MORRISON HERSHFIELD now Stantec

FINAL REPORT

THORSEN CREEK LANDFILL
DESIGN, OPERATIONS AND CLOSURE PLAN

Presented to:

Central Coast Regional District

PO Box 186, 626 Cliff Street

Bella Coola, BC

Project No. 133800052
Date: November 15, 2024

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APPENDICES

1. INTRODUCTION

1.1 Background

Morrison Hershfield (MH) was retained by the Central Coast Regional District (CCRD) to complete a review of the Thorsen Creek Landfill. Based on site observations and identified operational issues, MH recommended that a Landfill Design, Operations and Closure Plan (DOCP) be developed for the Thorsen Creek Landfill.

1.2 Scope of Work

The Landfill Design, Operations and Closure Plan (DOCP) for the Thorsen Creek Landfill was developed to meet the requirements of the current Operational Certificate MR-4223 (dated April 12, 2006) and in general accordance with the BC Landfill Criteria for Municipal Solid Waste (Second Edition, dated June 2016).

The purpose of the DOCP is to specify how the landfill site will be developed and closed, including the operational requirements and environmental controls that will be in place to support site development.

1.3 Regulatory Setting

This site is currently licensed as a waste management facility under Operational Certificate 4223, and is authorized to accept landfilled waste, as outlined in the Operational Certificate. A copy of the current Operational Certificate (MR-4223, issued April 12, 2006) is included in Appendix C. A new OC is being developed by the Ministry of Environment and Climate Change Strategy (MoECCS, or MOE) and is currently in draft.

The MOE has issued several guidelines pertinent to solid waste management. The following regulatory documents are applicable, as they relate to facility construction, operation, closure and monitoring:

- Landfill Criteria for Municipal Solid Waste, Second Edition (June 2016)
- Operation Certificate MR-4223 (2006)

Other provincial regulations and guidelines that are applicable include the BC Contaminated Sites Regulation under the Environmental Management Act, as well as BC water quality guidelines.

2. SITE DESCRIPTION

2.1 Location and Historic Use

The Thorsen Creek Waste and Recycling Center (TCWRC) is owned and operated by the CCRD on crown land under License of Occupation No. 5401605. The landfill is located

approximately 6.5 km east of Bella Coola, off Chilcotin-Bella Coola highway, towards the end of Thorsen Road. The site, operated by the CCRD by a contractor, serves as the primary facility for solid waste management in the Bella Coola Valley. The cleared area for the landfill is located at latitude 52°21'31.0"N and longitude 126°41'44.1"W. Current operations are only on previously landfilled areas.

The landfill is operated as a natural attenuation site, such that waste is placed on previously disturbed ground without an engineered soil or geomembrane basal liner to capture leachate for treatment.

Commercial cardboard is burned at the TCWRC.

Daily cover material is sourced from a gravel pit located at the southwest end of the landfill property. The TCWRC has a transfer station dedicated for a public drop-off facility located across the road from the landfill to the northwest.

2.2 Access and Layout

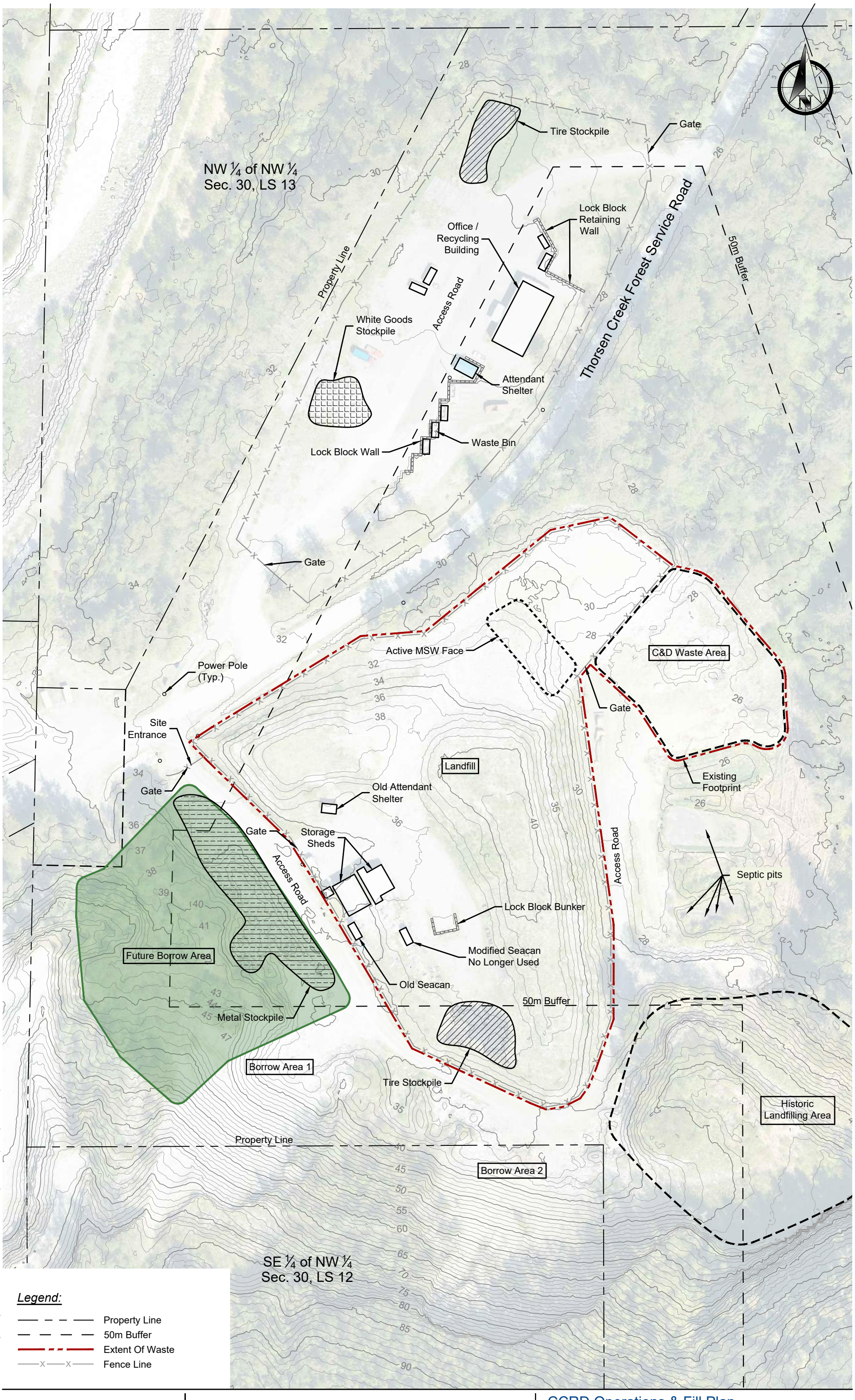
The Thorsen Creek Landfill is located at the end of Thorsen Creek Road, approximately 6 km east of Bella Coola. The current site layout and facility components are shown in Figure 1 (next page). There are two separate facilities at the TCWRC, a transfer station and a landfill. The transfer station and landfill are fenced separately (including electric fence) and gated, to prevent any wildlife from entering either of the sites.

