be taken: | Ensure that there is a contingency plan in place for the Facility, that provides adequate guidance to extinguish a planned open burn in the event of the above conditions. |
| Requirement Description: | **8. OPERATIONAL REQUIREMENTS FOR REGULATED OPEN BURNING, 8.9 Fire Supervision and Suppression**<br>8.9: An attendant shall be on-site to supervise the burn. Adequate fire suppression equipment shall be available for the entire duration of the event, and must be capable of extinguishing the fire if necessary. Local fire departments must be notified of the operational certificate holder's intent to bum, prior to ignition. |
| Details/Findings: | In email correspondence on November 30, 2022, the Environmental Services Coordinator informed Ministry staff that the landfill contractor is expected to remain at the Facility for the duration of the burn, and the contractor is provided accommodations to remain at the Facility.<br><br>The Environmental Services Coordinator informed Ministry staff in email correspondence on November 30, 2022, that the Facility is not located in a fire protection area for any local fire departments or volunteer fire departments. Therefore, compliance with the requirement to notify the local fire department was not applicable for the Inspection Period.<br><br>Fire suppression equipment listed in the 2021 Burn Record was a water can, fire extinguisher, loader, and sand. |
| Compliance: | In |

| | |
|---|---|
| Requirement Description: | **8. OPERATIONAL REQUIREMENTS FOR REGULATED OPEN BURNING, 8.10 Maintenance of Works and Emergency Procedures**<br>8.10: The operational certificate holder shall inspect the bum piles regularly and ensure that they are burning well. In the event of an emergency, or condition beyond the control of the operational certificate holder which prevents continuing operation of the approved method of open burning, the operational certificate holder shall notify the Director within two hours. If notification is necessary, it shall be accomplished by contacting the Environmental Protection program at (250) 847 - 7260. The Director may require additional controls on the burning process and may require that the burn be extinguished at any time based on its impacts on the receiving environment. |
| Details/Findings: | The 2021 Burn Record confirmed that the controlled burn operation was inspected and documented.<br><br>During the on-site inspection, the Site Supervisor informed Ministry staff that there were no emergency conditions during the Inspection Period, including the controlled burn event. Ministry staff reviewed the Ministry's internal electronic files and Natural Resources Information System (NRIS) and no complaints or notifications of a condition beyond the control of the RDKS were on file. |
| Compliance: | In |
| Requirement Description: | **8. OPERATIONAL REQUIREMENTS FOR REGULATED OPEN BURNING, 8.11 Documentation**<br>8.11: Following completion of each burn, notice shall be sent to the Director by fax (250-847-7591) or by e-mail to a Skeena Environmental Protection staff member advising of the following details: time of burn initiation, time of burn cessation, volume of wood residue burned, venting index values obtained for burning, and any extraordinary conditions encountered during the burn |
| Details/Findings: | The 2021 Burn Record was submitted to the Ministry on July 13, 2022, upon request from Ministry staff and not following the completion of the burn as required. The 2021 Burn Record included the time of burn initiation, time of burn cessation, the volume of wood waste burned, and the venting index values. No extraordinary conditions were identified. |
| Compliance: | Out |

| | |
|---|---|
| Actions to be taken: | Ensure to submit notice to the Director following the completion of each burn. Notifications can be submitted to the routine environmental reporting mailbox ENVAuthorizationsReporting@gov.bc.ca |
| Requirement Description: | **9. MONITORING REQUIREMENTS**<br><br>9.: The operational certificate holder shall have a qualified professional evaluate whether an environmental effects monitoring program is needed. The assessment and recommended monitoring program, should one be required, shall be submitted for Director's approval on or before June 30, 2013. In addition to surface water sites, the qualified professional should consider the necessity of establishing ground water monitoring locations. Until June 30, 2013, an interim monitoring program shall be implemented as follows: "see PDF table 9 in OC" |
| Details/Findings: | The assessment and potential recommendation for an environmental monitoring program predate the Inspection Period; therefore, compliance with this requirement was not applicable for the Inspection Period.<br><br>The 2020 and 2021 Environmental Monitoring Reports confirm that surface water from the Unnamed Creek, at locations upstream and downstream of the Facility, were collected twice annually during the Inspection Period. The Environmental Service Coordinator informed Ministry staff during the on-site inspection, that there were no groundwater monitoring wells at the Facility. The 2022 Closure Plan recommends that the RDKS install a groundwater well network to monitor groundwater quality.<br><br>The Environmental Services Coordinator informed Ministry staff in an email on November 30, 2022, that the RDKS installed three groundwater monitoring wells on August 8th and 9th of 2022. |
| Compliance: | Not Applicable |
| Requirement Description: | **10. REPORTING REOilIREMENTS, 10.1 Reporting**<br><br>10.1 : All reports, drawings, data, studies and the like shall be submitted in hardcopy and electronic formats unless otherwise specified by the Director. |
| Details/Findings: | During the Inspection Period, all reports were submitted to the Ministry in electronic form as required. |
| Compliance: | In |

| | |
|---|---|
| Requirement Description: | **10. REPORTING REOilIREMENTS, 10.2 Log Book**<br>10.2: As required by Sections 4.17.9 and 5.6 the operational certificate holder shall maintain a log book. The log book shall be made available for inspection by Ministry staff upon request. |
| Details/Findings: | The Landfill Inspection Forms were provided to Ministry staff upon request. |
| Compliance: | In |
| Requirement Description: | **10. REPORTING REOilIREMENTS, 10.3 Non-compliance Reporting**<br>10.3: The operational certificate holder shall immediately notify the Director of any non-compliance with the requirements of this operational certificate and take appropriate remedial action. Written confirmation of all noncompliance events, including available test results, is required by facsimile or email to Environmental Protection staff within 24 hours of the original notification unless otherwise directed by the Director. |
| Details/Findings: | The following non-compliances with the OC requirements were identified in this inspection:<br>- 4.16 Maintenance of Works and Emergency Procedures, and<br>- 11.5 Progressive Application of Final Cover.<br><br>Ministry staff conducted a review of the Ministry's internal electronic files and confirmed that there were no non-compliance notifications on file for the non-compliances that were identified in this inspection. |
| Compliance: | Out |
| Actions to be taken: | Ensure to notify the Ministry of any non-compliance with the requirements of this OC. Non-compliance notifications can be made to the non-compliance reporting mailbox EnvironmentalCompliance@gov.bc.ca |

| | |
|---|---|
| Requirement Description: | **10. REPORTING REOilIREMENTS, 10.4 Non-compliance Follow-up**<br><br>10.4: Upon request, the operational certificate holder shall submit to the Director a written report within 30 days of the non-compliance occurrence. The report shall include, but not necessarily be limited to, the following: i) All relevant information and test results related to the noncompliance; ii) an explanation of the most probably cause(s) of the non-compliance; and, iii) remedial action planned and/or taken to prevent similar noncompliance(s) in the future. |
| Details/Findings: | A review of the Ministry's internal filing system confirmed that a Director did not request a non-compliance report during the Inspection Period; therefore, this requirement was not applicable for the Inspection Period.<br><br>The RDKS voluntarily provided a follow-up non-compliance report for metal exceedances that were identified in the surrounding environment. |
| Compliance: | Not Applicable |
| Requirement Description: | **10. REPORTING REQUIREMENTS, 10.5 Annual Report**<br><br>10.5: The operational certificate holder shall submit a basic annual report to the Director on or before June 30 each year for the previous calendar year. The report shall contain, at a minimum: i) The type and tonnage or volume of waste received, recycled, and landfilled for the year; ii) occurrences or observations of wildlife attempting to access the facility; iii) the results of any monitoring programs undertaken by the operational certificate holder for this site. Trend analysis, as well as an evaluation of any identified impacts of the discharges on the receiving environment in the previous year shall be carried out by a qualified professional, if determined to be necessary by the Director. |
| Details/Findings: | Ministry staff conducted a review of the Ministry’s internal filing system and confirmed that the 2020 Annual Report was submitted to the Ministry on June 21, 2021, and that the 2021 Annual Report was submitted to the Ministry on June 29, 2022.<br><br>The 2020 and 2021 Annual Reports were prepared by a QP and contained the required information. |
| Compliance: | In |

| | |
|---|---|
| Requirement Description: | **11. CLOSURE REQUIREMENTS, 11.1 Notification of Closure**<br><br>11.1 : The operational certificate holder shall notify the Director in writing of intentions to close the landfill site. |
| Details/Findings: | Ministry staff conducted a search of the Ministry's internal filing system and confirmed that in 2016, there was correspondence between the RDKS and Ministry staff regarding the planned closure of the landfill on file.<br><br>The Annual Reports confirm that the landfill started closure activities in 2016. The time of the initial notification of the intention to close the landfill was not on file with the Ministry, therefore, it cannot be determined if the initial notification occurred prior to closure activities. |
| Compliance: | Not Determined |
| Requirement Description: | **11. CLOSURE REQUIREMENTS, 11.2 Closure Plan**<br><br>11.2: A closure plan shall be submitted to the Director no later than 6 months in advance of scheduled closure. The closure plan shall, at a minimum, include the following: i) Proposed end-use of the landfill property after closure; ii) anticipated total waste volume, tonnage, and life remaining of the landfill; iii) a topographic plan showing the final elevation contours of the landfill and surface water diversion and drainage controls; iv) design of the final cover suited to the intended end-use of the site, including the thickness and permeability of barrier layers and drainage layers, and information on topsoil, vegetative cover and erosion prevention controls; v) procedures for notifying the public about the closure and about alternative waste disposal facilities; vi) rodent and nuisance wildlife control procedures; vii) a comprehensive monitoring plan, if determined to be necessary by a qualified professional, including groundwater monitoring, surface water monitoring, landfill gas monitoring, leachate monitoring, final cover monitoring, and erosion and settlement monitoring, for a minimum post closure period of 25 years; viii) a plan and accompanying design for the collection, storage and treatment/use of landfill gas for a minimum 25 year post-closure period (if required); ix) a plan for operation of any required pollution abatement engineering works such as leachate collection and treatment systems, for a minimum post closure period of 25 years; and, x) an estimated cost, updated annually, to carry out closure and post-closure activities for a minimum period of 25 years. |
| Details/Findings: | The date the 2015 Closure Plan (dated December 3, 2015) was submitted to the Ministry was not in the Ministry's internal filing system, and the date on which closure activities began is unknown; therefore, compliance with the requirement to submit the closure plan no later than 6 months in advance of the scheduled closure was not determined.<br><br>The updated 2022 Closure Plan was submitted to the Ministry on May 12, 2022, and is the version used to assess compliance with this OC Section.<br><br>The 2022 Closure Plan was prepared by a QP and contained the applicable information required by this OC Section. |

| | |
|---|---|
| Compliance: | In |
| Requirement Description: | **11. CLOSURE REQUIREMENTS, 11.4 Final Cover**<br><br>11.4: The final cover system shall be designed by a qualified professional to match the intended end-use of the landfill site and to match the needs of any required environmental management systems (leachate minimization or recirculation, as the case may be, landfill gas collection and treatment, etc.). Generally, the final cover shall consist of a layer of 1 metre of low permeability (<1 x 10-5 cm/s) compacted soil followed by a layer of topsoil suitable for establishment of vegetation. Higher permeability soil may be used if determined to be acceptable by a qualified professional and specified in the DOCP. The final cover shall be constructed with minimum and maximum slopes as specified by a qualified professional (see Section 3 .4) to promote runoff and minimize erosion, with appropriate runon/runoff drainage controls, erosion controls, and gas venting controls. The site shall be seeded with a grass/legume mixture suited to the local climate. |
| Details/Findings: | The final cover system presented in the 2022 Closure Plan was prepared by QPs from Sperling Hanson. The 2022 Closure Plan describes the proposed end use for the closed landfill to be storage (parking equipment and storing materials). The 2022 Closure Plan describes the final cover to be sourced from the Hazelton Landfill site (OC-17226) with a permeability of 1 x 10-9 m/s (1 x 10-6 cm/s).<br><br>No final cover has been applied; therefore, compliance with the requirements relating to the permeability of the final cover was not applicable for the Inspection Period. During the on-site inspection, a stockpile of the landfill final cover material was observed by Ministry staff (Photo 3). The Environmental Service Coordinator informed Ministry staff in an email on January 4, 2023, that the RDKS plans to have the intended cover material tested to confirm that it meets the Landfill Criteria hydraulic conductivity requirements. |
| Compliance: | In |
| Requirement Description: | **11. CLOSURE REQUIREMENTS, 11.5 Progressive Application of Final Cover**<br><br>11.5: Completed portions of the landfill shall progressively receive final cover during the active life of the landfill. The maximum area of disposed refuse that has not yet received final cover shall not exceed 25% of the total final footprint area. Final cover is to be applied according to the specifications identified in Section 11.4. |

| | |
|---|---|
| Details/Findings: | During the on-site inspection, the Environmental Services Coordinator informed Ministry staff that the closed landfill has not received final cover. In an email on November 30, 2022, the Environmental Services Coordinator estimated that the only area that has received final cover is the active transfer station and public use area, which is covered with an engineered membrane. The remaining area still requiring final cover is approximately 8,900 m2 which is approximately 90% of the total landfill area. |
| Compliance: | Out |
| Actions to be taken: | Ensure that the maximum area of disposed refuse that has not yet received final cover shall not exceed 25% of the total final footprint area. |

Compliance History:
2014-05-28 IR17709 Advisory: 4.17.3 Wire Tension
2012-08-21 IR3689 Advisory 4.7.4 Wire Tension
2012-08-30 IR4090 Advisory: 4.7.4 Wire Tension
2012-08-30 IR4083 Notice of Compliance

The Ministry of Environment Compliance and Enforcement Policy and Procedure (C&E Policy) prescribes common requirements and procedures for all Ministry staff to ensure consistent and risk-based assessment and response to non-compliance. Using the Non-Compliance Decision Matrix, the compliance determination for this inspection has been assessed as **Level 2, Category A, Advisory.**

More information about Environmental Compliance, the Non-Compliance Decision Matrix, and reporting and data submission requirements can be found at the links below:
General compliance information:
www.gov.bc.ca/environmentalcompliance
Non-Compliance Decision Matrix information:
www.gov.bc.ca/environment/how-compliance-is-assessed
Reporting and data submission requirements (to be sent to EnvAuthorizationsReporting@gov.bc.ca):
https://www2.gov.bc.ca/gov/content/environment/waste-management/waste-discharge-authorization/comply

Please be advised that this inspection report may be published on the provincial government website within 7 days.

If you have any questions about this letter, please contact the undersigned.

Yours truly,

Julia Coleman
Environmental Protection Officer

cc: Nicole Lavoie: nlavoie@rdks.bc.ca; Erin Blaney: eblaney@rdks.bc.ca

**Attachments: Photo Record IR#: 195719**

**Deliver via:**
**Email:** [X] **Fax:** [ ] **Mail:** [ ]
**Registered Mail:** [ ] **Hand Delivery:** [ ]

**Ministry of Environment and Climate Change Strategy**
Compliance and Environmental Enforcement Branch
Mailing Address:
Bag 5000
3726 Alfred St
Smithers BC V0J 2N0
Telephone: 250 847 7260
Facsimile: 250 847 7591
Website: www.gov.bc.ca/env

Photo Record IR#: 195719

| | |
|---|---|
| Authorization: 5767 | Client Name: Regional District of Kitimat-Stikine |
| NRIS IR #: 195719 | Site Inspection Photos: May 24, 2022 |

| | |
|---|---|
| Photo 1 – Leachate breakout at the toe of the slope in the northwest corner of the landfill |  |
| Photo 2 – Landfill cover included coarse grained sands and gravels |  |

Photo Record IR#: 195719

| | | |
|---|---|---|
| Photo 3 – stock pile of the landfill cover material containing course sand and gravels. |  | |

# Appendix D Groundwater Well Installation Report

# GROUNDWATER MONITORING WELL DRILLING AND SAMPLING PROGRAM KITWANGA TRANSFER STATION NEAR KITWANGA, BRITISH COLUMBIA

Submitted To:

Regional District of Kitimat-Stikine

**Regional District of Kitimat-Stikine**
300 – 4545 Lazelle Ave
Terrace, British Columbia
V8G 4E1

Submitted By:

Waterline Resources Inc.
Smithers, British Columbia
February 1, 2023
3478-22-002

Waterline

# TABLE OF CONTENTS

## LIST OF TABLES (TABLES SECTION)



## LIST OF FIGURES (FIGURES SECTION)



## LIST OF APPENDICES

## 1.0 INTRODUCTION

The Regional District of Kitimat-Stikine (RDKS) operates the Kitwanga Transfer Station (the Site) located approximately 5.75 km northeast of Kitwanga, British Columbia (Figure 1). In 2012, the British Columbia Ministry of Environment (BC MOE) has issued RDKS an operational certificate (MR-5767) for the Site. The Guidelines for Environmental Monitoring at Municipal Solid Waste Landfills (the Guidelines) prescribe a requirement to conduct groundwater monitoring at the Site. The Operational Certificate currently requires that the RDKS carry out an interim environmental effects monitoring program for surface water twice yearly.

RDKS retained Waterline Resources Inc. (Waterline) to provide hydrogeological support for the design, construction, and sampling of a groundwater monitoring network at the Site (the Program).

## 2.0 OBJECTIVE AND SCOPE OF WORK

The objective of the Program was to install a groundwater monitoring network compliant with the Guidelines and the operational certificate for the Site. To achieve the above objective, Waterline completed the following scope of work:

- Conduct a desktop assessment of publicly available information to identify proposed groundwater monitoring locations at the Site.
- Coordinate with RDKS to retain a qualified drilling contractor to drill and install three groundwater monitoring wells at the Site.
- Conduct a field program that included in the drilling, installation, development, K-testing and water samples of the new groundwater monitoring wells at the Site.
- Prepare this report, which summarizes the results of the field program and provide recommendations for future groundwater monitoring efforts.

## 3.0 SITE HISTORY

The Kitwanga Landfill has been operational since the 1970’s, operating as a natural attenuation landfill. In 2012, RDKS was issued the most recent operational certificate MR-5767 by BC MOE for the landfill. Beginning in 2016, RDKS began closure activities of the landfill at the Site. Closure of the historic landfill continues and at present time, approximately 10% of the landfill has been closed with a liner. The remainder of the historic landfill is expected to be closed with clays and final vegetation cover following the approval of the Kitwanga Closure Plan that is currently in review with the Ministry.

In October 2017, RDKS opened the Kitwanga Transfer Station at the location of the closed landfill. The transfer station currently accepts materials for recycling and consolidates waste for landfilling at the Hazelton Waste Management Facility. Additional details regarding the operation of the Site are available in Annual Reports prepared by RDKS.

## 4.0 METHODS

Waterline field staff visited the Site on August 11 and 12, 2022, for the drilling and installation of the monitoring wells. Waterline field staff returned to the Site on September 27, 2022 to develop the monitoring wells and collect water samples for laboratory analysis. Descriptions of Waterline's standard methods for soil investigations, monitoring well installation, and groundwater monitoring and sampling are provided in Appendix A.

### 4.1 Monitoring Well Installation

Bluemax Drilling was contracted to drill and install three 51 mm inside diameter PVC monitoring wells at the Site. The monitoring well locations are shown on Figure 2.

Bluemax Drilling used a tracked sonic core rig to advance to the total depth prior to installing the monitoring wells. Monitoring well MW22-01 is located at the north end of the Site, MW22-02 is located on the west side of the Site, and MW22-03 is located downgradient of some staining that was observed southeast of the historic landfill.

Each borehole was completed with a monitoring well. The construction and completion details of the monitoring wells are summarized in Table 1. Borehole logs are presented in Appendix B.