The TCWRC offers a wide range of free recycling services, as well as a transfer station for household garbage, construction and demolition debris, yard waste, appliances and metals. Stockpiles of tires and white goods are found within the transfer station area.

The Thorsen Creek Landfill is located adjacent to the transfer station and can be accessed by commercial haulers. A tire stockpile is located south of the landfill. Two borrow pit areas are located to the south of the landfill where soil is excavated for daily and intermediate cover. Slightly to the west of the landfill is a metal stockpile. Septic pits are located to the east of the landfill. They are not under the TCWRC’s operational control.

2.3 Service Population

The landfill is operated by the CCRD on Crown land, and services a population of approximately 2,000 people in the Bella Coola Valley. Approximately half the population served are members of the Nuxalk Nation that live on reserve lands. The Nuxalk Nation has a financial agreement with the CCRD that enables them to participate as a partner in the CCRD’s solid waste service. It is estimated that the population of the Bella Coola Valley dispose of 900 tonnes of waste per year at the Thorsen Creek Landfill, which includes residential, commercial and construction/demolition sources (CCRD Solid Waste Management Plan, February 2017). There is currently no scale at the TCRWC.


NW ¼ of NW ¼
Sec. 30, LS 13
Tire Stockpile
Gate
Lock Block
Retaining
Wall
Office /
Recycling
Building
Property Line
Access Road
White Goods
Stockpile
Thorsen Creek Forest Service Road
50m Buffer
Attendant
Shelter
Waste Bin
Lock Block Wall
Gate
Power Pole
(Typ.)
Active MSW Face
C&D Waste Area
Gate
Site
Entrance
Gate
Landfill
Old Attendant
Shelter
Existing
Footprint
Gate
Storage
Sheds
Access Road
Access Road
Septic pits
Lock Block Bunker
Future Borrow Area
Modified Seacan
No Longer Used
Old Seacan
50m Buffer
Metal Stockpile
Borrow Area 1
Tire Stockpile
Historic
Landfilling Area
Property Line
Borrow Area 2
SE ¼ of NW ¼
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Legend:
Property Line
50m Buffer
Extent Of Waste
Fence Line
MORRISON HERSHFIELD
1:1250
0
12.5
37.5
62.5m
CCRD Operations & Fill Plan
Figure 1 - Site Layout
210629400
Oct 16, 2023
Plotted: by Warren Pare
x:\Proj\2021\210629400-ccrd landfill engineering services\09. cad\09 sketches\2023 DOCP\Figure 1 Site Layout.dwg

The most recent census data from 2021 indicates that the population of the CCRD has remained relatively constant since 2016 (approximately 1.6% growth annually). However, for the purposes of this DOCP report, it is assumed that there will be no growth in the service area.

2.4 Climate

The climate in Bella Coola is a moderate oceanic climate due to its proximity to the Pacific Ocean, falling exactly on the borderline with the warm-summer humid continental climate and close to the warm-summer Mediterranean climate and the warm-summer continental Mediterranean climate. Climate data for Bella Coola is available from the Bella Coola Airport. Average daily temperatures in Bella Coola range from 23.0 °C in July and -2.6 °C in January. The average precipitation of Bella Coola is approximately 1,199 mm per year (Environment Canada, 2016).

2.5 Topography and Drainage

The site is located on an alluvial fan associated with Thorsen Creek and was previously operated as a gravel pit. Precipitation typically infiltrates into the alluvial fan material, but runoff does occur from the landfill site and higher areas during high precipitation events. Old logging trails above the landfill collect some of the precipitation and convey it to the southwest corner of the site, where it flows down the excavated slope and onto the landfill. Any surface runoff eventually flows into the tributaries of Noohalk Creek, located to the north of the landfill and east of the access road. A number of springs discharge on the low ground to the north of the landfill, and these sustain baseflows in Noohalk Creek during the summer months.

2.6 Surficial and Bedrock Geology

The site is underlain by greenstone and shist bedrock (Baer, 1973). Bedrock is overlain by greater than 15 m of sand and gravel alluvial sediments. Bedrock likely rises to near surface at the east end of the site, where it is exposed in the valley wall. The sediments are typically a bedded sand and gravel with trace silt and many cobbly zones. Some interbeds of deltaic silty sand were noted in the adjacent gravel pit, but the sediments can be generally characterized as granular and free draining.

The raised alluvial and deltaic sediments on the valley walls above the landfill are interpreted to have been deposited by Thorsen Creek when sea level was higher than present. Alluvial sediments on the valley bottom have been deposited by the Bella Coola River and by the present day Thorsen Creek, which has cut down through the raised alluvial fan.

2.7 Geotechnical and Seismic Conditions

According to a Piteau Associates (December 1993), the existing landfill is located on a gently sloping alluvial fan and is underlain by competent granular sediments. The excavated slope above the landfill is estimated to be in the order of 20 to 30 m high. Some localized slumping is occurring on the slope due to borrowing of cover material at the toe.

Twenty-five kilometres to the east of the landfill is a fault line that is found relatively straight, from north to southeast (iMapBC).

2.8 Hydrogeology and Conceptual Site Model

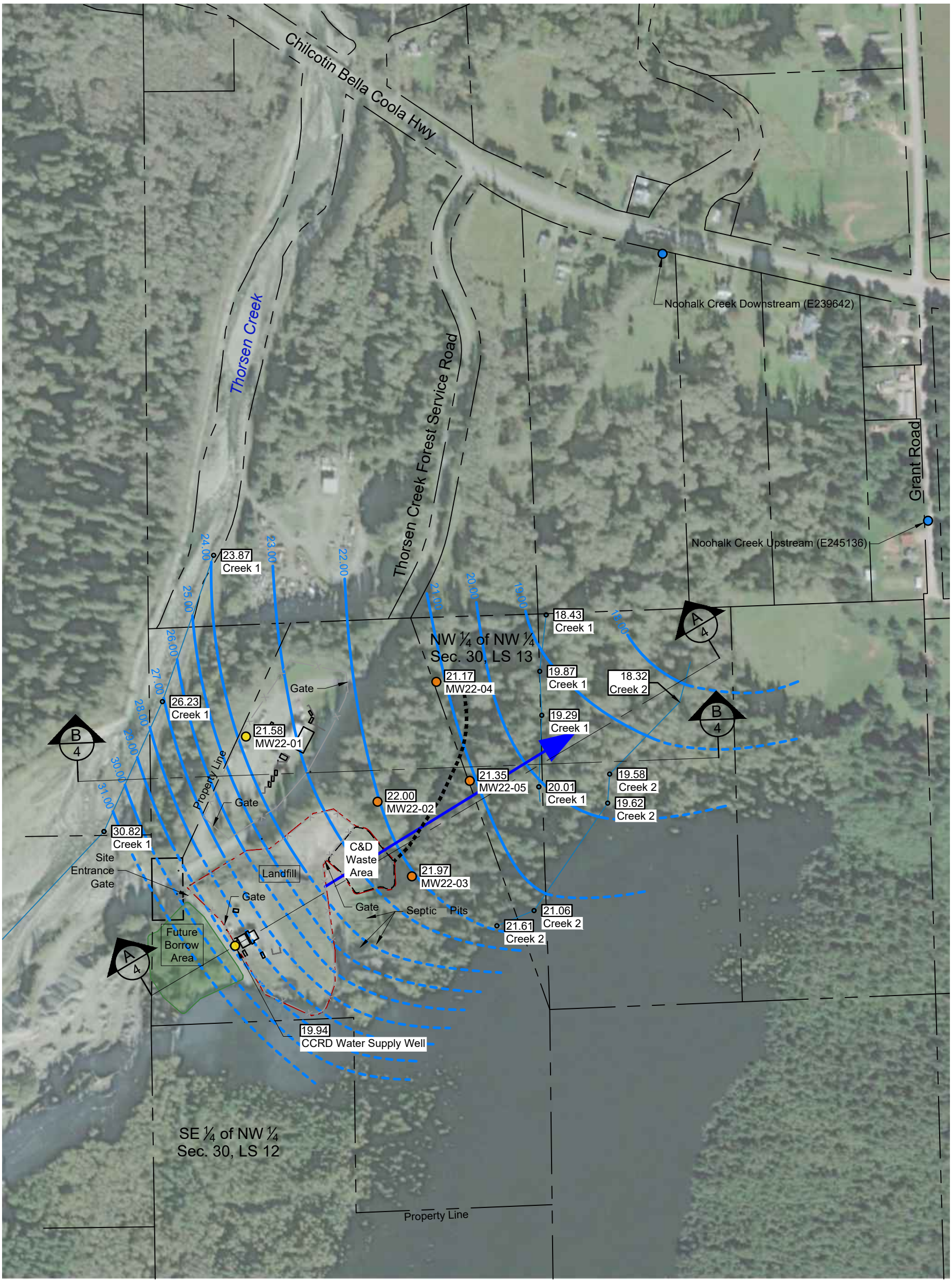
The hydrogeology of the site is a function of the character of the surficial sediments which underlie the landfill site, the sources of recharge and the location of groundwater discharge areas. The original hydrogeological assessment of the Thorsen Creek Landfill was completed by Piteau Associates in December 1993.