All three groundwater monitoring wells were observed to be dry immediately after installation. Approximately six weeks after installation, sufficient groundwater was present in MW22-01 and MW22-03 to develop the monitoring wells and collect samples for laboratory analysis, while MW22-02 had limited groundwater present and slow recharge rates which limited the ability to collect a representative groundwater sample from MW22-02.

### 4.2 Groundwater Monitoring and Sampling

Groundwater quality samples were collected at MW22-01 and MW22-03 to assess groundwater quality. Insufficient groundwater was present in MW22-02 to collect a representative groundwater sample for lab analysis. The samples were collected by Waterline field staff using a bailer and submitted by RDKS staff for laboratory analysis to ALS Environmental in Terrace, British Columbia. The samples were analyzed for general chemistry parameters, dissolved metals, biological oxygen demand and chemical oxygen demand. Laboratory issued water chemistry report is presented in Appendix C.

## 5.0 RESULTS

### 5.1 Site Setting

The site is located within the Kitwanga River watershed, approximately 400 m east of the Kitwanga River. The nearest surface water feature is an unnamed wetland located immediately east of the

site. An unnamed tributary to the Kitwanga River runs through the site tenure along the western boundary of the Site at the bottom of the escarpment.

The ground elevation at the site is approximately 390 metres above sea level (masl). The site is located on a relatively flat portion of land, while the ground surface falls on west of the site to the Kitwanga River located at an elevation of approximately 235 masl.

## 5.2 Geology

Regionally mapped surficial deposits beneath the site include morainal till deposits of clay, silt, sand, and minor gravel. West of the site, the surficial deposits are mapped as fluvial deposits associated with an unnamed nearby stream that drains in to the Kitwanga River (Fulton, 1995). The surficial deposits are underlain by sedimentary bedrock mapped by Cui et al (2005) as the Bowser Lake and Skeena which are described as Upper Jurassic to Lower Cretaceous aged sediments.

Drilling at the site identified a sequence of clay, and silt, with minor amounts of sand and gravel. Bedrock sediments were not encountered during the drilling program. The unconsolidated sediments are likely associated with the morainal till deposits regionally mapped as present at the site.

## 5.3 Hydrogeology

### 5.3.1 Regional Aquifers

The British Columbia Groundwater Wells and Aquifers database (BC MoE, 2023) was searched and no regional aquifers are mapped as present within the area of the site. A search of the British Columbia Groundwater Wells and Aquifers database (BC MoE, 2023) returned two water wells within a 1 km radius of the site as per the Landfill Criteria (BC MoE, 2016) A summary of the two water wells is:

- Well Tag: 54161
    - Total depth: 13.7 mbgl
    - Aquifer materials: unconsolidated
    - Intended water use: private domestic
    - Approximate distance from site: 950 m
- Well Tag: 107482
    - Total depth: 29.0 mbgl
    - Aquifer materials: unknown
    - Intended water use: unknown
    - Approximate distance from site: 975 m

### 5.3.2 Local Groundwater Conditions

At the site, groundwater was encountered within the unconsolidated sediments depths ranging from 2.87 to 11.52 mbgl (Table 2). The groundwater level data indicate that water table is significantly deeper (11.52 mbgl) in MW22-02 on the west side of the Site, when compared to the monitoring wells completed on the east side of the Site (MW22-01: 3.59 mbgl and MW22-03: 2.87 mbgl). This suggests that groundwater on the west side of the Site, likely flows towards the west, where the ground surface slopes steeply towards the unnamed tributary that flows into the Kitwanga River.

There is a localized area immediately east of the Site where the ground surface appears to be consistently saturated. Hydraulic conductivity testing and additional groundwater level monitoring efforts will be required to determine the flow direction, groundwater flow velocity and influence of seasonality on groundwater flow directions and velocities between the saturated ground east of the Site and the shallow groundwater present in MW22-01 and MW22-03. This area receives water from a wetland on the east side of the highway that is conveyed to the Site tenure through a culvert running under the highway.

### 5.3.3 Groundwater Chemistry

The groundwater chemistry results for the samples collected from the monitoring wells are summarized in Table 3 and Table 4. A copy of the analytical certificate and full laboratory results are presented in Appendix D. Groundwater chemistry results presented in Tables 3 and 4 have been compared to British Columbia Contaminated Sites Regulation Schedule 3.2 Generic Numerical Water Standards (BC CSR, 2021). BC CSR drinking water standards apply when drinking water wells are located within 500 metres of the contamination source, and for the protection of future drinking water use when a natural confining barrier beneath the site cannot be confirmed. BC CSR freshwater aquatic life standards apply to groundwater that is within 500 metres of an aquatic receiving environment. For the basis of this document, conservative assumptions have been made that the drinking water standards apply because a natural confining barrier beneath the site has not been confirmed, and the freshwater aquatic life standards apply because the Site is within 500 m of an aquatic receiving environment.

Based on the results of the water quality testing, the groundwater sourced from the monitoring wells is non-saline with TDS concentrations ranging from 507 to 880 mg/L. Exceedances of the generic CSR drinking water guidelines were observed in various dissolved metals collected from MW22-03 including: aluminum, arsenic, cadmium, chromium[1], cobalt, iron, lead, lithium, manganese, nickel, and vanadium. Exceedances of the generic CSR fresh water aquatic life guidelines were observed in various dissolved metals collected from MW22-03 including: beryllium, cadmium, chromium, and copper.

[1] Chromium values reported in Appendix D are for all chromium species, which exceed the hexavalent limits presented in the CSR. Speciation may be required to determine if the apparent exceedance reported in the data set exceeds the speciation specific exceedance limits in the CSR.

No exceedances of generic CSR drinking water or fresh water aquatic guidelines were observed in the groundwater sample collected from MW22-01.

## 6.0 DISCUSSION

Based on Waterline's investigation, the preliminary hydrogeological conceptual model for the site can be characterized as the Site is underlain by surficial sediments characterized as silt-dominated morainal till deposits. Groundwater levels in MW22-02 on the west side of the Site are significantly deeper (11.52 mbgl) than those recorded in the monitoring wells located on the east side of the Site (3.59 and 2.87 mbgl). Groundwater levels on the west side of the site appear to be influenced by the steeply dipping slope present in the area that leads down to the unnamed tributary that flows into the Kitwanga River.

Groundwater samples collected from MW22-03 contain elevated concentrations of various dissolved metals, which may be related to the staining that was visible on the ground surface near MW22-03. The source of the elevated metals concentrations in MW22-03 is not currently known, however it is possible that leachate originating from the historic landfill located at Site. Additional groundwater monitoring efforts, including the drilling and installation of additional monitoring wells, will be required to determine the source and the extent of the elevated metals concentrations present in MW22-03.

## 7.0 SUMMARY AND CONCLUSIONS

The results of the Phase 1 hydrogeological assessment completed at the site, based on the review of relevant public information and supported by the data gathered during the monitoring well installation and monitoring program, are summarized as follows:

- The site is located within the Kitwanga River watershed, within the Regional District of Kitimat-Stikine in Northern British Columbia and topography at the Site is relatively flat, while the ground surface west of the Site slopes steeply towards the Kitwanga River approximately 400 m west of the Site.
- Geology observed at the site is characterized as unconsolidated, silt-dominated, morainal till surficial sediments, with minor components of clays, sands and gravels. Bedrock was not observed in any of the boreholes.
- Three groundwater monitoring wells were installed in the first water-bearing interval encountered during drilling. Groundwater levels range from 2.87 to 11.52 mbgl.
- Groundwater collected from MW22-01 met all generic CSR guidelines for the protection of fresh water aquatic life and drinking water. Groundwater collected from MW22-03 contained dissolved metals concentrations for various parameters that exceed both the freshwater aquatic life and drinking water guidelines.
- The source of the elevated dissolved metals concentrations observed in MW22-03 is potentially leachate originating from the historic landfill present at the Site.

Based on the results of the field program, Waterline provides the following recommendations:

- Conduct hydraulic conductivity testing of the monitoring wells at the Site.
- Conduct quarterly site visits 2023 to collect groundwater samples, and measure groundwater levels in the monitoring wells to assess the seasonable variability of groundwater levels at the site.
    - Groundwater Analytical Schedule: major anions and cations, general chemistry, dissolved metals, hydrocarbons, and polycyclic aromatic hydrocarbons.
    - Purge MW22-02 dry with a clean bailer or waterra tubing during the next two site visits to continue well development efforts at the well and ensure the monitoring well has been purged dry three times before collection of water samples for lab analysis.
- Prepare to confirm the exceedances by confirming the presence of the CSR exceedances and based on the results of confirmatory sampling, prepare to delineate the dissolved metals exceedances present in MW22-03 through the:
    - Collection of a water sample from the nearby saturated area east of MW22-03 as part of the interim environmental effects surface water monitoring program.

## 8.0 CERTIFICATION

This document was prepared under the direction of a professional geoscientist registered in the Province of British Columbia.

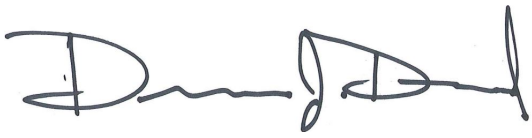
Waterline Resources Inc. trusts that the information provided in this document is sufficient for your requirements. Should you have any questions or concerns, please do not hesitate to contact the undersigned.

Respectfully submitted,

**Waterline Resources Inc.**
**EGBC Permit No. 1000669**


Joel Defoe, P.Geo.
Senior Hydrogeologist

**Reviewed By:**



Darren David, P.Geo.
Principal Hydrogeologist

## 9.0 REFERENCES

British Columbia, Ministry of Environment, 2016. Landfill Criteria for Municipal Solid Waste. June 2016.

British Columbia Ministry of Environment and Climate Change Strategy, 2023. Groundwater Wells and Aquifers database. https://apps.nrs.gov.bc.ca/gwells. Accessed January 2023.

Cui, Y., Miller, D., Nixon, G., and Nelson, J., 2015. British Columbia digital geology. British Columbia Geological Survey, Open File 2015-2.

Fulton, R. J., 1995. Surficial materials of Canada, Geological Survey of Canada, "A" Series Map, Issue 1880A, Date published - September 1, 1995

## 10.0 LIMITATIONS AND USE

The information presented in this document was compiled exclusively for the Regional District of Kitimat-Stikine (the Client) by Waterline Resources Inc. (Waterline). This work was completed in accordance with the scope of work for this project that was agreed between Waterline and the Client. Waterline exercised reasonable skill, care and diligence to assess the information acquired during the preparation of this document, but makes no guarantees or warranties as to the accuracy or completeness of this information. The information contained in this document is based upon, and limited by, the circumstances and conditions acknowledged herein, and upon information available at the time of the preparation of this document. Any information provided by others is believed to be accurate but cannot be guaranteed. No other warranty, expressed or implied, is made as to the professional services provided to the Client.

Any use, reliance on, or decision made, by a third party based on this document is the sole responsibility of said third party. Waterline makes no representation or warranty to any third party with regard to this document and, or the work referred to in this document, and accepts no duty of care to any third party or any liability or responsibility whatsoever for any losses, expenses, damages, fines, penalties or other harm that may be suffered or incurred as a result of the use of, reliance on, any decision made, or any action taken based on, this document or the work referred to in this document.

When Waterline submits instruments of professional service; including, reports, drawings and project-related deliverables, the Client agrees that only original signed and stamped paper versions shall be considered as original documents. The hard copy versions submitted by Waterline to the Client shall be considered as copies of the original documents, and in the event of a dispute or discrepancy, the signed and stamped original documents retained by Waterline shall govern over all copies, electronic or otherwise, provided to the Client.

This document is intended to be used in its entirety, and no individual part of the document may be taken as representative of the findings of the document. No part of this document may be reproduced, stored in a retrieval system, or transmitted in any form, by any third party, without the expressed written permission of the Client or Waterline.

## TABLES

**Table 1: Investigation Location Details** **Kitwanga Transfer Station**

| Location | UTM Coordinates | | | Depth | | Elevation (masl) | | | | | | Hydraulic Conduct. (m/s) | Formation Screened | Installation Date | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Grid Zone | Easting | Northing | Borehole (mbgl) | Well (mbtoc) | Ground | Top of Casing | Sand Pack | | Screen | | | | | |
| | | | | | | | | Top | Bottom | Top | Bottom | | | | |
| MW22-01 | 9 | 563376 | 6111540 | 6.1 | 6.55 | 308.00 | 308.76 | 304.34 | 301.90 | 303.73 | 302.21 | - | Surficial Sediments | 2022-08-12 | |
| MW22-02 | 9 | 563226 | 6111383 | 12.2 | 12.90 | 307.00 | 307.71 | 297.55 | 294.81 | 296.33 | 294.81 | - | Surficial Sediments | 2022-08-12 | |
| MW22-03 | 9 | 563302 | 6111338 | 6.1 | 6.35 | 311.00 | 311.56 | 307.65 | 304.90 | 306.73 | 305.21 | - | Surficial Sediments | 2022-08-12 | |

**Notes:**
**mbgl** indicates metres below ground level.
**mbtoc** indicates metres below top of casing.
**masl** indicates metres above sea level.
UTM Coordinates NAD 83.

**Table 2: Fluid Level Monitoring Data** **Kitwanga Transfer Station**

| Location | Date | Time | Depth (mbtoc) | Depth (mbgl) | Elevation (masl) | | | Comments |
|---|---|---|---|---|---|---|---|---|
| | | | To Water | To Water | TOC | Ground | Groundwater | |
| MW22-01 | 2022-09-27 | 07:48 | 4.35 | 3.59 | 308.76 | 308.00 | 304.41 | |
| MW22-02 | 2022-09-27 | 10:36 | 12.23 | 11.52 | 307.71 | 307.00 | 295.48 | |
| MW22-03 | 2022-09-27 | 07:25 | 3.43 | 2.87 | 311.56 | 311.00 | 308.13 | |

**Notes:**

*Corrected Hydraulic Head based on an assumed LNAPL specific gravity =*

**mbtoc** indicates metres below top of well casing.

**mbgl** indicates metres below ground level.

sea level.

**Table 3: Water Quality Data - Field Readings and General Chemistry**

**Kitwanga Transfer Station**

| | | | | Field Readings | | | | | Indicator Parameters | | | | | Major Cations | | | | Major Anions | | | | Nitrogen | | | | Metals | | | Other | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Sample Location** | **Sample Date** | **Field Sample ID** | **Lab ID** | **pH** | **Temperature** | **Dissolved Oxygen** | **ORP** | **Field Specific Conductivity** | **TDS** | **pH** | **Conductivity (EC)** | **Alkalinity, Total (as $CaCO_3$)** | **Hardness (as $CaCO_3$)** | **Calcium (Ca)** | **Magnesium (Mg)** | **Sodium (Na)** | **Potassium (K)** | **Chloride (Cl)** | **Fluoride (F)** | **Sulphate ($SO_4$)** | **Bromide (Br)** | **Nitrate (as N)** | **Nitrite (as N)** | **Ammonia (as N)-Total** | **Nitrogen-Total (as N)** | **Iron (Fe)** | **Manganese (Mn)** | **Phosphorus (P)-Total** | **Biochemical Oxygen Demand** | **Chemical Oxygen Demand** |
| | | | Units | - | °C | mg/L | mV | mS/cm | mg/L | - | µS/cm | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L |
| **Guidelines** | | **BC CSR Guidelines (Aquatic Life)** | | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **1500** | **3** | **4290** | **-** | **0.4** | **0.4** | **3.7** | **-** | **-** | **-** | **-** | **-** | **-** |
| MW22-01 | 2022-09-27 12:45 | MW22-01 | VA22C3713-001 | 7.36 | 13.6 | 8.5 | 215.4 | 0.5876 | 507 | 8.07 | 528 | 273 | 305 | 88.4 | 20.4 | 14.3 | 2.03 | 4.18 | 0.222 | 30.9 | <0.050 | 0.0710 | 0.0013 | 0.0087 | 0.312 | 0.037 | 0.409 | 0.503 | <2.0 | 29 |
| MW22-03 | 2022-09-27 12:30 | MW22-03 | VA22C3713-002 | 7.27 | 12.0 | 1.1 | 194.4 | 0.910 | 880 | 8.12 | 1010 | 314 | 961 | 252 | 80.6 | 47.5 | 6.72 | 25.6 | 0.179 | 138 | 0.258 | <0.0250 | <0.0050 | 0.401 | 39.6 | *61.8* | *11.7* | 46.5 | 79.4 | 1000 |