A drilling and site investigation program was conducted at the site in 2022 to install four monitoring wells and confirm the findings of the 1993 hydrogeological assessment. Observations collected during the drilling program completed in 2022 for monitoring well installation are described in detail in Appendix A.

A topographic survey was completed of the site in June of 2023, which included survey of the groundwater monitoring wells installed during the 2022 field program, existing onsite water wells, and surface water levels at a number of water bodies in the vicinity of the site (including Thorsen Creek and several springs northeast of the site).

2.8.1 Groundwater Setting

Existing wells in the area of the site, wells installed during the 2022 drilling program, and surveyed surface water elevations around the landfill are provided in Figure 2. Cross-sectional profiles showing the interpreted geology and water table elevations based on subsurface conditions observed during the drilling program are presented in Figure 3.



Legend:

- Property Line
- Extent Of Waste
- Fence Line
- Extent Of C&D Waste
- Future Borrow Area
- Surface Water Sampling Location
- 2022 Groundwater Monitoring Well Location
- Existing CCRD Groundwater Monitoring Well Location
- Interpreted Groundwater Flow Direction (June 2023)
- Surface Water Survey Location
- 21.61 Surveyed Water Level (June 2023, masl)
- Groundwater Elevation
- Interpreted Groundwater Elevation
- Approximate Access Road Location

MORRISON HERSHFIELD

1:4000 0 40 120 200m

CCRD Operations & Fill Plan
Figure 2 - Water Quality Monitoring Locations

210629400
Oct 16, 2023

x:\Proj\202\21\210629400-ccrd landfill engineering services\09. cad\09 sketches\2023 DOCP\Figure 2 Water Quality Monitoring.dwg Plotted: by Warren Pare

2.8.2 Geologic Structure

Surficial and bedrock geology is described in Section 2.6, and a depiction of geological conditions encountered during the 2022 drilling program are shown in the Figure 3 cross sections.

The site is underlain by greenstone and schist bedrock (Baer, 1973) at depth. Based on logs for wells drilled on the west side of Thorsen Creek, bedrock is overlain by greater than 15 m of sand and gravel alluvial sediments. Observations during the 2022 drilling program confirmed sand and gravel, with occasional boulders, to a depth greater than 8.5 m. Additionally, the water supply well drilled within the Thorsen Creek Landfill site in 2013 encountered sand and gravel to depths up to 18 m, and the water supply well drilled at the Thorsen Creek Waste and Recycling Center site in 2017 encountered sand to a depth of approximately 60 m, underlain by clay to a depth of 85 m. Bedrock must rise to near surface at the east end of the site, where it is exposed in the valley wall. The sediments are typically a bedded sand and gravel with trace silt and many cobbly zones. Some interbeds of deltaic silty sand were noted in the adjacent gravel pit, but the sediments can be generally characterized as granular and free draining.

The raised alluvial and deltaic sediments on the valley walls above the landfill are interpreted to have been deposited by Thorsen Creek when sea level was higher than present. Alluvial sediments on the valley bottom have been deposited by the Bella Coola River and by the present day Thorsen Creek, which has cut down through the raised alluvial fan.

The existing landfill is located on a gently sloping alluvial fan and is underlain by competent granular sediments. The excavated slope above the landfill is estimated to be in the order of 20 to 30 m high. Some localized slumping is occurring on the slope due to borrowing of cover material at the toe.

2.8.3 Hydraulic Conductivity

The soil underlying the landfill site is primarily comprised of medium-coarse sand and gravel. Specific hydraulic conductivity testing has not been conducted for the site, but hydraulic conductivity values typical for these material types range from 10^{-6} m/s to 10^{-2} m/s for clean sand, and 10^{-3} m/s to 1 m/s for gravels (Freeze and Cherry, 1979).

2.8.4 Groundwater Flow Direction

Based on groundwater elevations measured at the time of the 2023 survey, groundwater flow direction is inferred to be to the northeast, which is generally consistent with the assumed historical direction of flow. Thorsen Creek to the west appears to be perched and losing water (recharging the groundwater). Groundwater flows from the creek, northeastward under the site to discharge as a series of spring and wetlands northeast of the site.

2.8.5 Groundwater Flux

The hydrogeological assessment completed by Piteau Associates in 1993 included an estimate of creek and spring discharge, quantity of groundwater flow beneath the site, groundwater travel

time, and a high-level site water balance. At the time of this assessment (late summer), flow measurements were taken from the spring locations which rise downgradient of the landfill, and discharge from this area was estimated to be about 8 L/s.

The quantity of groundwater flow was calculated as shown below:

$$Flow = Q = K\ x\ i\ x\ A$$

Where: K = hydraulic conductivity

i = hydraulic gradient

A = cross-sectional area of flow

Based on observations from the 2022 field program, the hydraulic conductivity estimated by Piteau Associates is within the range expected for the subsurface material encountered at the site, which primarily consisted of medium-coarse sand. A hydraulic conductivity of 3 x 10^{-4} m/s as assumed by Piteau Associates is still considered reasonable. Hydraulic gradient at the site is estimated based on the difference between water table elevations at the furthest measured upgradient point (Thorsen Creek) and downgradient point (spring to the northeast of site). The 2022 measurements indicate that the hydraulic gradient is approximately 2% across the site. The drilling program completed in 2022 encountered saturated sediments with vertical thickness ranging from 1.5 m to 5 m; however, drilling did not encounter bedrock or aquitards in any of the 2022 test locations, and it is expected that saturated material extends deeper than the completion depths of drill holes. A 10 m saturated thickness of surficial sediments as assumed by Piteau Associates is therefore still used for this assessment. Further, the 250 m lateral distance between Thorsen Creek and the bedrock outcrop east of site is still considered applicable, as the landfill is still contained within these bounds. Based on this assessment of observed conditions in 2022, the original estimated groundwater flow beneath the site of 15 L/s from Piteau Associates is still considered to be a reasonable estimate. This is substantially higher than the estimated discharge from spring locations, but it is expected that a significant fraction of the groundwater flow continues on to the lower reaches of Noohalk Creek or the Bella Coola River, past the springs.