**Notes:** Contaminated Sites Regulation - BC Reg 375/96. Schedule 6. Generic Numerical Water Standards

**Bold** - Fresh Water Aquatic Life

Italic - Drinking Water

**Table 4: Water Quality Data - Dissolved Metals**

**Kitwanga Transfer Station**

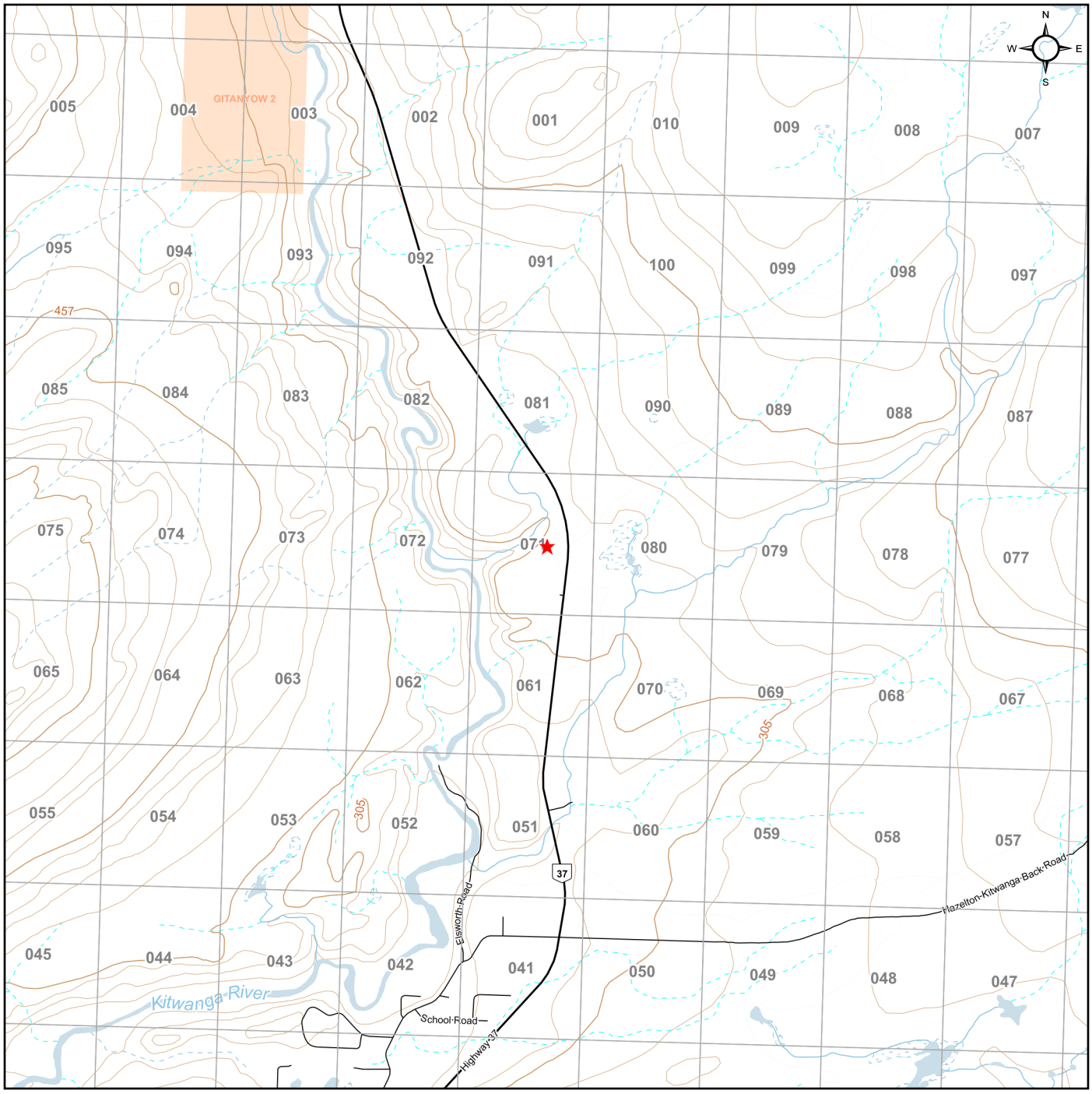
| | | | | Metals | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Sample Location** | **Sample Date** | **Field Sample ID** | **Lab ID** | **Aluminum (Al)-Dissolved** | **Antimony (Sb)-Dissolved** | **Arsenic (As)-Dissolved** | **Barium (Ba)-Dissolved** | **Beryllium (Be)-Dissolved** | **Bismuth (Bi)-Dissolved** | **Boron (B)-Dissolved** | **Cadmium (Cd)-Dissolved** | **Chromium (Cr)-Dissolved** | **Cobalt (Co)-Dissolved** | **Copper (Cu)-Dissolved** | **Lead (Pb)-Dissolved** | **Lithium (Li)-Dissolved** | **Mercury (Hg)-Dissolved** | **Molybdenum (Mo)-Dissolved** | **Nickel (Ni)-Dissolved** | **Phosphorus (P)-Dissolved** | **Selenium (Se)-Dissolved** | **Silicon (Si)-Dissolved** | **Silver (Ag)-Dissolved** | **Strontium (Sr)-Dissolved** | **Sulphur (S)-Dissolved** | **Tellurium (Te)-Dissolved** | **Thallium (Tl)-Dissolved** | **Thorium (Th)-Dissolved** | **Tin (Sn)-Dissolved** | **Titanium (Ti)-Dissolved** | **Uranium (U)-Dissolved** | **Vanadium (V)-Dissolved** | **Zinc (Zn)-Dissolved** | **Zirconium (Zr)-Dissolved** | **Tungsten (W)-Dissolved** | **Cesium (Cs)-Dissolved** | **Rubidium (Rb)-Dissolved** |
| | | | Units | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L |
| **Guidelines** | | **BC CSR Guidelines (Fresh Water Aquatic Life)** | | **-** | **0.09** | **0.05** | **10** | **0.0015** | **-** | **12** | **0.004** | **0.01** | **0.04** | **0.09** | **0.11** | **-** | **0.00025** | **10** | **1.5** | **-** | **0.02** | **-** | **0.015** | **-** | **-** | **-** | **0.003** | **-** | **-** | **1** | **0.085** | **-** | **1.65** | **-** | **-** | **-** | **-** |
| | | *BC CSR Guidelines (Drinking Water)* | | *9.5* | *0.006* | *0.01* | *1* | *0.008* | *-* | *5* | *0.005* | *0.05* | *0.001* | *1.5* | *0.01* | *0.008* | *0.001* | *0.25* | *0.08* | *-* | *0.01* | *-* | *0.02* | *2.5* | *-* | *-* | *-* | *-* | *2.5* | *-* | *0.02* | *0.02* | *3* | *-* | *0.003* | *-* | *-* |
| MW22-01 | 2022-09-27 12:45 | MW22-01 | VA22C3713-001 | 0.0270 | 0.00016 | 0.00054 | 0.0910 | <0.000100 | <0.000050 | 0.025 | 0.0000286 | <0.00050 | 0.00100 | 0.00221 | 0.000110 | 0.0034 | <0.0000050 | 0.00528 | 0.00312 | <0.050 | 0.000315 | 6.71 | <0.000010 | 0.394 | 10.2 | <0.00020 | 0.000012 | <0.00010 | <0.00010 | 0.00049 | 0.000864 | <0.00050 | 0.0037 | <0.00020 | <0.00010 | <0.000010 | 0.00071 |
| MW22-03 | 2022-09-27 12:30 | MW22-03 | VA22C3713-002 | *50.3* | <0.00050 | *0.0127* | 0.700 | **0.00373** | <0.000250 | 0.071 | ***0.00232*** | ***0.0885*** | ***0.115*** | **0.199** | *0.0424* | *0.0297* | <0.0000050 | 0.00146 | *0.110* | 2.38 | <0.000250 | 56.9 | <0.000050 | 1.71 | 50.4 | <0.00100 | 0.000176 | 0.00172 | <0.00050 | 0.0444 | 0.00460 | *0.112* | 0.250 | 0.00594 | <0.00050 | 0.000227 | 0.00617 |

**Notes:** Contaminated Sites Regulation - BC Reg 375/96. Schedule 6. Generic Numerical Water Standards

**Bold** - Fresh Water Aquatic Life

Italic - Drinking Water

## FIGURES




- Approximate Site Location
- Lake/Reservoir - Definite
- River
- Stream - Definite
- Stream - Indefinite
- Stream - Intermittent
- Wetlands
- Ground Surface Contour
- Ground Surface Index Contour (masl)
- Highway
- Collector Road
- Local Road



**Groundwater Monitoring Well Drilling and Sampling Program**
**Kitwanga Transfer Station**
**Submitted to Regional District of Kitimat-Stikine**

# LOCATION PLAN

Waterline

| | |
|---|---|
| Prepared By: | Waterline Resources Inc. |
| Project Number: | 3478-22-002 |
| Compiled By: | GIS |
| Date Issued: | January 20, 2023 |

**FIGURE 1**

Waterline

## Figure 2 - Site Plan

Groundwater Monitoring Well Network

N
W E
S
50 m

Data Locations

- Generic Data Location
- Borehole
- Borehole (Excavated)
- Monitoring Well
- Monitoring Well (Inactive/Abandoned)
- Test Pit
- Test Pit (Excavated)
- Surface Water
- Pore Water
- Excavation
- Other

# Appendix A

## Waterline Standard Methods

**Standard Methods – Soil Investigation – Drilling, Test Pitting, Trenching, and Hand Augering**
**Standard Methods – Monitoring Well Installation, Development, and Surveying**
**Standard Methods – Monitoring Well - Monitoring, Water Sampling, and Hydraulic Response Testing**

# Standard Methods
## Soil Investigation- Drilling, Test Pitting, Trenching, and Hand Augering

### 1.0 SOIL SAMPLING

Soil sampling (if applicable) was conducted as follows:

- Soil samples were handled using clean nitrile gloves;
- Soil sampling procedures for specific soil investigation methods included:
    - For auger drilling, the outer surface smeared against the borehole and the inner surface smeared against the augers was avoided.
    - For direct push drilling methods, the outer surface potentially smeared against the drive shoe and sampler casing were avoided.
    - For air rotary or ODEX drilling methods, disturbed soil or rock samples were collected from the air return.
    - For test pitting and trenching, samples were collected directly from the bucket of the excavator.
- Hand tools and hand augers were cleaned between samples;
- Soil samples were collected at pre-established regular intervals or based on field observations (e.g. ATH vapour, staining, lithology changes);
- The soil samples were placed in laboratory supplied jars or bags, suited to the required analyses;
- Soil samples for organic analyses (if collected) were filled with minimal headspace to reduce the potential loss of volatile organics;
- The samples were stored in coolers with ice for transport to the analytical laboratory to further limit volatilization and potential microbial degradation; and
- The soil samples were shipped to the project laboratory under standard Chain-of-Custody procedures.

### 2.0 GEOLOGICAL LOGGING AND AMBIENT TEMPERATURE HEADSPACE (ATH) VAPOURS MEASUREMENT

Waterline logged the geological conditions according to the Unified Soil Classification system. Other observations were recorded, such as: field moisture content, colour or staining, presence of salt precipitates, structure, etc. Soil samples for ATH combustible vapour concentration screening were: collected in a Ziploc™ or similar sealed bag; allowed to normalize to a consistent ambient temperature; and the ATH vapour concentrations were measured using a RKI™ Eagle combustible vapour meter that was calibrated to a hexane standard and had the methane response turned off. Under warm weather conditions, samples were allowed to normalize to ambient outdoor temperatures. Under dynamic or colder weather conditions, samples were warmed in the truck or an indoor workspace to approximate room temperature, prior to measuring the ATH vapour concentrations.

The coordinates of each investigation location were determined with a handheld GPS and/or surveyed. The investigation locations were noted on a site plan, aerial photograph or site sketch, relative to site infrastructure and features.

### 3.0 BACKFILLING

Boreholes, when not completed with monitoring wells, were backfilled with bentonite chips, pellets or grout, or according to client-specific requirements, and the surface was restored to its pre-disturbance state. Professional judgment was used to ensure that potential pathways for the vertical migration of groundwater or potential pathways for contaminant migration were eliminated.

During test pitting and trenching, topsoil was conserved (if present) and major horizons (e.g., topsoil, fill, clay, sand, etc.) were separated. Depending on the nature of the project, the test pits or trenches were backfilled either with the material excavated, maintaining the sequential order of the horizons. The backfilled material was compacted to satisfy site-specific restoration requirements. Topsoil (if present) was replaced, taking care not to mix topsoil and subsoil. The ground surface was restored to pre-disturbance conditions or to meet client-specific requirements.

| Rev. | Date | Description | Authored/ Reviewed by | Approved by |
|---|---|---|---|---|
| | Oct. 2, 2012 | | Brent Lennox | Jan Michaelian/Eric Pringle |

# Standard Methods
## Monitoring Well Installation, Development, and Surveying

### 1.0 MONITORING WELL INSTALLATION

Unless otherwise specified on the log, each well installation (if applicable) generally comprised a 5 cm inside diameter, machine slotted (No. 10 or 20 Slot), Schedule 40 PVC screen and well casing. A silica sand filter pack was placed surrounding, and generally extending at least 0.3 m above the screened interval. A bentonite seal was placed above the top of the filter sand to the ground surface. A well completed with an above ground stickup was controlled with a locking protective steel casing. If the top of the PVC well casing was completed as a flush mount, the well was protected with a metal road box with bolts on the lid, just below ground surface.

### 2.0 WELL DEVELOPMENT

The installed well(s) were developed to remove disturbed fines or foreign influences from drilling and well installation. This involved removing approximately ten casing volumes of water from the well and surrounding formation, or until dried once for wells completed in low permeability formations. All development activities were completed using dedicated bailers or Waterra tubing and foot valves. When manual purging was not practical due to the depth or volume of water to be purged, mechanical assistance may have been used (e.g. Waterra Power Pack II). Clean nylon string was used for all bailers. Disposable nitrile gloves were worn during all development activities and were changed between wells.

### 3.0 SURVEYING AND WELL DETAILS

The top of the PVC casing and ground elevations of any installed wells were surveyed by Waterline using a laser level, rod and laser receiver, unless specified otherwise. Elevations were either surveyed relative to a known or assumed datum and a local reference. The location of each borehole or monitoring well was determined using a handheld GPS. In addition, the distance from investigation locations to available site infrastructure and/or features were measured with a tape or approximated, and added to aerial photographs, site plans or sketches.

| Rev. | Date | Description | Authored/ Reviewed by | Approved by |
|---|---|---|---|---|
| 0 | Oct. 2, 2012 | | Brent Lennox | Jan Michaelian/Eric Pringle |
| | | | | |

# Standard Methods
## Monitoring Well - Monitoring, Water Sampling, and Hydraulic Response Testing

### 1.0 MONITORING

All monitoring activities were initiated in areas of lesser contamination and finished in areas of greater contamination, based on available data. Monitoring activities involved:

- Where hydrocarbons or other organics were a potential contaminant of concern, the combustible vapour concentration in the well casing was measured as soon as the well cap was removed using a combustible vapour meter with the methane response turned off;
- For wells in which non-aqueous phase liquids (NAPL) were historically present, or wells with elevated combustible vapour concentrations, an electronic interface probe was used to measure the depth to fluid levels (NAPL or water); and
- For all other wells, the depth to water was measured using an electronic water level meter.

All depth measurements were taken from the highest point on the well casing, unless otherwise marked. If no water was encountered (e.g. dry or frozen), the total well depth was measured with the water level tape, accounting for the length between the water level sensor and the bottom of the probe. If a well was suspected of being damaged, or material such as clay or bentonite was observed on the probe, it was recorded. All non-dedicated equipment (e.g., water level meter) was washed with Alconox and/or distilled water and wiped with clean paper towels between wells. Nitrile gloves were worn for all monitoring activities.

### 2.0 PURGING AND SAMPLING

To ensure that representative groundwater samples were collected, the wells were purged of at least three casing volumes of standing water or, for slowly recovering wells, the wells were purged dry at least once. Monitoring wells were typically sampled immediately after purging once a sufficient volume of water had recovered or, when this was not possible, within 24 hours following purging. A no purge sampling method may have been employed if:

- It was the established method for monitoring at the site;
- NAPL, film, emulsion or sheen was observed;
- The purge water was impacted such that it could cause an adverse effect if improperly disposed, and appropriate waste water handling or disposal facilities were not present at the site; and/or
- Low permeability conditions existed that would limit water level recovery such that a sufficient sample volume would not be obtainable within 24 hours of purging.

All purging and sampling of monitoring wells was completed with dedicated bailers or Waterra™ tubing and foot valves. When manual purging was not practical, mechanical purging methods were employed (e.g. Waterra™ Power Pack II). Clean nylon string was used for all bailers. Disposable nitrile gloves were worn during all purging and sampling activities and were changed between wells.

At the time of sample collection, field parameters were measured and may have included: pH, specific conductivity (SC), temperature, oxidation reduction potential (Eh, or ORP), and/or dissolved oxygen (DO) concentration using appropriate meters. All field meters were calibrated according to the manufacturer's instructions. Temperature, ORP, and DO measurements may reflect the influence of physical purging activities or ambient conditions and should be considered as qualitative values.

All groundwater samples were collected directly from the sampling equipment into laboratory supplied bottles, appropriate for the required analyses. If NAPL was present at a well that was proposed to be sampled, this well was not sampled for hydrocarbon or organic parameters related to the NAPL. All samples were appropriately filtered and/or preserved in accordance with the analytical requirements. If applicable, the laboratory bottles for volatile organic analyses were filled to ensure that no headspace was present. Samples were placed in coolers and maintained in cool but not freezing conditions for storage and shipment to the project laboratory under standard chain-of-custody procedures. Care was taken to ensure that particularly impacted samples or particularly sensitive samples (e.g., domestic water supplies) were isolated from other samples to reduce chances for cross contamination.

Field quality assurance/quality control (QA/QC) samples were collected at a general rate of one QA/QC sample (blind field duplicate, field blank, trip blank, etc.) for every ten groundwater samples unless otherwise specified.

### 3.0 HYDRAULIC RESPONSE TESTING

Hydraulic response tests (if applicable) were conducted by removing or adding a known volume from existing water column in the well and recording water level response with time using an electronic water level tape or an automatic water level recorder. Water level recovery data were interpreted using Aqtesolv™ software and applying the Bouwer and Rice (1976) method of analysis or another similar method[1].

| Rev. | Date | Description | Authored/ Reviewed by | Approved by |
|---|---|---|---|---|
| 0 | Sept. 13, 2012 | | Brent Lennox | Jan Michaelian/Eric Pringle |
| 1 | Feb. 11, 2014 | | | Eric Pringle |
| 2 | Dec. 4, 2019 | Clarifications re: combustible vapours and field parameters | Philip Low | Eric Pringle |
| 3 | Jun. 6, 2020 | Included calibration of field meters | Jan Michaelian | Eric Pringle |

[1] Bouwer, H., and R.C. Rice, 1976. A Slug Test Method for Determining Hydraulic Conductivity of Unconfined Aquifers With Completely or Partially Penetrating Wells. Water Resources Research, Vol. 12, No. 3, pp. 423-428.

# Appendix B

## Borehole Logs

**MW22-01**
**MW22-02**
**MW22-03**

| | | |
|---|---|---|
| PROJECT #: 3478-22-002 | SITE: Kitwanga Transfer Station | BOREHOLE: MW22-01 |
| OWNER: Regional District of Kitimat-Stikine | DRILLER: Bluemax Drilling | INSTALLED BY: Waterline Resources Inc. |
| DRILL TYPE: Sonic | EAST: 563376 NORTH: 6111546 | ELEVATION: 308.00 (masl) |

FILL TYPE: Backfill; Bentonite; Grout; Open Hole; Cement; Sand; Slough; Unknown

SAMPLE TYPE: Shelby Tube; No Recovery; Split Spoon; Disturbed; Dynamic Cone; Core; Grab Sample

| Depth (m) | SOIL DESCRIPTION | SAMPLE TYPE | SAMPLE NUMBER | WELL INSTALLATION (Borehole diam. = 0.150 m) |
|---|---|---|---|---|
| 0 | Gravelly (f-c) SILT, some Sand (f-c), subangular, well graded, non-plastic, dark grey, hard firm, massive, dry (0.0 to 6.1 m; Surficial Sediments) | | | Stickup (2" PVC) = 0.60 m |
| 1 | | | | |
| 2 | | | | Bentonite chips from 0 to 3.66 mbgl |
| 3 | … ... increase in moisture at 3 m | | | |
| 4 | | | | |
| 5 | | | | Filter sand from 6.11 to 3.66 mbgl<br>10-Slot screen from 5.79 to 4.27 mbgl |
| 6 | END OF HOLE AT 6.1 m<br>Water Level Date Sept 27, 2022 | | | |

| | | |
|---|---|---|
| | TYPE: Groundwater Monitoring Well | COMPLETION DEPTH: 6.1 (m) |
| | LOGGED BY: JD | COMPLETION DATE: 12-Aug-22 |
| | CHECKED BY: JD | Date printed: 30-Jan-2023 |

| PROJECT: 3478-22-002 | SITE: Kitwanga Transfer Station | BOREHOLE: MW22-02 |
|---|---|---|
| OWNER: Regional District of Kitimat-Stikine | DRILLER: Bluemax Drilling | INSTALLED BY: Waterline Resources Inc. |
| DRILL TYPE: Sonic | EAST: 563226 NORTH: 6111383 | ELEVATION: 307.00 (masl) |

FILL TYPE: Backfill | Bentonite | Grout | Open Hole | Cement | Sand | Slough | Unknown

SAMPLE TYPE: Shelby Tube | No Recovery | Split Spoon | Disturbed | Dynamic Cone | Core | Grab Sample

| Depth (m) | SOIL DESCRIPTION | SAMPLE TYPE | SAMPLE NUMBER | WELL INSTALLATION (Borehole diam. = 0.150 m) |
|---|---|---|---|---|
| 0 | Sandy (f-m) SILT, trace Gravel (f), subrounded to subangular, well graded, non plastic, brown, hard, massive, dry to moist (0.0 to 3.8 m; Surficial Sediments) | | | Stickup (2" PVC) = 0.60 m |
| 3.8 | SILT, some Sand (f-m), trace Gravel (f), trace Cobbles, subrounded to subangular, well graded, non plastic, brown, hard, massive, moist, dry (3.8 to 12.2 m; Surifical Sediments) | | | Bentonite chips from 0 to 9.45 mbgl |

| | | |
|---|---|---|
| | TYPE: Groundwater Monitoring Well | COMPLETION DEPTH: 12.2 (m) |
| | LOGGED BY: JD | COMPLETION DATE: 12-Aug-22 |
| | CHECKED BY: | Page 1 of 2 Date printed: 30-Jan-2023 |

| PROJECT #: 3478-22-002 | SITE: Kitwanga Transfer Station | BOREHOLE: MW22-02 |
|---|---|---|
| OWNER: Regional District of Kitimat-Stikine | DRILLER: Bluemax Drilling | INSTALLED BY: Waterline Resources Inc. |
| DRILL TYPE: Sonic | EAST: 563226 NORTH: 6111383 | ELEVATION: 307.00 (masl) |

FILL TYPE: Backfill | Bentonite | Grout | Open Hole | Cement | Sand | Slough | Unknown

SAMPLE TYPE: Shelby Tube | No Recovery | Split Spoon | Disturbed | Dynamic Cone | Core | Grab Sample

| Depth (m) | SOIL DESCRIPTION | SAMPLE TYPE | SAMPLE NUMBER | WELL INSTALLATION<br>Borehole diam. = 0.150 m |
|---|---|---|---|---|
| 8 | | | | |
| 9 | | | | |
| 10 | | | | |
| 11 | | | | Filter sand from 12.2 to 9.45 mbgl<br><br>10-Slot screen from 12.2 to 10.67 mbgl |
| 12 | END OF HOLE AT 12.2 m<br>Water Level Date Sept 27, 2022 | | | |
| 13 | | | | |

| | | |
|---|---|---|
| | TYPE: Groundwater Monitoring Well | COMPLETION DEPTH: 12.2 (m) |
| | LOGGED BY: JD | COMPLETION DATE: 12-Aug-22 |
| | CHECKED BY: JD | Page 2 of 2 Date printed: 30-Jan-2023 |

| | | |
|---|---|---|
| PROJECT #: 3478-22-002 | SITE: Kitwanga Transfer Station | BOREHOLE: MW22-03 |
| OWNER: Regional District of Kitimat-Stikine | DRILLER: Bluemax Drilling | INSTALLED BY: Waterline Resources Inc. |
| DRILL TYPE: Sonic | EAST: 563302 NORTH: 6111338 | ELEVATION: 311.00 (masl) |

FILL TYPE: Backfill | Bentonite | Grout | Open Hole | Cement | Sand | Slough | Unknown

SAMPLE TYPE: Shelby Tube | No Recovery | Split Spoon | Disturbed | Dynamic Cone | Core | Grab Sample

| Depth (m) | SOIL DESCRIPTION | SAMPLE TYPE | SAMPLE NUMBER | WELL INSTALLATION (Borehole diam. = 0.150 m) |
|---|---|---|---|---|
| 0 | Gravelly (f-c) SILT, some sand (f-c), s.rnd-s.ang, well graded, non plastic, brown, hard to firm, massive, dry to moist (0.0 to 6.1 m; Surficial Sediments) | | | Stickup (2' PVC) = 0.60 m |
| 1 | | | | |
| 2 | | | | Bentonite chips from 0 to 3.35 mbgl |
| 2 | ... ... dark grey at 2.3 m | | | |
| 3 | | | | |
| 4 | | | | |
| 5 | | | | Filter sand from 6.11 to 3.66 mbgl<br>10-Slot screen from 5.79 to 4.27 mbgl |
| 6 | END OF HOLE AT 6.1 m<br>Water Level Date Sept 27, 2022 | | | |

| | | |
|---|---|---|
| | TYPE: Groundwater Monitoring Well | COMPLETION DEPTH: 6.1 (m) |
| | LOGGED BY: JD | COMPLETION DATE: 12-Aug-22 |
| | CHECKED BY: | Date printed: 30-Jan-2023 |

# Appendix C

# Lab Results

ALS Environmental

# CERTIFICATE OF ANALYSIS

| | | | |
|---|---|---|---|
| **Work Order** | : **VA22C3713** | Page | : 1 of 5 |
| Client | : **Regional District of Kitimat-Stikine** | Laboratory | : Vancouver - Environmental |
| Contact | : Hannah Shinton | Account Manager | : Amber Springer |
| Address | : # 300 - 4545 Lazelle Avenue<br>Terrace BC Canada V8G 4E1 | Address | : 8081 Lougheed Highway<br>Burnaby BC Canada V5A 1W9 |
| Telephone | : ---- | Telephone | : +1 604 253 4188 |
| Project | : Kitwanga Landfill Groundwater | Date Samples Received | : 30-Sep-2022 11:55 |
| PO | : ---- | Date Analysis Commenced | : 01-Oct-2022 |
| C-O-C number | : ---- | Issue Date | : 11-Oct-2022 10:34 |
| Sampler | : Hannah Shinton | | |
| Site | : | | |
| Quote number | : Default Water Testing (Q62338) | | |
| No. of samples received | : 3 | | |
| No. of samples analysed | : 3 | | |

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QC Interpretive report to assist with Quality Review and Sample Receipt Notification (SRN).

## *Signatories*

This document has been electronically signed by the authorized signatories below. Electronic signing is conducted in accordance with US FDA 21 CFR Part 11.

| *Signatories* | *Position* | *Laboratory Department* |
|---|---|---|
| Ann Joby | Lab Assistant | Metals, Burnaby, British Columbia |
| Caitlin Macey | Team Leader - Inorganics | Inorganics, Burnaby, British Columbia |
| Delson Resende | Lab Assistant | Metals, Burnaby, British Columbia |
| Kevin Duarte | Supervisor - Metals ICP Instrumentation | Metals, Burnaby, British Columbia |
| Lindsay Gung | Supervisor - Water Chemistry | Inorganics, Burnaby, British Columbia |
| Qammar Almas | Lab Assistant | Metals, Burnaby, British Columbia |

## General Comments

The analytical methods used by ALS are developed using internationally recognized reference methods (where available), such as those published by US EPA, APHA Standard Methods, ASTM, ISO, Environment Canada, BC MOE, and Ontario MOE. Refer to the ALS Quality Control Interpretive report (QCI) for applicable references and methodology summaries. Reference methods may incorporate modifications to improve performance.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Please refer to Quality Control Interpretive report (QCI) for information regarding Holding Time compliance.

Key : CAS Number: Chemical Abstracts Services number is a unique identifier assigned to discrete substances
LOR: Limit of Reporting (detection limit).

| *Unit* | *Description* |
|---|---|
| - | No Unit |
| µS/cm | Microsiemens per centimetre |
| mg/L | milligrams per litre |
| pH units | pH units |

<: less than.

>: greater than.

Surrogate: An analyte that is similar in behavior to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED on SRN or QCI Report, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

## Qualifiers

| *Qualifier* | *Description* |
|---|---|
| *DLA* | *Detection Limit adjusted for required dilution.* |
| *DLDS* | *Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity.* |
| *RRV* | *Reported result verified by repeat analysis.* |

## Analytical Results

Sub-Matrix: **Water**
(Matrix: **Water**)

| Analyte | CAS Number | Method | LOR | Unit | Client sample ID | MW22-01 | MW22-03 | Field Blank | ---- | ---- |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Client sampling date / time | 27-Sep-2022 12:45 | 27-Sep-2022 12:30 | 27-Sep-2022 13:30 | ---- | ---- |
| | | | | | | VA22C3713-001 | VA22C3713-002 | VA22C3713-003 | -------- | -------- |
| | | | | | | Result | Result | Result | ---- | ---- |
| **Physical Tests** | | | | | | | | | | |
| **conductivity** | ---- | E100 | 2.0 | µS/cm | | 528 | 1010 | ---- | ---- | ---- |
| **hardness (as CaCO3), dissolved** | ---- | EC100 | 0.60 | mg/L | | 305 | 961 | <0.60 | ---- | ---- |
| **pH** | ---- | E108 | 0.10 | pH units | | 8.07 | 8.12 | ---- | ---- | ---- |
| **solids, total dissolved [TDS]** | ---- | E162 | 10 | mg/L | | 507 | 880 | ---- | ---- | ---- |
| **alkalinity, total (as CaCO3)** | ---- | E290 | 2.0 | mg/L | | 273 | 314 | <2.0 | ---- | ---- |
| **Anions and Nutrients** | | | | | | | | | | |
| **ammonia, total (as N)** | 7664-41-7 | E298 | 0.0050 | mg/L | | 0.0087 | 0.401 | <0.0050 | ---- | ---- |
| **bromide** | 24959-67-9 | E235.Br-L | 0.050 | mg/L | | <0.050 | 0.258 | ---- | ---- | ---- |
| **chloride** | 16887-00-6 | E235.Cl | 0.50 | mg/L | | 4.18 | 25.6 | ---- | ---- | ---- |
| **fluoride** | 16984-48-8 | E235.F | 0.020 | mg/L | | 0.222 | 0.179 | ---- | ---- | ---- |
| **nitrate (as N)** | 14797-55-8 | E235.NO3-L | 0.0050 | mg/L | | 0.0710 | <0.0250 DLDS | ---- | ---- | ---- |
| **nitrite (as N)** | 14797-65-0 | E235.NO2-L | 0.0010 | mg/L | | 0.0013 | <0.0050 DLDS | ---- | ---- | ---- |
| **nitrogen, total** | 7727-37-9 | E366 | 0.030 | mg/L | | 0.312 | 39.6 | ---- | ---- | ---- |
| **phosphorus, total** | 7723-14-0 | E372-U | 0.0020 | mg/L | | 0.503 | 46.5 | ---- | ---- | ---- |
| **sulfate (as SO4)** | 14808-79-8 | E235.SO4 | 0.30 | mg/L | | 30.9 | 138 | ---- | ---- | ---- |
| **Dissolved Metals** | | | | | | | | | | |
| **aluminum, dissolved** | 7429-90-5 | E421 | 0.0010 | mg/L | | 0.0270 | 50.3 | 0.0013 RRV | ---- | ---- |
| **antimony, dissolved** | 7440-36-0 | E421 | 0.00010 | mg/L | | 0.00016 | <0.00050 DLA | <0.00010 | ---- | ---- |
| **arsenic, dissolved** | 7440-38-2 | E421 | 0.00010 | mg/L | | 0.00054 | 0.0127 | <0.00010 | ---- | ---- |
| **barium, dissolved** | 7440-39-3 | E421 | 0.00010 | mg/L | | 0.0910 | 0.700 | <0.00010 | ---- | ---- |
| **beryllium, dissolved** | 7440-41-7 | E421 | 0.000100 | mg/L | | <0.000100 | 0.00373 | <0.000100 | ---- | ---- |
| **bismuth, dissolved** | 7440-69-9 | E421 | 0.000050 | mg/L | | <0.000050 | <0.000250 DLA | <0.000050 | ---- | ---- |
| **boron, dissolved** | 7440-42-8 | E421 | 0.010 | mg/L | | 0.025 | 0.071 | <0.010 | ---- | ---- |
| **cadmium, dissolved** | 7440-43-9 | E421 | 0.0000050 | mg/L | | 0.0000286 | 0.00232 | <0.0000050 | ---- | ---- |
| **calcium, dissolved** | 7440-70-2 | E421 | 0.050 | mg/L | | 88.4 | 252 | <0.050 | ---- | ---- |
| **cesium, dissolved** | 7440-46-2 | E421 | 0.000010 | mg/L | | <0.000010 | 0.000227 | <0.000010 | ---- | ---- |
| **chromium, dissolved** | 7440-47-3 | E421 | 0.00050 | mg/L | | <0.00050 | 0.0885 | <0.00050 | ---- | ---- |
| **cobalt, dissolved** | 7440-48-4 | E421 | 0.00010 | mg/L | | 0.00100 | 0.115 | <0.00010 | ---- | ---- |
| **copper, dissolved** | 7440-50-8 | E421 | 0.00020 | mg/L | | 0.00221 | 0.199 | <0.00020 | ---- | ---- |
| **iron, dissolved** | 7439-89-6 | E421 | 0.010 | mg/L | | 0.037 | 61.8 | <0.010 | ---- | ---- |

## Analytical Results

Sub-Matrix: **Water**
(Matrix: **Water**)

| Analyte | CAS Number | Method | LOR | Unit | Client sample ID | MW22-01 | MW22-03 | Field Blank | ---- | ---- |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Client sampling date / time | 27-Sep-2022 12:45 | 27-Sep-2022 12:30 | 27-Sep-2022 13:30 | ---- | ---- |
| | | | | | | VA22C3713-001 | VA22C3713-002 | VA22C3713-003 | -------- | -------- |
| | | | | | | Result | Result | Result | ---- | ---- |
| **Dissolved Metals** | | | | | | | | | | |
| **lead, dissolved** | 7439-92-1 | E421 | 0.000050 | mg/L | | 0.000110 | 0.0424 | <0.000050 | ---- | ---- |
| **lithium, dissolved** | 7439-93-2 | E421 | 0.0010 | mg/L | | 0.0034 | 0.0297 | <0.0010 | ---- | ---- |
| **magnesium, dissolved** | 7439-95-4 | E421 | 0.0050 | mg/L | | 20.4 | 80.6 | <0.0050 | ---- | ---- |
| **manganese, dissolved** | 7439-96-5 | E421 | 0.00010 | mg/L | | 0.409 | 11.7 | <0.00010 | ---- | ---- |
| **mercury, dissolved** | 7439-97-6 | E509 | 0.0000050 | mg/L | | <0.0000050 | <0.0000050 | <0.0000050 | ---- | ---- |
| **molybdenum, dissolved** | 7439-98-7 | E421 | 0.000050 | mg/L | | 0.00528 | 0.00146 | <0.000050 | ---- | ---- |
| **nickel, dissolved** | 7440-02-0 | E421 | 0.00050 | mg/L | | 0.00312 | 0.110 | <0.00050 | ---- | ---- |
| **phosphorus, dissolved** | 7723-14-0 | E421 | 0.050 | mg/L | | <0.050 | 2.38 | <0.050 | ---- | ---- |
| **potassium, dissolved** | 7440-09-7 | E421 | 0.050 | mg/L | | 2.03 | 6.72 | <0.050 | ---- | ---- |
| **rubidium, dissolved** | 7440-17-7 | E421 | 0.00020 | mg/L | | 0.00071 | 0.00617 | <0.00020 | ---- | ---- |
| **selenium, dissolved** | 7782-49-2 | E421 | 0.000050 | mg/L | | 0.000315 | <0.000250 DLA | <0.000050 | ---- | ---- |
| **silicon, dissolved** | 7440-21-3 | E421 | 0.050 | mg/L | | 6.71 | 56.9 | <0.050 | ---- | ---- |
| **silver, dissolved** | 7440-22-4 | E421 | 0.000010 | mg/L | | <0.000010 | <0.000050 DLA | <0.000010 | ---- | ---- |
| **sodium, dissolved** | 7440-23-5 | E421 | 0.050 | mg/L | | 14.3 | 47.5 | <0.050 | ---- | ---- |
| **strontium, dissolved** | 7440-24-6 | E421 | 0.00020 | mg/L | | 0.394 | 1.71 | <0.00020 | ---- | ---- |
| **sulfur, dissolved** | 7704-34-9 | E421 | 0.50 | mg/L | | 10.2 | 50.4 | <0.50 | ---- | ---- |
| **tellurium, dissolved** | 13494-80-9 | E421 | 0.00020 | mg/L | | <0.00020 | <0.00100 DLA | <0.00020 | ---- | ---- |
| **thallium, dissolved** | 7440-28-0 | E421 | 0.000010 | mg/L | | 0.000012 | 0.000176 | <0.000010 | ---- | ---- |
| **thorium, dissolved** | 7440-29-1 | E421 | 0.00010 | mg/L | | <0.00010 | 0.00172 | <0.00010 | ---- | ---- |
| **tin, dissolved** | 7440-31-5 | E421 | 0.00010 | mg/L | | <0.00010 | <0.00050 DLA | <0.00010 | ---- | ---- |
| **titanium, dissolved** | 7440-32-6 | E421 | 0.00030 | mg/L | | 0.00049 | 0.0444 | <0.00030 | ---- | ---- |
| **tungsten, dissolved** | 7440-33-7 | E421 | 0.00010 | mg/L | | <0.00010 | <0.00050 DLA | <0.00010 | ---- | ---- |
| **uranium, dissolved** | 7440-61-1 | E421 | 0.000010 | mg/L | | 0.000864 | 0.00460 | <0.000010 | ---- | ---- |
| **vanadium, dissolved** | 7440-62-2 | E421 | 0.00050 | mg/L | | <0.00050 | 0.112 | <0.00050 | ---- | ---- |
| **zinc, dissolved** | 7440-66-6 | E421 | 0.0010 | mg/L | | 0.0037 | 0.250 | <0.0010 | ---- | ---- |
| **zirconium, dissolved** | 7440-67-7 | E421 | 0.00020 | mg/L | | <0.00020 | 0.00594 | <0.00020 | ---- | ---- |
| **dissolved mercury filtration location** | ---- | EP509 | - | - | | Field | Field | Field | ---- | ---- |
| **dissolved metals filtration location** | ---- | EP421 | - | - | | Field | Field | Field | ---- | ---- |
| **Aggregate Organics** | | | | | | | | | | |
| **biochemical oxygen demand [BOD]** | ---- | E550 | 2.0 | mg/L | | <2.0 | 79.4 | ---- | ---- | ---- |
| **chemical oxygen demand [COD]** | ---- | E559-L | 10 | mg/L | | 29 | 1000 | ---- | ---- | ---- |

Please refer to the General Comments section for an explanation of any qualifiers detected.

# QUALITY CONTROL INTERPRETIVE REPORT

| | | | |
|---|---|---|---|
| **Work Order** | : **VA22C3713** | Page | : 1 of 12 |
| Client | : **Regional District of Kitimat-Stikine** | Laboratory | : Vancouver - Environmental |
| Contact | : Hannah Shinton | Account Manager | : Amber Springer |
| Address | : # 300 - 4545 Lazelle Avenue<br>Terrace BC Canada V8G 4E1 | Address | : 8081 Lougheed Highway<br>Burnaby, British Columbia Canada V5A 1W9 |
| Telephone | : ---- | Telephone | : +1 604 253 4188 |
| Project | : Kitwanga Landfill Groundwater | Date Samples Received | : 30-Sep-2022 11:55 |
| PO | : ---- | Issue Date | : 11-Oct-2022 10:34 |
| C-O-C number | : ---- | | |
| Sampler | : Hannah Shinton | | |
| Site | : | | |
| Quote number | : Default Water Testing (Q62338) | | |
| No. of samples received | : 3 | | |
| No. of samples analysed | : 3 | | |

**This report is automatically generated by the ALS LIMS (Laboratory Information Management System) through evaluation of Quality Control (QC) results and other QA parameters associated with this submission, and is intended to facilitate rapid data validation by auditors or reviewers. The report highlights any exceptions and outliers to ALS Data Quality Objectives, provides holding time details and exceptions, summarizes QC sample frequencies, and lists applicable methodology references and summaries.**

**Key**

**Anonymous: Refers to samples which are not part of this work order, but which formed part of the QC process lot.**
**CAS Number: Chemical Abstracts Service number is a unique identifier assigned to discrete substances.**
**DQO: Data Quality Objective.**
**LOR: Limit of Reporting (detection limit).**
**RPD: Relative Percent Difference.**

## Workorder Comments

Holding times are displayed as "---" if no guidance exists from CCME, Canadian provinces, or broadly recognized international references.

## Summary of Outliers

### Outliers : Quality Control Samples

- No Method Blank value outliers occur.
- No Duplicate outliers occur.
- No Laboratory Control Sample (LCS) outliers occur
- No Matrix Spike outliers occur.
- No Test sample Surrogate recovery outliers exist.

### Outliers: Reference Material (RM) Samples

- No Reference Material (RM) Sample outliers occur.

### Outliers : Analysis Holding Time Compliance (Breaches)

- Analysis Holding Time Outliers exist - please see following pages for full details.

### Outliers : Frequency of Quality Control Samples

- No Quality Control Sample Frequency Outliers occur.

## Analysis Holding Time Compliance

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times, which are selected to meet known provincial and /or federal requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by organizations such as CCME, US EPA, APHA Standard Methods, ASTM, or Environment Canada (where available). Dates and holding times reported below represent the first dates of extraction or analysis. If subsequent tests or dilutions exceeded holding times, qualifiers are added (refer to COA).