The material encountered during the 2022 drilling program was primarily medium-coarse sand, and the porosity (n) assumed for this material is 30%. Given the above parameters, the time taken for groundwater to flow the distance from the landfill to the springs (approximately 250 m) is calculated as shown below:

$$Time = (K\ x\ i)/n$$

Groundwater potentially affected by the landfill is therefore expected to travel at approximately 1.8 m/day and would take on the order of half a year to travel the 250 m distance to the springs.

2.8.6 Springs/Groundwater Discharge

The groundwater flow regime was historically interpreted to consist of a single flow system in the surficial sediments, which flows in a northerly direction towards Noohalk Creek. This flow

regime was interpreted from inspection of the surficial sediments at the site, water level data from test pits, interpreted sources of recharge, and observations of springs in the area. Infiltration of direct precipitation during the wet seasons would recharge the aquifer and augment this baseflow condition (Piteau Associates, 1993).

In 2022, groundwater was observed in the upper sand and gravel layer, with small creeks/springs observed downgradient of the landfill site in the inferred direction of groundwater flow toward Noohalk Creek, as shown in Figure 2 and Figure 3. This interpretation is consistent with the previous assessment.

2.8.7 Surface Hydrology

Surface water bodies located near the site include the following:

- Thorsen Creek (approximately 100 m northwest of the landfill).
- Noohalk Creek (approximately 400 m northeast of the landfill).
- Bella Coola River (approximately 1 km northwest of the landfill).
- Septic pits (approximately 25 m east of the landfill)

Precipitation typically infiltrates into the alluvial fan material, but runoff does occur from the landfill site and surrounding areas during high precipitation events. Old logging trails above the landfill collect some of the precipitation and convey it to the southwest corner of the site, where it flows down the excavated slope and onto the landfill. Surface runoff eventually flows into the tributaries of Noohalk Creek, located to the north of the landfill and east of the access road. A number of springs discharge on the low ground to the north of the landfill, between the landfill and Noohalk Creek, and these sustain baseflows in Noohalk Creek during the summer months. Noohalk Creek eventually flows back into Thorsen Creek, shortly before Thorsen Creek flows into the Bella Coola River.

The septic pits are located down- and cross-gradient from the landfill and slightly upgradient from the C&D waste area according to the inferred groundwater flow direction.

2.8.8 Water Quality and Background

A description of surface and groundwater quality at the site is provided in Section 3. Background/baseline surface water conditions are understood to be represented by the Noohalk Creek upstream sampling point, which is located along Noohalk Creek upstream of the area where the creek is affected by the landfill. Background/baseline groundwater conditions are understood to be represented by MW22-01. A full description of the monitoring program conducted in 2022 and subsequent survey completed in 2023 are available in Appendix A.

2.8.9 Land and Water Use

Homes located to the north and northeast of the landfill are serviced by a Water District and are not supplied from a local well or creek source. There are some water licenses for withdrawal from surrounding creeks as well as groundwater wells in the area surrounding the site; most of

these are located either upgradient of the landfill, or on the west side of Thorsen Creek in the opposite direction of groundwater flow from the landfill site. Thorsen Creek acts as a groundwater divide and effectively separates the landfill area from the properties west of the creek.

Groundwater wells located within an approximate 1 km radius of the site include the following (as per a search of the iMapBC and the Northwest Water Tool conducted in January 2023):

Table 1: Project area groundwater well locations

Groundwater Well No.	Water Use	Approximate Distance from Landfill Property (km)	Location with Respect to Inferred Groundwater Flow Direction
107900	Water Supply System (owned by CCRD)	**Within landfill property** (located at the MSW landfill toe)	Upgradient of landfill, within site
113191	Commercial & Industrial (owned by CCRD)	**<0.1** (located within the Thorsen Creek Waste and Recycling Centre site)	Cross-gradient west of site
36791	Private Domestic	**0.9**	Upgradient west of site (separated from landfill by Thorsen Creek)
37163	Private Domestic	**0.9**	Upgradient west of site (separated from landfill by Thorsen Creek)
37853	Unknown Well Use	**0.9**	Upgradient west of site (separated from landfill by Thorsen Creek)
37923	Unknown Well Use	**0.8**	Upgradient west of site (separated from landfill by Thorsen Creek)
37938	Unknown Well Use	**0.9**	Upgradient west of site (separated from landfill by Thorsen Creek)
37939	Unknown Well Use	**0.9**	Upgradient west of site (separated from landfill by Thorsen Creek)
37970	Unknown Well Use	**0.7**	Upgradient west of site (separated from landfill by Thorsen Creek)
40422	Unknown Well Use	**0.8**	Upgradient west of site (separated from landfill by Thorsen Creek)
46273	Private Domestic	**1.0**	Upgradient west of site (separated from landfill by Thorsen Creek)
60837	Private Domestic	**0.8**	Upgradient west of site (separated from landfill by Thorsen Creek)
60838	Private Domestic	**0.8**	Upgradient west of site (separated from landfill by Thorsen Creek)
60839	Private Domestic	**0.8**	Upgradient west of site (separated from landfill by Thorsen Creek)
75742	Water Supply System	**1.0**	Upgradient west of site (separated from landfill by Thorsen Creek)