If samples are identified below as having been analyzed or extracted outside of recommended holding times, measurement uncertainties may be increased, and this should be taken into consideration when interpreting results.

Where actual sampling date is not provided on the chain of custody, the date of receipt with time at 00:00 is used for calculation purposes.

Where only the sample date without time is provided on the chain of custody, the sampling date at 00:00 is used for calculation purposes.

Matrix: **Water**

Evaluation: × = Holding time exceedance ; ✓ = Within Holding Time

| Analyte Group / Container / Client Sample ID(s) | Method | Sampling Date | Extraction / Preparation | | | | Analysis | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Preparation Date | Holding Times Rec | Holding Times Actual | Eval | Analysis Date | Holding Times Rec | Holding Times Actual | Eval |
| **Aggregate Organics : Biochemical Oxygen Demand - 5 day** | | | | | | | | | | |
| **HDPE [BOD HT 3d]** MW22-01 | E550 | 27-Sep-2022 | ---- | ---- | ---- | | 01-Oct-2022 | 3 days | 4 days | × EHTL |
| **Aggregate Organics : Biochemical Oxygen Demand - 5 day** | | | | | | | | | | |
| **HDPE [BOD HT 3d]** MW22-03 | E550 | 27-Sep-2022 | ---- | ---- | ---- | | 01-Oct-2022 | 3 days | 4 days | × EHTL |
| **Aggregate Organics : Chemical Oxygen Demand by Colourimetry (Low Level)** | | | | | | | | | | |
| **Amber glass total (sulfuric acid)** MW22-01 | E559-L | 27-Sep-2022 | ---- | ---- | ---- | | 03-Oct-2022 | 28 days | 6 days | ✓ |
| **Aggregate Organics : Chemical Oxygen Demand by Colourimetry (Low Level)** | | | | | | | | | | |
| **Amber glass total (sulfuric acid)** MW22-03 | E559-L | 27-Sep-2022 | ---- | ---- | ---- | | 03-Oct-2022 | 28 days | 6 days | ✓ |
| **Anions and Nutrients : Ammonia by Fluorescence** | | | | | | | | | | |
| **Amber glass total (sulfuric acid)** Field Blank | E298 | 27-Sep-2022 | 04-Oct-2022 | ---- | ---- | | 09-Oct-2022 | 28 days | 12 days | ✓ |
| **Anions and Nutrients : Ammonia by Fluorescence** | | | | | | | | | | |
| **Amber glass total (sulfuric acid)** MW22-01 | E298 | 27-Sep-2022 | 04-Oct-2022 | ---- | ---- | | 09-Oct-2022 | 28 days | 12 days | ✓ |
| **Anions and Nutrients : Ammonia by Fluorescence** | | | | | | | | | | |
| **Amber glass total (sulfuric acid)** MW22-03 | E298 | 27-Sep-2022 | 04-Oct-2022 | ---- | ---- | | 09-Oct-2022 | 28 days | 12 days | ✓ |

Matrix: **Water**

Evaluation: × = Holding time exceedance ; ✓ = Within Holding Time

| Analyte Group / Container / Client Sample ID(s) | Method | Sampling Date | Extraction / Preparation | | | | Analysis | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Preparation Date | Holding Times Rec | Holding Times Actual | Eval | Analysis Date | Holding Times Rec | Holding Times Actual | Eval |
| **Anions and Nutrients : Bromide in Water by IC (Low Level)** | | | | | | | | | | |
| **HDPE** | | | | | | | | | | |
| MW22-01 | E235.Br-L | 27-Sep-2022 | 04-Oct-2022 | ---- | ---- | | 04-Oct-2022 | 28 days | 7 days | ✓ |
| **Anions and Nutrients : Bromide in Water by IC (Low Level)** | | | | | | | | | | |
| **HDPE** | | | | | | | | | | |
| MW22-03 | E235.Br-L | 27-Sep-2022 | 04-Oct-2022 | ---- | ---- | | 04-Oct-2022 | 28 days | 7 days | ✓ |
| **Anions and Nutrients : Chloride in Water by IC** | | | | | | | | | | |
| **HDPE** | | | | | | | | | | |
| MW22-01 | E235.Cl | 27-Sep-2022 | 04-Oct-2022 | ---- | ---- | | 04-Oct-2022 | 28 days | 7 days | ✓ |
| **Anions and Nutrients : Chloride in Water by IC** | | | | | | | | | | |
| **HDPE** | | | | | | | | | | |
| MW22-03 | E235.Cl | 27-Sep-2022 | 04-Oct-2022 | ---- | ---- | | 04-Oct-2022 | 28 days | 7 days | ✓ |
| **Anions and Nutrients : Fluoride in Water by IC** | | | | | | | | | | |
| **HDPE** | | | | | | | | | | |
| MW22-01 | E235.F | 27-Sep-2022 | 04-Oct-2022 | ---- | ---- | | 04-Oct-2022 | 28 days | 7 days | ✓ |
| **Anions and Nutrients : Fluoride in Water by IC** | | | | | | | | | | |
| **HDPE** | | | | | | | | | | |
| MW22-03 | E235.F | 27-Sep-2022 | 04-Oct-2022 | ---- | ---- | | 04-Oct-2022 | 28 days | 7 days | ✓ |
| **Anions and Nutrients : Nitrate in Water by IC (Low Level)** | | | | | | | | | | |
| **HDPE** | | | | | | | | | | |
| MW22-01 | E235.NO3-L | 27-Sep-2022 | 04-Oct-2022 | 3 days | 7 days | × EHTL | 04-Oct-2022 | 3 days | 0 days | ✓ |
| **Anions and Nutrients : Nitrate in Water by IC (Low Level)** | | | | | | | | | | |
| **HDPE** | | | | | | | | | | |
| MW22-03 | E235.NO3-L | 27-Sep-2022 | 04-Oct-2022 | 3 days | 7 days | × EHTL | 04-Oct-2022 | 3 days | 0 days | ✓ |
| **Anions and Nutrients : Nitrite in Water by IC (Low Level)** | | | | | | | | | | |
| **HDPE** | | | | | | | | | | |
| MW22-01 | E235.NO2-L | 27-Sep-2022 | 04-Oct-2022 | ---- | ---- | | 04-Oct-2022 | 3 days | 7 days | × EHTL |

Matrix: **Water**

Evaluation: × = Holding time exceedance ; ✓ = Within Holding Time

| Analyte Group / Container / Client Sample ID(s) | Method | Sampling Date | Extraction / Preparation | | | | Analysis | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Preparation Date | Holding Times Rec | Holding Times Actual | Eval | Analysis Date | Holding Times Rec | Holding Times Actual | Eval |
| **Anions and Nutrients : Nitrite in Water by IC (Low Level)** | | | | | | | | | | |
| **HDPE** | | | | | | | | | | |
| MW22-03 | E235.NO2-L | 27-Sep-2022 | 04-Oct-2022 | ---- | ---- | | 04-Oct-2022 | 3 days | 7 days | × EHTL |
| **Anions and Nutrients : Sulfate in Water by IC** | | | | | | | | | | |
| **HDPE** | | | | | | | | | | |
| MW22-01 | E235.SO4 | 27-Sep-2022 | 04-Oct-2022 | ---- | ---- | | 04-Oct-2022 | 28 days | 7 days | ✓ |
| **Anions and Nutrients : Sulfate in Water by IC** | | | | | | | | | | |
| **HDPE** | | | | | | | | | | |
| MW22-03 | E235.SO4 | 27-Sep-2022 | 04-Oct-2022 | ---- | ---- | | 04-Oct-2022 | 28 days | 7 days | ✓ |
| **Anions and Nutrients : Total Nitrogen by Colourimetry** | | | | | | | | | | |
| **Amber glass total (sulfuric acid)** | | | | | | | | | | |
| MW22-01 | E366 | 27-Sep-2022 | 04-Oct-2022 | ---- | ---- | | 05-Oct-2022 | 28 days | 8 days | ✓ |
| **Anions and Nutrients : Total Nitrogen by Colourimetry** | | | | | | | | | | |
| **Amber glass total (sulfuric acid)** | | | | | | | | | | |
| MW22-03 | E366 | 27-Sep-2022 | 04-Oct-2022 | ---- | ---- | | 05-Oct-2022 | 28 days | 8 days | ✓ |
| **Anions and Nutrients : Total Phosphorus by Colourimetry (0.002 mg/L)** | | | | | | | | | | |
| **Amber glass total (sulfuric acid)** | | | | | | | | | | |
| MW22-01 | E372-U | 27-Sep-2022 | 04-Oct-2022 | ---- | ---- | | 05-Oct-2022 | 28 days | 8 days | ✓ |
| **Anions and Nutrients : Total Phosphorus by Colourimetry (0.002 mg/L)** | | | | | | | | | | |
| **Amber glass total (sulfuric acid)** | | | | | | | | | | |
| MW22-03 | E372-U | 27-Sep-2022 | 04-Oct-2022 | ---- | ---- | | 05-Oct-2022 | 28 days | 8 days | ✓ |
| **Dissolved Metals : Dissolved Mercury in Water by CVAAS** | | | | | | | | | | |
| **Glass vial dissolved (hydrochloric acid)** | | | | | | | | | | |
| Field Blank | E509 | 27-Sep-2022 | 04-Oct-2022 | ---- | ---- | | 04-Oct-2022 | 28 days | 7 days | ✓ |
| **Dissolved Metals : Dissolved Mercury in Water by CVAAS** | | | | | | | | | | |
| **Glass vial dissolved (hydrochloric acid)** | | | | | | | | | | |
| MW22-01 | E509 | 27-Sep-2022 | 04-Oct-2022 | ---- | ---- | | 04-Oct-2022 | 28 days | 7 days | ✓ |

Matrix: **Water**

Evaluation: × = Holding time exceedance ; ✓ = Within Holding Time

| Analyte Group / Container / Client Sample ID(s) | Method | Sampling Date | Extraction / Preparation | | | | Analysis | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Preparation Date | Holding Times Rec | Holding Times Actual | Eval | Analysis Date | Holding Times Rec | Holding Times Actual | Eval |
| **Dissolved Metals : Dissolved Mercury in Water by CVAAS** | | | | | | | | | | |
| **Glass vial dissolved (hydrochloric acid)** | | | | | | | | | | |
| MW22-03 | E509 | 27-Sep-2022 | 04-Oct-2022 | ---- | ---- | | 04-Oct-2022 | 28 days | 7 days | ✓ |
| **Dissolved Metals : Dissolved Metals in Water by CRC ICPMS** | | | | | | | | | | |
| **HDPE dissolved (nitric acid)** | | | | | | | | | | |
| Field Blank | E421 | 27-Sep-2022 | 04-Oct-2022 | ---- | ---- | | 04-Oct-2022 | 180 days | 8 days | ✓ |
| **Dissolved Metals : Dissolved Metals in Water by CRC ICPMS** | | | | | | | | | | |
| **HDPE dissolved (nitric acid)** | | | | | | | | | | |
| MW22-01 | E421 | 27-Sep-2022 | 04-Oct-2022 | ---- | ---- | | 04-Oct-2022 | 180 days | 8 days | ✓ |
| **Dissolved Metals : Dissolved Metals in Water by CRC ICPMS** | | | | | | | | | | |
| **HDPE dissolved (nitric acid)** | | | | | | | | | | |
| MW22-03 | E421 | 27-Sep-2022 | 04-Oct-2022 | ---- | ---- | | 04-Oct-2022 | 180 days | 8 days | ✓ |
| **Physical Tests : Alkalinity Species by Titration** | | | | | | | | | | |
| **HDPE** | | | | | | | | | | |
| Field Blank | E290 | 27-Sep-2022 | 04-Oct-2022 | ---- | ---- | | 06-Oct-2022 | 14 days | 10 days | ✓ |
| **Physical Tests : Alkalinity Species by Titration** | | | | | | | | | | |
| **HDPE** | | | | | | | | | | |
| MW22-01 | E290 | 27-Sep-2022 | 04-Oct-2022 | ---- | ---- | | 06-Oct-2022 | 14 days | 10 days | ✓ |
| **Physical Tests : Alkalinity Species by Titration** | | | | | | | | | | |
| **HDPE** | | | | | | | | | | |
| MW22-03 | E290 | 27-Sep-2022 | 04-Oct-2022 | ---- | ---- | | 06-Oct-2022 | 14 days | 10 days | ✓ |
| **Physical Tests : Conductivity in Water** | | | | | | | | | | |
| **HDPE** | | | | | | | | | | |
| MW22-01 | E100 | 27-Sep-2022 | 04-Oct-2022 | ---- | ---- | | 06-Oct-2022 | 28 days | 10 days | ✓ |
| **Physical Tests : Conductivity in Water** | | | | | | | | | | |
| **HDPE** | | | | | | | | | | |
| MW22-03 | E100 | 27-Sep-2022 | 04-Oct-2022 | ---- | ---- | | 06-Oct-2022 | 28 days | 10 days | ✓ |

Matrix: **Water**

Evaluation: ✖ = Holding time exceedance ; ✓ = Within Holding Time

| Analyte Group / Container / Client Sample ID(s) | Method | Sampling Date | Extraction / Preparation | | | | Analysis | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Preparation Date | Holding Times Rec | Holding Times Actual | Eval | Analysis Date | Holding Times Rec | Holding Times Actual | Eval |
| **Physical Tests : pH by Meter** | | | | | | | | | | |
| **HDPE** MW22-01 | E108 | 27-Sep-2022 | 04-Oct-2022 | ---- | ---- | | 06-Oct-2022 | 0.25 hrs | 60.25 hrs | ✖ EHTR-FM |
| **Physical Tests : pH by Meter** | | | | | | | | | | |
| **HDPE** MW22-03 | E108 | 27-Sep-2022 | 04-Oct-2022 | ---- | ---- | | 06-Oct-2022 | 0.25 hrs | 60.25 hrs | ✖ EHTR-FM |
| **Physical Tests : TDS by Gravimetry** | | | | | | | | | | |
| **HDPE** MW22-01 | E162 | 27-Sep-2022 | ---- | ---- | ---- | | 03-Oct-2022 | 7 days | 6 days | ✓ |
| **Physical Tests : TDS by Gravimetry** | | | | | | | | | | |
| **HDPE** MW22-03 | E162 | 27-Sep-2022 | ---- | ---- | ---- | | 03-Oct-2022 | 7 days | 6 days | ✓ |

**Legend & Qualifier Definitions**

EHTR-FM: Exceeded ALS recommended hold time prior to sample receipt. Field Measurement recommended

EHTL: Exceeded ALS recommended hold time prior to analysis. Sample was received less than 24 hours prior to expiry.

Rec. HT: ALS recommended hold time (see units).

# Quality Control Parameter Frequency Compliance

The following report summarizes the frequency of laboratory QC samples analyzed within the analytical batches (QC lots) in which the submitted samples were processed. The actual frequency should be greater than or equal to the expected frequency.

Matrix: **Water**

Evaluation: × = QC frequency outside specification; ✓ = QC frequency within specification.

| Quality Control Sample Type | | | Count | | Frequency (%) | | |
|---|---|---|---|---|---|---|---|
| *Analytical Methods* | *Method* | *QC Lot #* | *QC* | *Regular* | *Actual* | *Expected* | *Evaluation* |
| **Laboratory Duplicates (DUP)** | | | | | | | |
| Alkalinity Species by Titration | E290 | 678595 | 1 | 18 | 5.5 | 5.0 | ✓ |
| Ammonia by Fluorescence | E298 | 679307 | 1 | 19 | 5.2 | 5.0 | ✓ |
| Biochemical Oxygen Demand - 5 day | E550 | 675761 | 1 | 20 | 5.0 | 5.0 | ✓ |
| Bromide in Water by IC (Low Level) | E235.Br-L | 678592 | 1 | 14 | 7.1 | 5.0 | ✓ |
| Chemical Oxygen Demand by Colourimetry (Low Level) | E559-L | 677785 | 1 | 20 | 5.0 | 5.0 | ✓ |
| Chloride in Water by IC | E235.Cl | 678591 | 1 | 16 | 6.2 | 5.0 | ✓ |
| Conductivity in Water | E100 | 678594 | 1 | 17 | 5.8 | 5.0 | ✓ |
| Dissolved Mercury in Water by CVAAS | E509 | 680325 | 1 | 20 | 5.0 | 5.0 | ✓ |
| Dissolved Metals in Water by CRC ICPMS | E421 | 678395 | 1 | 19 | 5.2 | 5.0 | ✓ |
| Fluoride in Water by IC | E235.F | 678590 | 1 | 14 | 7.1 | 5.0 | ✓ |
| Nitrate in Water by IC (Low Level) | E235.NO3-L | 678588 | 1 | 19 | 5.2 | 5.0 | ✓ |
| Nitrite in Water by IC (Low Level) | E235.NO2-L | 678589 | 1 | 19 | 5.2 | 5.0 | ✓ |
| pH by Meter | E108 | 678593 | 1 | 19 | 5.2 | 5.0 | ✓ |
| Sulfate in Water by IC | E235.SO4 | 678586 | 1 | 17 | 5.8 | 5.0 | ✓ |
| TDS by Gravimetry | E162 | 677587 | 1 | 12 | 8.3 | 5.0 | ✓ |
| Total Nitrogen by Colourimetry | E366 | 679306 | 1 | 16 | 6.2 | 5.0 | ✓ |
| Total Phosphorus by Colourimetry (0.002 mg/L) | E372-U | 679308 | 1 | 19 | 5.2 | 5.0 | ✓ |
| **Laboratory Control Samples (LCS)** | | | | | | | |
| Alkalinity Species by Titration | E290 | 678595 | 1 | 18 | 5.5 | 5.0 | ✓ |
| Ammonia by Fluorescence | E298 | 679307 | 1 | 19 | 5.2 | 5.0 | ✓ |
| Biochemical Oxygen Demand - 5 day | E550 | 675761 | 1 | 20 | 5.0 | 5.0 | ✓ |
| Bromide in Water by IC (Low Level) | E235.Br-L | 678592 | 1 | 14 | 7.1 | 5.0 | ✓ |
| Chemical Oxygen Demand by Colourimetry (Low Level) | E559-L | 677785 | 1 | 20 | 5.0 | 5.0 | ✓ |
| Chloride in Water by IC | E235.Cl | 678591 | 1 | 16 | 6.2 | 5.0 | ✓ |
| Conductivity in Water | E100 | 678594 | 1 | 17 | 5.8 | 5.0 | ✓ |
| Dissolved Mercury in Water by CVAAS | E509 | 680325 | 1 | 20 | 5.0 | 5.0 | ✓ |
| Dissolved Metals in Water by CRC ICPMS | E421 | 678395 | 1 | 19 | 5.2 | 5.0 | ✓ |
| Fluoride in Water by IC | E235.F | 678590 | 1 | 14 | 7.1 | 5.0 | ✓ |
| Nitrate in Water by IC (Low Level) | E235.NO3-L | 678588 | 1 | 19 | 5.2 | 5.0 | ✓ |
| Nitrite in Water by IC (Low Level) | E235.NO2-L | 678589 | 1 | 19 | 5.2 | 5.0 | ✓ |
| pH by Meter | E108 | 678593 | 1 | 19 | 5.2 | 5.0 | ✓ |
| Sulfate in Water by IC | E235.SO4 | 678586 | 1 | 17 | 5.8 | 5.0 | ✓ |
| TDS by Gravimetry | E162 | 677587 | 1 | 12 | 8.3 | 5.0 | ✓ |
| Total Nitrogen by Colourimetry | E366 | 679306 | 1 | 16 | 6.2 | 5.0 | ✓ |
| Total Phosphorus by Colourimetry (0.002 mg/L) | E372-U | 679308 | 1 | 19 | 5.2 | 5.0 | ✓ |
| **Method Blanks (MB)** | | | | | | | |
| Alkalinity Species by Titration | E290 | 678595 | 1 | 18 | 5.5 | 5.0 | ✓ |