85508	Water Supply System	**1.0**	Upgradient west of site (separated from landfill by Thorsen Creek)
88139	Water Supply System	**1.0**	Upgradient west of site (separated from landfill by Thorsen Creek)
33074	Private Domestic	**0.8**	Cross-gradient northwest of site (separated from landfill by Thorsen Creek)
98794	Private Domestic	**0.7**	Cross-gradient north of site (separated from landfill by Thorsen Creek)

Other water licences within an approximate 1 km radius of the site include the following (as per a search of the iMapBC and the Northwest Water Tool conducted in January 2023):

Table 2: Project area surface water licence locations

Water Licence No.	Water Use	Approximate Distance from Landfill Property (km)	Location with Respect to Inferred Groundwater Flow Direction
C058860	Domestic - primary licensee: Indian & Northern Affairs Canada	**1.2**	Upstream (located on Thorsen Creek)
C132209	Transportation Management (dust control) – primary licensee: Ministry of Transportation & Infrastructure	**0.6**	Cross-gradient north of site (located on Thorsen Creek)
C063238	Irrigation	**1.2**	Cross-gradient (located on a tributary to the Bella Coola River, upstream of convergence with Thorsen Creek)

3. GROUNDWATER AND SURFACE WATER IMPACT ASSESSMENT

This section details the groundwater and surface water monitoring program conducted at the site to date. A full description of the monitoring program conducted in 2022 and subsequent survey completed in 2023 are available in Appendix A.

3.1.1 Groundwater Quality

Groundwater monitoring at the site was initiated in the fall of 2022 with the installation of four new monitoring wells. Groundwater monitoring consists of collecting field parameters (including chemical parameters and static water level measurements), and sampling for laboratory analysis. The groundwater monitoring program includes five monitoring wells, with characteristics summarized in Table 3 and shown in Figure 2.

Table 3: Groundwater monitoring well properties

Well	Site Description	Screen Interval (mbgs)	Screen Elevation (masl)
MW22-01	Existing well, located cross-gradient from the landfill mass	19.8 – 22.9	11.4 – 8.4
MW22-02	Installed in 2022, located immediately down-gradient of the northern extent of the MSW landfill footprint	6.1 – 7.6	20.6 – 19.1
MW22-03	Installed in 2022, located immediately down-gradient of the C&D landfill footprint	3.8 – 5.3	21.2 – 19.7
MW22-04	Installed in 2022, located down-gradient of the landfill, at the approximate property boundary	4.0 – 5.5	19.9 – 18.4
MW22-05	Installed in 2022, located down-gradient of the landfill, at the approximate property boundary	4.3 – 5.8	19.1 – 17.6

Four of the above monitoring wells were installed and sampled in November 2022. MW22-01 is an existing water supply well that was installed in 2017, but sampling of this well also commenced in November 2022.

With respect to groundwater quality, the following observations can be made based on the initial monitoring conducted in November 2022:

- Indicators of leachate-influenced groundwater appear in locations down-gradient of the landfill, including chloride, hardness, and sulfate. Impacts appear to be most prevalent at MW22-05 (located near the site property line), and at MW22-02 (located adjacent to the current C&D waste cell), and less so at MW22-03 and MW22-04.
- Cobalt exceeded the BC CSR standard for Drinking Water use in the sample collected from MW22-05.

- Ammonia concentrations were also high in MW22-02 and MW22-05 compared to other groundwater monitoring wells, which is possibly due to the influence of the septic pits located at the east side of the site.
- Sulfate in groundwater at landfill sites can be indicative of drywall in the waste stream. Although sulfate is not in exceedance of the BC CSR standards at any of the groundwater wells sampled, it is elevated at MW22-05 compared to other locations on site, indicating influence of leachate at this location.
- No detectable hydrocarbons were identified in any groundwater samples.
- There may be seasonal variability in flow direction in order for impacts to be detected in both MW22-02 and MW22-05, but not MW22-03, as observed.
- Groundwater from well MW22-01 shows the least impact from waste management activities. This is because it is upgradient of the landfill site.
- In general, groundwater sampling results at the site indicate some influence of landfill leachate on groundwater, which is expected.

Recommendations related to groundwater monitoring at the site are provided in Section 9.2. A full description of the well installation, water quality sampling results, and program conclusions and recommendations are included in Appendix A.

3.1.2 Surface Water Quality

Two surface water monitoring locations are identified in the Operational Certificate for the site, both located on Noohalk Creek. Monitoring at these two locations in 2022 included collecting field parameters and sampling for laboratory analysis. Location details for the two sites are as follows, based on the assumed direction of groundwater flow derived from historical site observations:

- Noohalk Creek Upstream (E245136): Located upstream of surface/groundwater flow path leaving the landfill site.
- Noohalk Creek Downstream (E239642): Located downstream of surface/groundwater flow path leaving the landfill site. Sample was collected from Noohalk Creek just upstream of the convergence with another tributary, upstream of a bridge along Highway 20.

Although groundwater in the site area reports to the tributaries of Noohalk Creek, located to the north of the landfill and east of the access road, a number of springs discharge on the low ground to the north of the landfill, between the landfill and Noohalk Creek, and these sustain baseflows in Noohalk Creek during the summer months. During the topographical survey of groundwater monitoring locations on site, a survey was also completed of the surface water elevations at a number of spring sites downstream of the landfill.