Matrix: **Water**

Evaluation: × = QC frequency outside specification; ✓ = QC frequency within specification.

| Quality Control Sample Type | | | Count | | Frequency (%) | | |
|---|---|---|---|---|---|---|---|
| *Analytical Methods* | *Method* | *QC Lot #* | *QC* | *Regular* | *Actual* | *Expected* | *Evaluation* |
| Method Blanks (MB) - Continued | | | | | | | |
| Ammonia by Fluorescence | E298 | 679307 | 1 | 19 | 5.2 | 5.0 | ✓ |
| Biochemical Oxygen Demand - 5 day | E550 | 675761 | 1 | 20 | 5.0 | 5.0 | ✓ |
| Bromide in Water by IC (Low Level) | E235.Br-L | 678592 | 1 | 14 | 7.1 | 5.0 | ✓ |
| Chemical Oxygen Demand by Colourimetry (Low Level) | E559-L | 677785 | 1 | 20 | 5.0 | 5.0 | ✓ |
| Chloride in Water by IC | E235.Cl | 678591 | 1 | 16 | 6.2 | 5.0 | ✓ |
| Conductivity in Water | E100 | 678594 | 1 | 17 | 5.8 | 5.0 | ✓ |
| Dissolved Mercury in Water by CVAAS | E509 | 680325 | 1 | 20 | 5.0 | 5.0 | ✓ |
| Dissolved Metals in Water by CRC ICPMS | E421 | 678395 | 1 | 19 | 5.2 | 5.0 | ✓ |
| Fluoride in Water by IC | E235.F | 678590 | 1 | 14 | 7.1 | 5.0 | ✓ |
| Nitrate in Water by IC (Low Level) | E235.NO3-L | 678588 | 1 | 19 | 5.2 | 5.0 | ✓ |
| Nitrite in Water by IC (Low Level) | E235.NO2-L | 678589 | 1 | 19 | 5.2 | 5.0 | ✓ |
| Sulfate in Water by IC | E235.SO4 | 678586 | 1 | 17 | 5.8 | 5.0 | ✓ |
| TDS by Gravimetry | E162 | 677587 | 1 | 12 | 8.3 | 5.0 | ✓ |
| Total Nitrogen by Colourimetry | E366 | 679306 | 1 | 16 | 6.2 | 5.0 | ✓ |
| Total Phosphorus by Colourimetry (0.002 mg/L) | E372-U | 679308 | 1 | 19 | 5.2 | 5.0 | ✓ |
| Matrix Spikes (MS) | | | | | | | |
| Ammonia by Fluorescence | E298 | 679307 | 1 | 19 | 5.2 | 5.0 | ✓ |
| Bromide in Water by IC (Low Level) | E235.Br-L | 678592 | 1 | 14 | 7.1 | 5.0 | ✓ |
| Chemical Oxygen Demand by Colourimetry (Low Level) | E559-L | 677785 | 1 | 20 | 5.0 | 5.0 | ✓ |
| Chloride in Water by IC | E235.Cl | 678591 | 1 | 16 | 6.2 | 5.0 | ✓ |
| Dissolved Mercury in Water by CVAAS | E509 | 680325 | 1 | 20 | 5.0 | 5.0 | ✓ |
| Dissolved Metals in Water by CRC ICPMS | E421 | 678395 | 1 | 19 | 5.2 | 5.0 | ✓ |
| Fluoride in Water by IC | E235.F | 678590 | 1 | 14 | 7.1 | 5.0 | ✓ |
| Nitrate in Water by IC (Low Level) | E235.NO3-L | 678588 | 1 | 19 | 5.2 | 5.0 | ✓ |
| Nitrite in Water by IC (Low Level) | E235.NO2-L | 678589 | 1 | 19 | 5.2 | 5.0 | ✓ |
| Sulfate in Water by IC | E235.SO4 | 678586 | 1 | 17 | 5.8 | 5.0 | ✓ |
| Total Nitrogen by Colourimetry | E366 | 679306 | 1 | 16 | 6.2 | 5.0 | ✓ |
| Total Phosphorus by Colourimetry (0.002 mg/L) | E372-U | 679308 | 1 | 19 | 5.2 | 5.0 | ✓ |

## Methodology References and Summaries

The analytical methods used by ALS are developed using internationally recognized reference methods (where available), such as those published by US EPA, APHA Standard Methods, ASTM, ISO, Environment Canada, BC MOE, and Ontario MOE. Reference methods may incorporate modifications to improve performance (indicated by "mod").

| Analytical Methods | Method / Lab | Matrix | Method Reference | Method Descriptions |
|---|---|---|---|---|
| Conductivity in Water | E100<br>Vancouver - Environmental | Water | APHA 2510 (mod) | Conductivity, also known as Electrical Conductivity (EC) or Specific Conductance, is measured by immersion of a conductivity cell with platinum electrodes into a water sample. Conductivity measurements are temperature-compensated to 25°C. |
| pH by Meter | E108<br>Vancouver - Environmental | Water | APHA 4500-H (mod) | pH is determined by potentiometric measurement with a pH electrode, and is conducted at ambient laboratory temperature (normally 20 ± 5°C). For high accuracy test results, pH should be measured in the field within the recommended 15 minute hold time. |
| TDS by Gravimetry | E162<br>Vancouver - Environmental | Water | APHA 2540 C (mod) | Total Dissolved Solids (TDS) are determined by filtering a sample through a glass fibre filter, with evaporation of the filtrate at 180 ± 2°C for 16 hours or to constant weight, with gravimetric measurement of the residue. |
| Bromide in Water by IC (Low Level) | E235.Br-L<br>Vancouver - Environmental | Water | EPA 300.1 (mod) | Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. |
| Chloride in Water by IC | E235.Cl<br>Vancouver - Environmental | Water | EPA 300.1 (mod) | Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. |
| Fluoride in Water by IC | E235.F<br>Vancouver - Environmental | Water | EPA 300.1 (mod) | Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. |
| Nitrite in Water by IC (Low Level) | E235.NO2-L<br>Vancouver - Environmental | Water | EPA 300.1 (mod) | Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. |
| Nitrate in Water by IC (Low Level) | E235.NO3-L<br>Vancouver - Environmental | Water | EPA 300.1 (mod) | Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. |
| Sulfate in Water by IC | E235.SO4<br>Vancouver - Environmental | Water | EPA 300.1 (mod) | Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection. |
| Alkalinity Species by Titration | E290<br>Vancouver - Environmental | Water | APHA 2320 B (mod) | Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values. |

| Analytical Methods | Method / Lab | Matrix | Method Reference | Method Descriptions |
|---|---|---|---|---|
| Ammonia by Fluorescence | E298<br><br>Vancouver - Environmental | Water | Method Fialab 100, 2018 | Ammonia in water is determined by automated continuous flow analysis with membrane diffusion and fluorescence detection, after reaction with OPA (ortho-phthalaldehyde). This method is approved under US EPA 40 CFR Part 136 (May 2021) |
| Total Nitrogen by Colourimetry | E366<br><br>Vancouver - Environmental | Water | APHA 4500-P J (mod) | Total Nitrogen is determined colourimetrically using a discrete analyzer after heated persulfate digestion of the sample. |
| Total Phosphorus by Colourimetry (0.002 mg/L) | E372-U<br><br>Vancouver - Environmental | Water | APHA 4500-P E (mod). | Total Phosphorus is determined colourimetrically using a discrete analyzer after heated persulfate digestion of the sample. |
| Dissolved Metals in Water by CRC ICPMS | E421<br><br>Vancouver - Environmental | Water | APHA 3030B/EPA 6020B (mod) | Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by Collision/Reaction Cell ICPMS.<br><br>Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. |
| Dissolved Mercury in Water by CVAAS | E509<br><br>Vancouver - Environmental | Water | APHA 3030B/EPA 1631E (mod) | Water samples are filtered (0.45 um), preserved with HCl, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS. |
| Biochemical Oxygen Demand - 5 day | E550<br><br>Vancouver - Environmental | Water | APHA 5210 B (mod) | Samples are diluted and incubated for a specified time period, after which the oxygen depletion is measured using a dissolved oxygen meter.<br><br>Free chlorine is a negative interference in the BOD method; please advise ALS when free chlorine is present in samples. |
| Chemical Oxygen Demand by Colourimetry (Low Level) | E559-L<br><br>Vancouver - Environmental | Water | APHA 5220 D (mod) | Samples are analyzed using the closed reflux colourimetric method. |
| Dissolved Hardness (Calculated) | EC100<br><br>Vancouver - Environmental | Water | APHA 2340B | “Hardness (as CaCO3), dissolved” is calculated from the sum of dissolved Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. “Total Hardness” refers to the sum of Calcium and Magnesium Hardness. Hardness is normally or preferentially calculated from dissolved Calcium and Magnesium concentrations, because it is a property of water due to dissolved divalent cations. |

| Preparation Methods | Method / Lab | Matrix | Method Reference | Method Descriptions |
|---|---|---|---|---|
| Preparation for Ammonia | EP298<br><br>Vancouver - Environmental | Water | | Sample preparation for Preserved Nutrients Water Quality Analysis. |
| Digestion for Total Nitrogen in water | EP366<br><br>Vancouver - Environmental | Water | APHA 4500-P J (mod) | Samples are heated with a persulfate digestion reagent. |

| Preparation Methods | Method / Lab | Matrix | Method Reference | Method Descriptions |
|---|---|---|---|---|
| Digestion for Total Phosphorus in water | EP372<br><br>Vancouver - Environmental | Water | APHA 4500-P E (mod). | Samples are heated with a persulfate digestion reagent. |
| Dissolved Metals Water Filtration | EP421<br><br>Vancouver - Environmental | Water | APHA 3030B | Water samples are filtered (0.45 um), and preserved with HNO3. |
| Dissolved Mercury Water Filtration | EP509<br><br>Vancouver - Environmental | Water | APHA 3030B | Water samples are filtered (0.45 um), and preserved with HCl. |

ALS Environmental

# QUALITY CONTROL REPORT

| | | | |
|---|---|---|---|
| **Work Order** | : **VA22C3713** | Page | : 1 of 14 |
| Client | : Regional District of Kitimat-Stikine | Laboratory | : Vancouver - Environmental |
| Contact | : Hannah Shinton | Account Manager | : Amber Springer |
| Address | : # 300 - 4545 Lazelle Avenue<br>Terrace BC Canada V8G 4E1 | Address | : 8081 Lougheed Highway<br>Burnaby, British Columbia Canada V5A 1W9 |
| Telephone | : ---- | Telephone | : +1 604 253 4188 |
| Project | : Kitwanga Landfill Groundwater | Date Samples Received | : 30-Sep-2022 11:55 |
| PO | : ---- | Date Analysis Commenced | : 01-Oct-2022 |
| C-O-C number | : ---- | Issue Date | : 11-Oct-2022 10:34 |
| Sampler | : Hannah Shinton | | |
| Site | : | | |
| Quote number | : Default Water Testing (Q62338) | | |
| No. of samples received | : 3 | | |
| No. of samples analysed | : 3 | | |

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percent Difference (RPD) and Data Quality Objectives
- Matrix Spike (MS) Report; Recovery and Data Quality Objectives
- Method Blank (MB) Report; Recovery and Data Quality Objectives
- Laboratory Control Sample (LCS) Report; Recovery and Data Quality Objectives

## *Signatories*

This document has been electronically signed by the authorized signatories below. Electronic signing is conducted in accordance with US FDA 21 CFR Part 11.

| *Signatories* | *Position* | *Laboratory Department* |
|---|---|---|
| Ann Joby | Lab Assistant | Vancouver Metals, Burnaby, British Columbia |
| Caitlin Macey | Team Leader - Inorganics | Vancouver Inorganics, Burnaby, British Columbia |
| Delson Resende | Lab Assistant | Vancouver Metals, Burnaby, British Columbia |
| Kevin Duarte | Supervisor - Metals ICP Instrumentation | Vancouver Metals, Burnaby, British Columbia |
| Lindsay Gung | Supervisor - Water Chemistry | Vancouver Inorganics, Burnaby, British Columbia |
| Qammar Almas | Lab Assistant | Vancouver Metals, Burnaby, British Columbia |

## General Comments

The ALS Quality Control (QC) report is optionally provided to ALS clients upon request. ALS test methods include comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against predetermined Data Quality Objectives (DQOs) to provide confidence in the accuracy of associated test results. This report contains detailed results for all QC results applicable to this sample submission. Please refer to the ALS Quality Control Interpretation report (QCI) for applicable method references and methodology summaries.

Key :

Anonymous = Refers to samples which are not part of this work order, but which formed part of the QC process lot.
CAS Number = Chemical Abstracts Service number is a unique identifier assigned to discrete substances.
DQO = Data Quality Objective.
LOR = Limit of Reporting (detection limit).
RPD = Relative Percent Difference
# = Indicates a QC result that did not meet the ALS DQO.

## Workorder Comments

Holding times are displayed as "---" if no guidance exists from CCME, Canadian provinces, or broadly recognized international references.

## Laboratory Duplicate (DUP) Report

A Laboratory Duplicate (DUP) is a randomly selected intralaboratory replicate sample. Laboratory Duplicates provide information regarding method precision and sample heterogeneity. ALS DQOs for Laboratory Duplicates are expressed as test-specific limits for Relative Percent Difference (RPD), or as an absolute difference limit of 2 times the LOR for low concentration duplicates within ~ 4-10 times the LOR (cut-off is test-specific).

Sub-Matrix: **Water**

| | | | | | Laboratory Duplicate (DUP) Report | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *Laboratory sample ID* | *Client sample ID* | *Analyte* | *CAS Number* | *Method* | *LOR* | *Unit* | *Original Result* | *Duplicate Result* | *RPD(%) or Difference* | *Duplicate Limits* | *Qualifier* |
| **Physical Tests (QC Lot: 677587)** | | | | | | | | | | | |
| VA22C3713-001 | MW22-01 | solids, total dissolved [TDS] | ---- | E162 | 20 | mg/L | 507 | 484 | 4.54% | 20% | ---- |
| **Physical Tests (QC Lot: 678593)** | | | | | | | | | | | |
| VA22C3537-014 | Anonymous | pH | ---- | E108 | 0.10 | pH units | 8.26 | 8.26 | 0.0363% | 4% | ---- |
| **Physical Tests (QC Lot: 678594)** | | | | | | | | | | | |
| VA22C3537-014 | Anonymous | conductivity | ---- | E100 | 2.0 | µS/cm | 318 | 318 | 0.00% | 10% | ---- |
| **Physical Tests (QC Lot: 678595)** | | | | | | | | | | | |
| VA22C3537-014 | Anonymous | alkalinity, total (as CaCO3) | ---- | E290 | 1.0 | mg/L | 138 | 136 | 1.02% | 20% | ---- |
| **Anions and Nutrients (QC Lot: 678586)** | | | | | | | | | | | |
| VA22C3537-012 | Anonymous | sulfate (as SO4) | 14808-79-8 | E235.SO4 | 0.30 | mg/L | 50.5 | 50.9 | 0.771% | 20% | ---- |
| **Anions and Nutrients (QC Lot: 678588)** | | | | | | | | | | | |
| VA22C3537-012 | Anonymous | nitrate (as N) | 14797-55-8 | E235.NO3-L | 0.0050 | mg/L | 0.812 | 0.819 | 0.864% | 20% | ---- |
| **Anions and Nutrients (QC Lot: 678589)** | | | | | | | | | | | |
| VA22C3537-012 | Anonymous | nitrite (as N) | 14797-65-0 | E235.NO2-L | 0.0010 | mg/L | 0.0081 | 0.0076 | 0.0005 | Diff <2x LOR | ---- |
| **Anions and Nutrients (QC Lot: 678590)** | | | | | | | | | | | |
| VA22C3713-001 | MW22-01 | fluoride | 16984-48-8 | E235.F | 0.020 | mg/L | 0.222 | 0.222 | 0.274% | 20% | ---- |
| **Anions and Nutrients (QC Lot: 678591)** | | | | | | | | | | | |
| VA22C3713-001 | MW22-01 | chloride | 16887-00-6 | E235.Cl | 0.50 | mg/L | 4.18 | 4.18 | 0.004 | Diff <2x LOR | ---- |
| **Anions and Nutrients (QC Lot: 678592)** | | | | | | | | | | | |
| VA22C3713-001 | MW22-01 | bromide | 24959-67-9 | E235.Br-L | 0.050 | mg/L | <0.050 | <0.050 | 0 | Diff <2x LOR | ---- |
| **Anions and Nutrients (QC Lot: 679306)** | | | | | | | | | | | |
| VA22C3438-001 | Anonymous | nitrogen, total | 7727-37-9 | E366 | 0.030 | mg/L | 0.088 | 0.086 | 0.002 | Diff <2x LOR | ---- |
| **Anions and Nutrients (QC Lot: 679307)** | | | | | | | | | | | |
| FJ2202696-003 | Anonymous | ammonia, total (as N) | 7664-41-7 | E298 | 0.0050 | mg/L | 0.0064 | 0.0072 | 0.0008 | Diff <2x LOR | ---- |
| **Anions and Nutrients (QC Lot: 679308)** | | | | | | | | | | | |
| FJ2202696-003 | Anonymous | phosphorus, total | 7723-14-0 | E372-U | 0.0020 | mg/L | <0.0020 | <0.0020 | 0 | Diff <2x LOR | ---- |
| **Dissolved Metals (QC Lot: 678395)** | | | | | | | | | | | |
| VA22C3496-001 | Anonymous | aluminum, dissolved | 7429-90-5 | E421 | 0.0020 | mg/L | 0.0059 | 0.0060 | 0.0001 | Diff <2x LOR | ---- |
| | | antimony, dissolved | 7440-36-0 | E421 | 0.00020 | mg/L | 0.00052 | 0.00054 | 0.00001 | Diff <2x LOR | ---- |
| | | arsenic, dissolved | 7440-38-2 | E421 | 0.00020 | mg/L | 0.00039 | 0.00036 | 0.00003 | Diff <2x LOR | ---- |
| | | barium, dissolved | 7440-39-3 | E421 | 0.00020 | mg/L | 0.0136 | 0.0143 | 4.77% | 20% | ---- |
| | | beryllium, dissolved | 7440-41-7 | E421 | 0.000040 | mg/L | <0.000040 | <0.000040 | 0 | Diff <2x LOR | ---- |

Sub-Matrix: **Water**

| | | | | | Laboratory Duplicate (DUP) Report | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *Laboratory sample ID* | *Client sample ID* | *Analyte* | *CAS Number* | *Method* | *LOR* | *Unit* | *Original Result* | *Duplicate Result* | *RPD(%) or Difference* | *Duplicate Limits* | *Qualifier* |
| **Dissolved Metals (QC Lot: 678395) - continued** | | | | | | | | | | | |
| VA22C3496-001 | Anonymous | bismuth, dissolved | 7440-69-9 | E421 | 0.000100 | mg/L | <0.000100 | <0.000100 | 0 | Diff <2x LOR | ---- |
| | | boron, dissolved | 7440-42-8 | E421 | 0.020 | mg/L | <0.020 | <0.020 | 0 | Diff <2x LOR | ---- |
| | | cadmium, dissolved | 7440-43-9 | E421 | 0.0000100 | mg/L | 0.000127 | 0.000139 | 9.28% | 20% | ---- |
| | | calcium, dissolved | 7440-70-2 | E421 | 0.100 | mg/L | 540 | 520 | 3.70% | 20% | ---- |
| | | cesium, dissolved | 7440-46-2 | E421 | 0.000020 | mg/L | 0.000423 | 0.000412 | 2.76% | 20% | ---- |
| | | chromium, dissolved | 7440-47-3 | E421 | 0.00050 | mg/L | <0.00050 | <0.00050 | 0 | Diff <2x LOR | ---- |
| | | cobalt, dissolved | 7440-48-4 | E421 | 0.00020 | mg/L | 0.0107 | 0.0106 | 0.996% | 20% | ---- |
| | | copper, dissolved | 7440-50-8 | E421 | 0.00040 | mg/L | 0.00273 | 0.00266 | 0.00007 | Diff <2x LOR | ---- |
| | | iron, dissolved | 7439-89-6 | E421 | 0.020 | mg/L | <0.020 | <0.020 | 0 | Diff <2x LOR | ---- |
| | | lead, dissolved | 7439-92-1 | E421 | 0.000100 | mg/L | <0.000100 | <0.000100 | 0 | Diff <2x LOR | ---- |
| | | lithium, dissolved | 7439-93-2 | E421 | 0.0020 | mg/L | <0.0020 | <0.0020 | 0 | Diff <2x LOR | ---- |
| | | magnesium, dissolved | 7439-95-4 | E421 | 0.100 | mg/L | 41.9 | 41.8 | 0.0104% | 20% | ---- |
| | | manganese, dissolved | 7439-96-5 | E421 | 0.00020 | mg/L | 1.10 | 1.07 | 2.66% | 20% | ---- |
| | | molybdenum, dissolved | 7439-98-7 | E421 | 0.000100 | mg/L | 0.0934 | 0.0958 | 2.47% | 20% | ---- |
| | | nickel, dissolved | 7440-02-0 | E421 | 0.00100 | mg/L | 0.0158 | 0.0156 | 1.25% | 20% | ---- |
| | | phosphorus, dissolved | 7723-14-0 | E421 | 0.100 | mg/L | <0.100 | <0.100 | 0 | Diff <2x LOR | ---- |
| | | potassium, dissolved | 7440-09-7 | E421 | 0.100 | mg/L | 15.9 | 16.0 | 0.413% | 20% | ---- |
| | | rubidium, dissolved | 7440-17-7 | E421 | 0.00040 | mg/L | 0.0245 | 0.0245 | 0.122% | 20% | ---- |
| | | selenium, dissolved | 7782-49-2 | E421 | 0.000100 | mg/L | 0.000206 | 0.000176 | 0.000031 | Diff <2x LOR | ---- |
| | | silicon, dissolved | 7440-21-3 | E421 | 0.100 | mg/L | 3.90 | 3.95 | 1.29% | 20% | ---- |
| | | silver, dissolved | 7440-22-4 | E421 | 0.000020 | mg/L | <0.000020 | <0.000020 | 0 | Diff <2x LOR | ---- |
| | | sodium, dissolved | 7440-23-5 | E421 | 0.100 | mg/L | 63.1 | 62.3 | 1.33% | 20% | ---- |
| | | strontium, dissolved | 7440-24-6 | E421 | 0.00040 | mg/L | 1.77 | 1.82 | 2.78% | 20% | ---- |
| | | sulfur, dissolved | 7704-34-9 | E421 | 1.00 | mg/L | 527 | 534 | 1.27% | 20% | ---- |
| | | tellurium, dissolved | 13494-80-9 | E421 | 0.00040 | mg/L | <0.00040 | <0.00040 | 0 | Diff <2x LOR | ---- |
| | | thallium, dissolved | 7440-28-0 | E421 | 0.000020 | mg/L | 0.000073 | 0.000076 | 0.000003 | Diff <2x LOR | ---- |
| | | thorium, dissolved | 7440-29-1 | E421 | 0.00020 | mg/L | <0.00020 | <0.00020 | 0 | Diff <2x LOR | ---- |
| | | tin, dissolved | 7440-31-5 | E421 | 0.00020 | mg/L | <0.00020 | <0.00020 | 0 | Diff <2x LOR | ---- |
| | | titanium, dissolved | 7440-32-6 | E421 | 0.00060 | mg/L | <0.00060 | <0.00060 | 0 | Diff <2x LOR | ---- |
| | | tungsten, dissolved | 7440-33-7 | E421 | 0.00020 | mg/L | <0.00020 | <0.00020 | 0 | Diff <2x LOR | ---- |
| | | uranium, dissolved | 7440-61-1 | E421 | 0.000020 | mg/L | 0.00164 | 0.00173 | 5.18% | 20% | ---- |
| | | vanadium, dissolved | 7440-62-2 | E421 | 0.00100 | mg/L | <0.00100 | <0.00100 | 0 | Diff <2x LOR | ---- |
| | | zinc, dissolved | 7440-66-6 | E421 | 0.0020 | mg/L | 0.0028 | 0.0028 | 0.00006 | Diff <2x LOR | ---- |
| | | zirconium, dissolved | 7440-67-7 | E421 | 0.00040 | mg/L | <0.00040 | <0.00040 | 0 | Diff <2x LOR | ---- |
| **Dissolved Metals (QC Lot: 680325)** | | | | | | | | | | | |

Sub-Matrix: **Water**

| | | | | | Laboratory Duplicate (DUP) Report | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *Laboratory sample ID* | *Client sample ID* | *Analyte* | *CAS Number* | *Method* | *LOR* | *Unit* | *Original Result* | *Duplicate Result* | *RPD(%) or Difference* | *Duplicate Limits* | *Qualifier* |
| **Dissolved Metals (QC Lot: 680325) - continued** | | | | | | | | | | | |
| VA22C3650-001 | Anonymous | mercury, dissolved | 7439-97-6 | E509 | 0.0000050 | mg/L | <0.0050 µg/L | <0.0000050 | 0 | Diff <2x LOR | ---- |
| **Aggregate Organics (QC Lot: 675761)** | | | | | | | | | | | |
| FJ2202792-001 | Anonymous | biochemical oxygen demand [BOD] | ---- | E550 | 2.0 | mg/L | <2.0 | <2.0 | 0.0% | 30% | ---- |
| **Aggregate Organics (QC Lot: 677785)** | | | | | | | | | | | |
| VA22C2822-001 | Anonymous | chemical oxygen demand [COD] | ---- | E559-L | 10 | mg/L | 17 | 16 | 1.0 | Diff <2x LOR | ---- |

## Method Blank (MB) Report

A Method Blank is an analyte-free matrix that undergoes sample processing identical to that carried out for test samples. Method Blank results are used to monitor and control for potential contamination from the laboratory environment and reagents. For most tests, the DQO for Method Blanks is for the result to be < LOR.

Sub-Matrix: **Water**

| Analyte | CAS Number | Method | LOR | Unit | Result | Qualifier |
|---|---|---|---|---|---|---|
| **Physical Tests (QCLot: 677587)** | | | | | | |
| solids, total dissolved [TDS] | ---- | E162 | 10 | mg/L | <10 | ---- |
| **Physical Tests (QCLot: 678594)** | | | | | | |
| conductivity | ---- | E100 | 1 | µS/cm | 1.1 | ---- |
| **Physical Tests (QCLot: 678595)** | | | | | | |
| alkalinity, total (as CaCO3) | ---- | E290 | 1 | mg/L | <1.0 | ---- |
| **Anions and Nutrients (QCLot: 678586)** | | | | | | |
| sulfate (as SO4) | 14808-79-8 | E235.SO4 | 0.3 | mg/L | <0.30 | ---- |
| **Anions and Nutrients (QCLot: 678588)** | | | | | | |
| nitrate (as N) | 14797-55-8 | E235.NO3-L | 0.005 | mg/L | <0.0050 | ---- |
| **Anions and Nutrients (QCLot: 678589)** | | | | | | |
| nitrite (as N) | 14797-65-0 | E235.NO2-L | 0.001 | mg/L | <0.0010 | ---- |
| **Anions and Nutrients (QCLot: 678590)** | | | | | | |
| fluoride | 16984-48-8 | E235.F | 0.02 | mg/L | <0.020 | ---- |
| **Anions and Nutrients (QCLot: 678591)** | | | | | | |
| chloride | 16887-00-6 | E235.Cl | 0.5 | mg/L | <0.50 | ---- |
| **Anions and Nutrients (QCLot: 678592)** | | | | | | |
| bromide | 24959-67-9 | E235.Br-L | 0.05 | mg/L | <0.050 | ---- |
| **Anions and Nutrients (QCLot: 679306)** | | | | | | |
| nitrogen, total | 7727-37-9 | E366 | 0.03 | mg/L | <0.030 | ---- |
| **Anions and Nutrients (QCLot: 679307)** | | | | | | |
| ammonia, total (as N) | 7664-41-7 | E298 | 0.005 | mg/L | <0.0050 | ---- |
| **Anions and Nutrients (QCLot: 679308)** | | | | | | |
| phosphorus, total | 7723-14-0 | E372-U | 0.002 | mg/L | <0.0020 | ---- |
| **Dissolved Metals (QCLot: 678395)** | | | | | | |
| aluminum, dissolved | 7429-90-5 | E421 | 0.001 | mg/L | <0.0010 | ---- |
| antimony, dissolved | 7440-36-0 | E421 | 0.0001 | mg/L | <0.00010 | ---- |
| arsenic, dissolved | 7440-38-2 | E421 | 0.0001 | mg/L | <0.00010 | ---- |
| barium, dissolved | 7440-39-3 | E421 | 0.0001 | mg/L | <0.00010 | ---- |
| beryllium, dissolved | 7440-41-7 | E421 | 0.00002 | mg/L | <0.000020 | ---- |
| bismuth, dissolved | 7440-69-9 | E421 | 0.00005 | mg/L | <0.000050 | ---- |
| boron, dissolved | 7440-42-8 | E421 | 0.01 | mg/L | <0.010 | ---- |
| cadmium, dissolved | 7440-43-9 | E421 | 0.000005 | mg/L | <0.0000050 | ---- |
| calcium, dissolved | 7440-70-2 | E421 | 0.05 | mg/L | <0.050 | ---- |

Sub-Matrix: **Water**

| Analyte | CAS Number | Method | LOR | Unit | Result | Qualifier |
|---|---|---|---|---|---|---|
| **Dissolved Metals (QCLot: 678395) - continued** | | | | | | |
| cesium, dissolved | 7440-46-2 | E421 | 0.00001 | mg/L | <0.000010 | ---- |
| chromium, dissolved | 7440-47-3 | E421 | 0.0005 | mg/L | <0.00050 | ---- |
| cobalt, dissolved | 7440-48-4 | E421 | 0.0001 | mg/L | <0.00010 | ---- |
| copper, dissolved | 7440-50-8 | E421 | 0.0002 | mg/L | <0.00020 | ---- |
| iron, dissolved | 7439-89-6 | E421 | 0.01 | mg/L | <0.010 | ---- |
| lead, dissolved | 7439-92-1 | E421 | 0.00005 | mg/L | <0.000050 | ---- |
| lithium, dissolved | 7439-93-2 | E421 | 0.001 | mg/L | <0.0010 | ---- |
| magnesium, dissolved | 7439-95-4 | E421 | 0.005 | mg/L | <0.0050 | ---- |
| manganese, dissolved | 7439-96-5 | E421 | 0.0001 | mg/L | <0.00010 | ---- |
| molybdenum, dissolved | 7439-98-7 | E421 | 0.00005 | mg/L | <0.000050 | ---- |
| nickel, dissolved | 7440-02-0 | E421 | 0.0005 | mg/L | <0.00050 | ---- |
| phosphorus, dissolved | 7723-14-0 | E421 | 0.05 | mg/L | <0.050 | ---- |
| potassium, dissolved | 7440-09-7 | E421 | 0.05 | mg/L | <0.050 | ---- |
| rubidium, dissolved | 7440-17-7 | E421 | 0.0002 | mg/L | <0.00020 | ---- |
| selenium, dissolved | 7782-49-2 | E421 | 0.00005 | mg/L | <0.000050 | ---- |
| silicon, dissolved | 7440-21-3 | E421 | 0.05 | mg/L | <0.050 | ---- |
| silver, dissolved | 7440-22-4 | E421 | 0.00001 | mg/L | <0.000010 | ---- |
| sodium, dissolved | 7440-23-5 | E421 | 0.05 | mg/L | <0.050 | ---- |
| strontium, dissolved | 7440-24-6 | E421 | 0.0002 | mg/L | <0.00020 | ---- |
| sulfur, dissolved | 7704-34-9 | E421 | 0.5 | mg/L | <0.50 | ---- |
| tellurium, dissolved | 13494-80-9 | E421 | 0.0002 | mg/L | <0.00020 | ---- |
| thallium, dissolved | 7440-28-0 | E421 | 0.00001 | mg/L | <0.000010 | ---- |
| thorium, dissolved | 7440-29-1 | E421 | 0.0001 | mg/L | <0.00010 | ---- |
| tin, dissolved | 7440-31-5 | E421 | 0.0001 | mg/L | <0.00010 | ---- |
| titanium, dissolved | 7440-32-6 | E421 | 0.0003 | mg/L | <0.00030 | ---- |
| tungsten, dissolved | 7440-33-7 | E421 | 0.0001 | mg/L | <0.00010 | ---- |
| uranium, dissolved | 7440-61-1 | E421 | 0.00001 | mg/L | <0.000010 | ---- |
| vanadium, dissolved | 7440-62-2 | E421 | 0.0005 | mg/L | <0.00050 | ---- |
| zinc, dissolved | 7440-66-6 | E421 | 0.001 | mg/L | <0.0010 | ---- |
| zirconium, dissolved | 7440-67-7 | E421 | 0.0002 | mg/L | <0.00020 | ---- |
| **Dissolved Metals (QCLot: 680325)** | | | | | | |
| mercury, dissolved | 7439-97-6 | E509 | 0.000005 | mg/L | <0.0000050 | ---- |
| **Aggregate Organics (QCLot: 675761)** | | | | | | |
| biochemical oxygen demand [BOD] | ---- | E550 | 2 | mg/L | <2.0 | ---- |
| **Aggregate Organics (QCLot: 677785)** | | | | | | |
| chemical oxygen demand [COD] | ---- | E559-L | 10 | mg/L | <10 | ---- |

## Laboratory Control Sample (LCS) Report

A Laboratory Control Sample (LCS) is an analyte-free matrix that has been fortified (spiked) with test analytes at known concentration and processed in an identical manner to test samples. LCS results are expressed as percent recovery, and are used to monitor and control test method accuracy and precision, independent of test sample matrix.

Sub-Matrix: **Water**

| | | | | | Laboratory Control Sample (LCS) Report | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Spike | Recovery (%) | Recovery Limits (%) | | |
| Analyte | CAS Number | Method | LOR | Unit | Concentration | LCS | Low | High | Qualifier |
| **Physical Tests (QCLot: 677587)** | | | | | | | | | |
| solids, total dissolved [TDS] | ---- | E162 | 10 | mg/L | 1000 mg/L | 104 | 85.0 | 115 | ---- |
| **Physical Tests (QCLot: 678593)** | | | | | | | | | |
| pH | ---- | E108 | ---- | pH units | 7 pH units | 99.4 | 98.0 | 102 | ---- |
| **Physical Tests (QCLot: 678594)** | | | | | | | | | |
| conductivity | ---- | E100 | 1 | µS/cm | 146.9 µS/cm | 100 | 90.0 | 110 | ---- |
| **Physical Tests (QCLot: 678595)** | | | | | | | | | |
| alkalinity, total (as CaCO3) | ---- | E290 | 1 | mg/L | 500 mg/L | 108 | 85.0 | 115 | ---- |
| **Anions and Nutrients (QCLot: 678586)** | | | | | | | | | |
| sulfate (as SO4) | 14808-79-8 | E235.SO4 | 0.3 | mg/L | 100 mg/L | 105 | 90.0 | 110 | ---- |
| **Anions and Nutrients (QCLot: 678588)** | | | | | | | | | |
| nitrate (as N) | 14797-55-8 | E235.NO3-L | 0.005 | mg/L | 2.5 mg/L | 103 | 90.0 | 110 | ---- |
| **Anions and Nutrients (QCLot: 678589)** | | | | | | | | | |
| nitrite (as N) | 14797-65-0 | E235.NO2-L | 0.001 | mg/L | 0.5 mg/L | 98.4 | 90.0 | 110 | ---- |
| **Anions and Nutrients (QCLot: 678590)** | | | | | | | | | |
| fluoride | 16984-48-8 | E235.F | 0.02 | mg/L | 1 mg/L | 99.0 | 90.0 | 110 | ---- |
| **Anions and Nutrients (QCLot: 678591)** | | | | | | | | | |
| chloride | 16887-00-6 | E235.Cl | 0.5 | mg/L | 100 mg/L | 103 | 90.0 | 110 | ---- |
| **Anions and Nutrients (QCLot: 678592)** | | | | | | | | | |
| bromide | 24959-67-9 | E235.Br-L | 0.05 | mg/L | 0.5 mg/L | 99.0 | 85.0 | 115 | ---- |
| **Anions and Nutrients (QCLot: 679306)** | | | | | | | | | |
| nitrogen, total | 7727-37-9 | E366 | 0.03 | mg/L | 0.5 mg/L | 101 | 75.0 | 125 | ---- |
| **Anions and Nutrients (QCLot: 679307)** | | | | | | | | | |
| ammonia, total (as N) | 7664-41-7 | E298 | 0.005 | mg/L | 0.2 mg/L | 91.6 | 85.0 | 115 | ---- |
| **Anions and Nutrients (QCLot: 679308)** | | | | | | | | | |
| phosphorus, total | 7723-14-0 | E372-U | 0.002 | mg/L | 0.05 mg/L | 83.9 | 80.0 | 120 | ---- |
| **Dissolved Metals (QCLot: 678395)** | | | | | | | | | |
| aluminum, dissolved | 7429-90-5 | E421 | 0.001 | mg/L | 2 mg/L | 96.9 | 80.0 | 120 | ---- |
| antimony, dissolved | 7440-36-0 | E421 | 0.0001 | mg/L | 1 mg/L | 97.0 | 80.0 | 120 | ---- |
| arsenic, dissolved | 7440-38-2 | E421 | 0.0001 | mg/L | 1 mg/L | 102 | 80.0 | 120 | ---- |
| barium, dissolved | 7440-39-3 | E421 | 0.0001 | mg/L | 0.25 mg/L | 102 | 80.0 | 120 | ---- |
| beryllium, dissolved | 7440-41-7 | E421 | 0.00002 | mg/L | 0.1 mg/L | 95.9 | 80.0 | 120 | ---- |
| bismuth, dissolved | 7440-69-9 | E421 | 0.00005 | mg/L | 1 mg/L | 100 | 80.0 | 120 | ---- |