With respect to surface water quality, the following observations can be made based on the monitoring conducted in 2022:

- In surface water from Noohalk Creek, aluminum (upstream and downstream) and iron (downstream) marginally exceeded the BC AWQG in 2022.

- Chloride, conductivity, hardness and sulphate at the downstream Noohalk Creek sampling location were slightly elevated (in the order of 10-30% higher) compared to the upstream location.
- No detectable hydrocarbons were identified in any surface water samples.
- No other guideline exceedances were identified in surface water samples collected in 2022.
- Surface water spring sites observed between the northeast end of the landfill and Noohalk Creek were surveyed and incorporated into groundwater flow mapping for the site. The elevation of these springs supports the interpreted direction of groundwater flow to the northeast. Based on the groundwater flow direction, samples from the groundwater springs may be more representative and provide a better option for sampling.
- Surface water quality results from Noohalk Creek in 2022 were relatively consistent with the data obtained from 2013 sampling.
- The current surface water sampling locations at Noohalk Creek are a greater distance away from the landfill (approximately 400 m) compared to these groundwater springs (approximately 100-200 m range). The Noohalk Creek sampling points are separated from the landfill site by several residences and other factors which have the potential to influence surface water quality in Noohalk Creek; it is therefore difficult to isolate the impacts of the landfill on this creek from other sources of interference.

Recommendations related to surface water monitoring at the site are provided in Section 9.2. A description of the surface water locations, water quality sampling results, and recommendations related to surface water monitoring are included in Appendix A.

4. WASTE DISPOSAL AND DIVERSION

The CCRD operates the Thorsen Creek Recycle Depot, Thorsen Creek Transfer Station and Thorsen Creek Landfill within the TCWRC. A privately run recycling depot is located within Bella Coola – the Bella Coola Recycling Depot (BCRD) which accepts recycling. Materials accepted at the BCRD site are brought to TCWRC.

The TCWRC facility includes the following:

- A transfer area, where small vehicles can access the site
- A scrap metal storage area
- A tire storage area
- Drop-off areas within the Thorsen Creek Recycle Depot for a wide variety of Extended Producer Responsibility (EPR) materials, regulated under the Recycling Regulation, including residential packaging and printed paper
- A Free Store for reusable items

- An active landfill area (Thorsen Creek Landfill) for disposal of Municipal Solid Waste (MSW), which is surrounded by electric fencing to detract bears from the site
- An area for clean wood for burning/incineration
- An area for commercial cardboard for burning/incineration
- A fill area for inert waste

4.1 Waste Disposal

Materials accepted at the Thorsen Creek Landfill for disposal include municipal solid waste (MSW) and construction and demolition (C&D) waste.

There are no formal waste characterization studies that have been completed since the 2017 Solid Waste Management Plan (SWMP) was approved. The 2017 SWMP estimated waste disposal amounts based on typical waste compositions of similar communities.

Residual waste (garbage, also referred to as refuse) generated by residents and businesses located around the Bella Coola Valley is disposed at the Thorsen Creek Landfill. This disposal facility does not have a weigh scale and tipping fees are charged by volume. The waste disposal data is currently based on estimated disposal volumes at the Thorsen Creek Landfill.

Since there is no weigh scale at the TCWRC, staff use the available size of the garbage trucks and C&D waste bins to calculate the approximate volumes entering into the site.

In the 2017 SWMP, disposal was estimated based on data from comparable communities with scales (communities of Valemount, Port McNeill and Port Alice). As outlined in the 2017 SWMP, it is estimated that approximately 900 tonnes of waste are disposed of at the Thorsen Creek landfill, based on a 450 kg per capita annual disposal rate and a population of the Bella Coola Valley of 2,000 people. This 900 tonnes per year disposal rate is the basis of the lifespan and airspace estimates provided in Section 5.

4.2 Waste Diversion

The five-year effectiveness review completed by MH in July 2023 focused on the estimated disposal rates and the quantifiable progress in the per capita recovery of recyclables through Recycle BC.

EPR materials collected at the Thorsen Creek Recycle Depot are collected and managed by Stewardship Agencies. Major appliances are not managed by the Steward (MARR) and these are instead managed as part of scrap metal recycling. The following materials are accepted at the Recycling Depot:

- Residential cardboard
- Propane tanks
- Used clothing
- White goods

- Household Hazardous Waste
- Batteries, smoke alarms and thermostat recycling
- Residential packaging and paper product (PPP)

A full and detailed list of accepted items for recycling can be found on the CCRD's website under recycling information. As reported by Recycle BC, the tonnage of packaging and paper materials collected by the CCRD in 2021 and 2022 are 87 and 83 tonnes, respectively.

5. LANDFILL DESIGN AND PHASING

5.1 Lifespan Analysis, Airspace Analysis and Cell Design

To evaluate the landfill capacity and remaining landfill life, the utilization of available airspace is assessed. This assessment also identifies the estimated current waste compaction and soil usage.

Ideally the annual airspace consumption is determined by calculating the volume used between two topographic landfill surveys. This can be done by using AutoCAD or similar software. The annual airspace consumption and remaining life is then calculated by calculating the volume consumed compared to the tonnes of waste landfilled during the same period. There are currently two available surveys to compare the change between the two dates. The first survey was completed for the Thorsen Creek Landfill on September 9, 2020. The second survey was completed on June 27, 2023. By comparing the two surveys, a difference in volumes will provide the average annual amount of airspace consumed.

There is approximately 33.5 months between the two surveys taken. The volume between the two surveys was calculated to be 9,979 m^3. Therefore, the annual airspace consumption is calculated to be 3,575 m^3.