Sub-Matrix: **Water**

| Analyte | CAS Number | Method | LOR | Unit | Laboratory Control Sample (LCS) Report: Spike Concentration | Recovery (%): LCS | Recovery Limits (%): Low | Recovery Limits (%): High | Qualifier |
|---|---|---|---|---|---|---|---|---|---|
| **Dissolved Metals (QCLot: 678395) - continued** | | | | | | | | | |
| boron, dissolved | 7440-42-8 | E421 | 0.01 | mg/L | 1 mg/L | 88.3 | 80.0 | 120 | ---- |
| cadmium, dissolved | 7440-43-9 | E421 | 0.000005 | mg/L | 0.1 mg/L | 99.7 | 80.0 | 120 | ---- |
| calcium, dissolved | 7440-70-2 | E421 | 0.05 | mg/L | 50 mg/L | 103 | 80.0 | 120 | ---- |
| cesium, dissolved | 7440-46-2 | E421 | 0.00001 | mg/L | 0.05 mg/L | 97.7 | 80.0 | 120 | ---- |
| chromium, dissolved | 7440-47-3 | E421 | 0.0005 | mg/L | 0.25 mg/L | 99.4 | 80.0 | 120 | ---- |
| cobalt, dissolved | 7440-48-4 | E421 | 0.0001 | mg/L | 0.25 mg/L | 98.3 | 80.0 | 120 | ---- |
| copper, dissolved | 7440-50-8 | E421 | 0.0002 | mg/L | 0.25 mg/L | 99.4 | 80.0 | 120 | ---- |
| iron, dissolved | 7439-89-6 | E421 | 0.01 | mg/L | 1 mg/L | 101 | 80.0 | 120 | ---- |
| lead, dissolved | 7439-92-1 | E421 | 0.00005 | mg/L | 0.5 mg/L | 97.9 | 80.0 | 120 | ---- |
| lithium, dissolved | 7439-93-2 | E421 | 0.001 | mg/L | 0.25 mg/L | 90.8 | 80.0 | 120 | ---- |
| magnesium, dissolved | 7439-95-4 | E421 | 0.005 | mg/L | 50 mg/L | 99.6 | 80.0 | 120 | ---- |
| manganese, dissolved | 7439-96-5 | E421 | 0.0001 | mg/L | 0.25 mg/L | 98.6 | 80.0 | 120 | ---- |
| molybdenum, dissolved | 7439-98-7 | E421 | 0.00005 | mg/L | 0.25 mg/L | 95.4 | 80.0 | 120 | ---- |
| nickel, dissolved | 7440-02-0 | E421 | 0.0005 | mg/L | 0.5 mg/L | 97.2 | 80.0 | 120 | ---- |
| phosphorus, dissolved | 7723-14-0 | E421 | 0.05 | mg/L | 10 mg/L | 103 | 80.0 | 120 | ---- |
| potassium, dissolved | 7440-09-7 | E421 | 0.05 | mg/L | 50 mg/L | 101 | 80.0 | 120 | ---- |
| rubidium, dissolved | 7440-17-7 | E421 | 0.0002 | mg/L | 0.1 mg/L | 105 | 80.0 | 120 | ---- |
| selenium, dissolved | 7782-49-2 | E421 | 0.00005 | mg/L | 1 mg/L | 98.7 | 80.0 | 120 | ---- |
| silicon, dissolved | 7440-21-3 | E421 | 0.05 | mg/L | 10 mg/L | 102 | 80.0 | 120 | ---- |
| silver, dissolved | 7440-22-4 | E421 | 0.00001 | mg/L | 0.1 mg/L | 86.6 | 80.0 | 120 | ---- |
| sodium, dissolved | 7440-23-5 | E421 | 0.05 | mg/L | 50 mg/L | 96.3 | 80.0 | 120 | ---- |
| strontium, dissolved | 7440-24-6 | E421 | 0.0002 | mg/L | 0.25 mg/L | 102 | 80.0 | 120 | ---- |
| sulfur, dissolved | 7704-34-9 | E421 | 0.5 | mg/L | 50 mg/L | 97.8 | 80.0 | 120 | ---- |
| tellurium, dissolved | 13494-80-9 | E421 | 0.0002 | mg/L | 0.1 mg/L | 91.2 | 80.0 | 120 | ---- |
| thallium, dissolved | 7440-28-0 | E421 | 0.00001 | mg/L | 1 mg/L | 99.6 | 80.0 | 120 | ---- |
| thorium, dissolved | 7440-29-1 | E421 | 0.0001 | mg/L | 0.1 mg/L | 100 | 80.0 | 120 | ---- |
| tin, dissolved | 7440-31-5 | E421 | 0.0001 | mg/L | 0.5 mg/L | 97.8 | 80.0 | 120 | ---- |
| titanium, dissolved | 7440-32-6 | E421 | 0.0003 | mg/L | 0.25 mg/L | 97.7 | 80.0 | 120 | ---- |
| tungsten, dissolved | 7440-33-7 | E421 | 0.0001 | mg/L | 0.1 mg/L | 98.6 | 80.0 | 120 | ---- |
| uranium, dissolved | 7440-61-1 | E421 | 0.00001 | mg/L | 0.005 mg/L | 102 | 80.0 | 120 | ---- |
| vanadium, dissolved | 7440-62-2 | E421 | 0.0005 | mg/L | 0.5 mg/L | 100 | 80.0 | 120 | ---- |
| zinc, dissolved | 7440-66-6 | E421 | 0.001 | mg/L | 0.5 mg/L | 97.3 | 80.0 | 120 | ---- |
| zirconium, dissolved | 7440-67-7 | E421 | 0.0002 | mg/L | 0.1 mg/L | 96.9 | 80.0 | 120 | ---- |
| mercury, dissolved | 7439-97-6 | E509 | 0.000005 | mg/L | 0.0001 mg/L | 96.6 | 80.0 | 120 | ---- |
| **Aggregate Organics (QCLot: 675761)** | | | | | | | | | |
| biochemical oxygen demand [BOD] | ---- | E550 | 2 | mg/L | 198 mg/L | 97.3 | 85.0 | 115 | ---- |

Sub-Matrix: **Water**

| | | | | | Laboratory Control Sample (LCS) Report | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Spike | Recovery (%) | Recovery Limits (%) | | |
| Analyte | CAS Number | Method | LOR | Unit | Concentration | LCS | Low | High | Qualifier |
| **Aggregate Organics (QCLot: 677785)** | | | | | | | | | |
| chemical oxygen demand [COD] | ---- | E559-L | 10 | mg/L | 100 mg/L | 109 | 85.0 | 115 | ---- |

## Matrix Spike (MS) Report

A Matrix Spike (MS) is a randomly selected intra-laboratory replicate sample that has been fortified (spiked) with test analytes at known concentration, and processed in an identical manner to test samples. Matrix Spikes provide information regarding analyte recovery and potential matrix effects. MS DQO exceedances due to sample matrix may sometimes be unavoidable; in such cases, test results for the associated sample (or similar samples) may be subject to bias. ND – Recovery not determined, background level >= 1x spike level.

Sub-Matrix: **Water**

| | | | | | Matrix Spike (MS) Report | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Spike | | Recovery (%) | Recovery Limits (%) | | |
| Laboratory sample ID | Client sample ID | Analyte | CAS Number | Method | Concentration | Target | MS | Low | High | Qualifier |
| **Anions and Nutrients (QCLot: 678586)** | | | | | | | | | | |
| VA22C3537-013 | Anonymous | sulfate (as SO4) | 14808-79-8 | E235.SO4 | 107 mg/L | 100 mg/L | 107 | 75.0 | 125 | ---- |
| **Anions and Nutrients (QCLot: 678588)** | | | | | | | | | | |
| VA22C3537-013 | Anonymous | nitrate (as N) | 14797-55-8 | E235.NO3-L | 2.72 mg/L | 2.5 mg/L | 109 | 75.0 | 125 | ---- |
| **Anions and Nutrients (QCLot: 678589)** | | | | | | | | | | |
| VA22C3537-013 | Anonymous | nitrite (as N) | 14797-65-0 | E235.NO2-L | 0.523 mg/L | 0.5 mg/L | 105 | 75.0 | 125 | ---- |
| **Anions and Nutrients (QCLot: 678590)** | | | | | | | | | | |
| VA22C3713-002 | MW22-03 | fluoride | 16984-48-8 | E235.F | 5.05 mg/L | 5 mg/L | 101 | 75.0 | 125 | ---- |
| **Anions and Nutrients (QCLot: 678591)** | | | | | | | | | | |
| VA22C3713-002 | MW22-03 | chloride | 16887-00-6 | E235.Cl | 517 mg/L | 500 mg/L | 103 | 75.0 | 125 | ---- |
| **Anions and Nutrients (QCLot: 678592)** | | | | | | | | | | |
| VA22C3713-002 | MW22-03 | bromide | 24959-67-9 | E235.Br-L | 2.43 mg/L | 2.5 mg/L | 97.4 | 75.0 | 125 | ---- |
| **Anions and Nutrients (QCLot: 679306)** | | | | | | | | | | |
| VA22C3713-001 | MW22-01 | nitrogen, total | 7727-37-9 | E366 | 1.92 mg/L | 2 mg/L | 96.1 | 70.0 | 130 | ---- |
| **Anions and Nutrients (QCLot: 679307)** | | | | | | | | | | |
| VA22C3713-001 | MW22-01 | ammonia, total (as N) | 7664-41-7 | E298 | 0.0911 mg/L | 0.1 mg/L | 91.1 | 75.0 | 125 | ---- |
| **Anions and Nutrients (QCLot: 679308)** | | | | | | | | | | |
| VA22C3438-001 | Anonymous | phosphorus, total | 7723-14-0 | E372-U | 0.0474 mg/L | 0.05 mg/L | 94.9 | 70.0 | 130 | ---- |
| **Dissolved Metals (QCLot: 678395)** | | | | | | | | | | |
| VA22C3496-002 | Anonymous | aluminum, dissolved | 7429-90-5 | E421 | 0.389 mg/L | 0.4 mg/L | 97.3 | 70.0 | 130 | ---- |
| | | antimony, dissolved | 7440-36-0 | E421 | 0.0374 mg/L | 0.04 mg/L | 93.6 | 70.0 | 130 | ---- |
| | | arsenic, dissolved | 7440-38-2 | E421 | 0.0411 mg/L | 0.04 mg/L | 103 | 70.0 | 130 | ---- |
| | | barium, dissolved | 7440-39-3 | E421 | 0.0359 mg/L | 0.04 mg/L | 89.7 | 70.0 | 130 | ---- |
| | | beryllium, dissolved | 7440-41-7 | E421 | 0.0766 mg/L | 0.08 mg/L | 95.7 | 70.0 | 130 | ---- |
| | | bismuth, dissolved | 7440-69-9 | E421 | 0.0174 mg/L | 0.02 mg/L | 87.0 | 70.0 | 130 | ---- |
| | | boron, dissolved | 7440-42-8 | E421 | 0.172 mg/L | 0.2 mg/L | 85.9 | 70.0 | 130 | ---- |
| | | cadmium, dissolved | 7440-43-9 | E421 | 0.00742 mg/L | 0.008 mg/L | 92.7 | 70.0 | 130 | ---- |
| | | calcium, dissolved | 7440-70-2 | E421 | ND mg/L | 8 mg/L | ND | 70.0 | 130 | ---- |
| | | cesium, dissolved | 7440-46-2 | E421 | 0.0195 mg/L | 0.02 mg/L | 97.5 | 70.0 | 130 | ---- |
| | | chromium, dissolved | 7440-47-3 | E421 | 0.0762 mg/L | 0.08 mg/L | 95.3 | 70.0 | 130 | ---- |
| | | cobalt, dissolved | 7440-48-4 | E421 | 0.0376 mg/L | 0.04 mg/L | 94.1 | 70.0 | 130 | ---- |

Sub-Matrix: **Water**

| | | | | | Matrix Spike (MS) Report | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Spike | | Recovery (%) | Recovery Limits (%) | | |
| Laboratory sample ID | Client sample ID | Analyte | CAS Number | Method | Concentration | Target | MS | Low | High | Qualifier |
| **Dissolved Metals (QCLot: 678395) - continued** | | | | | | | | | | |
| VA22C3496-002 | Anonymous | copper, dissolved | 7440-50-8 | E421 | 0.0355 mg/L | 0.04 mg/L | 88.8 | 70.0 | 130 | ---- |
| | | iron, dissolved | 7439-89-6 | E421 | 3.85 mg/L | 4 mg/L | 96.2 | 70.0 | 130 | ---- |
| | | lead, dissolved | 7439-92-1 | E421 | 0.0349 mg/L | 0.04 mg/L | 87.2 | 70.0 | 130 | ---- |
| | | lithium, dissolved | 7439-93-2 | E421 | 0.189 mg/L | 0.2 mg/L | 94.6 | 70.0 | 130 | ---- |
| | | magnesium, dissolved | 7439-95-4 | E421 | ND mg/L | 2 mg/L | ND | 70.0 | 130 | ---- |
| | | manganese, dissolved | 7439-96-5 | E421 | ND mg/L | 0.04 mg/L | ND | 70.0 | 130 | ---- |
| | | molybdenum, dissolved | 7439-98-7 | E421 | ND mg/L | 0.04 mg/L | ND | 70.0 | 130 | ---- |
| | | nickel, dissolved | 7440-02-0 | E421 | 0.0728 mg/L | 0.08 mg/L | 91.0 | 70.0 | 130 | ---- |
| | | phosphorus, dissolved | 7723-14-0 | E421 | 22.1 mg/L | 20 mg/L | 110 | 70.0 | 130 | ---- |
| | | potassium, dissolved | 7440-09-7 | E421 | ND mg/L | 8 mg/L | ND | 70.0 | 130 | ---- |
| | | rubidium, dissolved | 7440-17-7 | E421 | 0.0388 mg/L | 0.04 mg/L | 97.0 | 70.0 | 130 | ---- |
| | | selenium, dissolved | 7782-49-2 | E421 | 0.0881 mg/L | 0.08 mg/L | 110 | 70.0 | 130 | ---- |
| | | silicon, dissolved | 7440-21-3 | E421 | 18.9 mg/L | 20 mg/L | 94.6 | 70.0 | 130 | ---- |
| | | silver, dissolved | 7440-22-4 | E421 | 0.00720 mg/L | 0.008 mg/L | 90.0 | 70.0 | 130 | ---- |
| | | sodium, dissolved | 7440-23-5 | E421 | ND mg/L | 4 mg/L | ND | 70.0 | 130 | ---- |
| | | strontium, dissolved | 7440-24-6 | E421 | ND mg/L | 0.04 mg/L | ND | 70.0 | 130 | ---- |
| | | sulfur, dissolved | 7704-34-9 | E421 | ND mg/L | 40 mg/L | ND | 70.0 | 130 | ---- |
| | | tellurium, dissolved | 13494-80-9 | E421 | 0.0793 mg/L | 0.08 mg/L | 99.1 | 70.0 | 130 | ---- |
| | | thallium, dissolved | 7440-28-0 | E421 | 0.00711 mg/L | 0.008 mg/L | 88.9 | 70.0 | 130 | ---- |
| | | thorium, dissolved | 7440-29-1 | E421 | 0.0386 mg/L | 0.04 mg/L | 96.6 | 70.0 | 130 | ---- |
| | | tin, dissolved | 7440-31-5 | E421 | 0.0378 mg/L | 0.04 mg/L | 94.4 | 70.0 | 130 | ---- |
| | | titanium, dissolved | 7440-32-6 | E421 | 0.0810 mg/L | 0.08 mg/L | 101 | 70.0 | 130 | ---- |
| | | tungsten, dissolved | 7440-33-7 | E421 | 0.0370 mg/L | 0.04 mg/L | 92.6 | 70.0 | 130 | ---- |
| | | uranium, dissolved | 7440-61-1 | E421 | 0.00752 mg/L | 0.008 mg/L | 94.1 | 70.0 | 130 | ---- |
| | | vanadium, dissolved | 7440-62-2 | E421 | 0.202 mg/L | 0.2 mg/L | 101 | 70.0 | 130 | ---- |
| | | zinc, dissolved | 7440-66-6 | E421 | 0.712 mg/L | 0.8 mg/L | 89.0 | 70.0 | 130 | ---- |
| | | zirconium, dissolved | 7440-67-7 | E421 | 0.0800 mg/L | 0.08 mg/L | 99.9 | 70.0 | 130 | ---- |
| **Dissolved Metals (QCLot: 680325)** | | | | | | | | | | |
| VA22C3650-002 | Anonymous | mercury, dissolved | 7439-97-6 | E509 | 0.0000947 mg/L | 0.0001 mg/L | 94.7 | 70.0 | 130 | ---- |
| **Aggregate Organics (QCLot: 677785)** | | | | | | | | | | |
| VA22C2822-002 | Anonymous | chemical oxygen demand [COD] | ---- | E559-L | 95 mg/L | 100 mg/L | 94.9 | 75.0 | 125 | ---- |

# Chain of Custody (COC) / Analytical Request Form

ALS Environmental

www.alsglobal.com

Canada Toll Free: 1 800 668 9878

Affix ALS barcode label here (lab use only)

COC Number: 17 -

Page of

| Report To | Contact and company name below will appear on the final report |
|---|---|
| Company: | Regional District of Kitimat-Stikine |
| Contact: | Hannah Shinton |
| Phone: | 250-615-6100 |
| | Company address below will appear on the final report |
| Street: | 4545 Lazelle Avenue |
| City/Province: | Terrace/BC |
| Postal Code: | V8G4E1 |
| **Invoice To** | Same as Report To ☑ YES ☐ NO |
| | Copy of Invoice with Report ☑ YES ☐ NO |
| Company: | Regional District of Kitimat-Stikine |
| Contact: | Hannah Shinton |

**Report Format / Distribution**

Select Report Format: ☑ PDF ☑ EXCEL ☑ EDD (DIGITAL)

Quality Control (QC) Report with Report ☑ YES ☐ NO

☑ Compare Results to Criteria on Report - provide details below if box checked

Select Distribution: ☑ EMAIL ☐ MAIL ☐ FAX

Email 1 or Fax: hshinton@rdks.bc.ca; enviro.dept@rdks.bc.ca

Email 2:

Email 3:

**Invoice Distribution**

Select Invoice Distribution: ☑ EMAIL ☐ MAIL ☐ FAX

Email 1 or Fax: anne-maries@rdks.bc.ca

Email 2: hshinton@rdks.bc.ca; enviro.dept@rdks.bc.ca

**Project Information**

| | |
|---|---|
| ALS Account # / Quote #: | VA19-RDKS100-001 |
| Job #: | Kitwanga Landfill Groundwater |
| PO / AFE: | |
| LSD: | |

**Oil and Gas Required Fields (client use)**

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

ALS Lab Work Order # (lab use only):

ALS Contact:

Sampler: Hannah Shinton

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

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

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

EMERGENCY: 1 Business day [E1 - 100%] ☐ | Same Day, Weekend or Statutory holiday [E2 -200% (Laboratory opening fees may apply)] ☐

Date and Time Required for all E&P TATs:

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

**Analysis Request**

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

| ALS Sample # (lab use only) | Sample Identification and/or Coordinates (This description will appear on the report) | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | BOD (P) | Total Nitrogen (P) | Phosphorus (P) | Ammonia, Ammoniacal Nitorgen (P) | pH, anions | COD (P) | Dissolved Metals (F/P) | Electrical Conductivity | Nitrogen + Nitrite | Nitrogen, Nitrite | Total Nutrients | Hardness | Alkalinity Total (CaCO3) | Total Dissolved Solids | Sulfate | SAMPLES ON HOLD | Sample is hazardous (please provide further detail) | NUMBER OF CONTAINERS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | MW22-01 | 27-Sep-22 | 12:45 | Water | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | | | |
| | MW22-03 | 27-Sep-22 | 12:30 | Water | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | | | |
| | Field Blank | 27-Sep-22 | 13:30 | Water | [redacted] | | | R | | | R | | | | R | | R | | | | | |

Environmental Division Vancouver
Work Order Reference
VA22C3713

Telephone : +1 604 253 4188

Terrace Shipping
# 1 Coolers
# ___ Carbouys
Ground ☐
Air ☑
SFX ☐

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

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

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

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

British Columbia Approved and Working Water Quality Guidelines (MAY, 2015)

**SAMPLE CONDITION AS RECEIVED (lab use only)**

Frozen ☐ SIF Observations Yes ☐ No ☐

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

Cooling Initiated ☐

| INITIAL COOLER TEMPERATURES °C | FINAL COOLER TEMPERATURES °C |
|---|---|
| 5.3 | |

| SHIPMENT RELEASE (client use) | | | INITIAL SHIPMENT RECEPTION (lab use only) | | | FINAL SHIPMENT RECEPTION (lab use only) | | |
|---|---|---|---|---|---|---|---|---|
| Released by: Hannah Shinton | Date: Sept. 28 2022 | Time: | Received by: Chris | Date: 28 Sep 22 | Time: 1500 | Received by: UP | Date: 9/30/22 | Time: 11:05 |

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

SEPT 2015 FRONT

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

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