MH has conservatively assumed the annual airspace consumption will remain constant over the 50-year projection period (2020 to 2069) as the waste disposal rate is dependant on population which is assumed to not increase and diversion rates are assumed to not improve (remain constant).

Table 4shows the annual volumetric consumption by waste and soil, the estimated settlement and total annual airspace consumption for the Thorsen Creek Landfill.

Table 4: Annual Volumetric Consumption at the Thorsen Creek Landfill

Annual Volumetric Consumption (m^3)	
Waste	1,800 m^3
Soil	1,811 m^3
Settlement	-36 m^3
Total	3,575 m^3

The compaction rate achieved at larger landfills using modern landfill compaction equipment is generally over 800 kg/m^3. However, a compaction rate of 500 kg/m^3 is considered realistic and on the conservative side when using the current equipment present at the Thorsen Creek Landfill for compaction of mixed MSW and C&D waste.

Soil is readily available near the site, just south of the operating landfill at a borrow pit. The borrow pit has abundant soil for use as intermediate and final cover of the landfill, therefore soil import is assumed unnecessary. Further discussion on materials management is provided in Section 5.5. Daily cover is currently applied at the end of each operating day (twice per week) and MH recommends using the soil sparingly or invest in an alternative daily cover to improve airspace utilization and increase the landfill lifespan. An ideal waste to cover ratio is 3:1 (by volume). However, based on the waste disposal assumptions and airspace consumption as shown in Table 4, the waste to cover ratio is estimated at approximately 1:1 by volume.

This cover soil volume was checked using the estimated cover soil use from the landfill operations contractor. Assuming one 20yd^3 (15.3 m^3) truck of cover soil is used per operational day (twice per week), this equates to approximately 1,600 m^3 of cover soil used per year.

MH recommends the Thorsen Creek Landfill be surveyed a minimum of every 3 years to track the progression of landfilling. The survey would also facilitate the assessment of the landfill operations performance through compaction, use of operational soil and use of airspace. The detailed filling plan should be updated every 5 years, based on the survey results and the filling activities in the 5 years prior.

The final contours of the landfill design presented in Figure 4 was developed based on the annual airspace consumption for filling and extending the eastern slope by 15 m into an existing disturbed area. The expansion is to areas that have historically been used as the C&D waste area in the northeast portion of the site and is intended to optimize the final landfill geometry and address over steepened slopes.

The landfill will be developed in phases, focusing on the north portion first, and moving clockwise to fill the landfill to equal heights. Table 5 below indicates the approximate available volumes of each phase and each of its estimated lifespan with an assumed annual volumetric consumption of 3,575 m^3. There is an estimated 20 years of landfill lifespan remaining.

Table 5: Phase Volume and Landfill Lifespan (Scenario 1 – Status Quo Waste to Cover Ratio)

Phase	Fill Volume Available (m^3)	Lifespan (years)
Phase 1	18,000 m^3	5.0 years
Phase 2a	22,000 m^3	6.2 years
Phase 2b	5,500 m^3	1.5 years
Phase 3	27,000 m^3	7.6 years

The above table shows the estimated lifespan if a 1:1 waste to cover ratio continues. In order to use the space efficiently and extend the landfill lifespan, it is recommended that the operations are improved with a target of 3:1 waste to cover ratio (by volume).

Table 6 below shows the updated airspace consumption if the waste to cover ratio is improved to 3:1 (by volume).

Table 6: Annual Volumetric Consumption at the Thorsen Creek Landfill, with Improved Waste to Cover Ratio

Annual Volumetric Consumption (m^3)	
Waste	1,800 m^3
Soil	600 m^3
Settlement	-36 m^3
Total	2,364 m^3

With the 3:1 waste to cover ratio, a calculation for the lifespan is shown in Table 7 below. Table 7 below shows the approximate available volumes of each phase and each of its estimated lifespan with an assumed annual volumetric consumption of the ideal rate at 2,364 m^3. There is an estimated 30 years of landfill lifespan remaining.

Table 7: Phase Volume and Landfill Lifespan (Scenario 2 – Improved Waste to Cover Ratio)

Phase	Fill Volume Available (m^3)	Lifespan (years)
Phase 1	18,000 m^3	7.6 years
Phase 2a	22,000 m^3	9.3 years

Phase 2b	5,500 m^3	2.3 years
Phase 3	27,000 m^3	11.4 years

The final landfill design is based on the following general design criteria with consideration to the BC Landfill Criteria for Municipal Solid Waste, Second Edition (MOE, June 2016):

- The final landfill design has been developed to optimize capacity of the facility, to be developed in three major Phases.
- The landfill side slopes are designed to optimize available airspace while maintaining slope stability. The final side slopes are no steeper than 3V:1H.
- The plateau of the final landfill is graded to promote runoff at a minimum grade of 10%.
- The landfill crest access road is to be constructed at a maximum of 10% grade to facilitate access by landfilling equipment and waste haulers.
- The landfill footprint is designed to optimize the area available within the existing disturbed area within the property, while allowing sufficient space for an access road along the landfill toe. The locations of future groundwater monitoring wells at the toe of the landfill are also considered in this plan. The final footprint of the landfill will encompass the entire area of historic landfilling activities (historic MSW and C&D filling areas). The two existing borrow pits located SW of the landfill will remain as the primary borrow sources over the life of the landfill. It is assumed that this area has not been used for landfilling historically.
- The proposed filling is generally vertically on existing landfilled waste. Filling remains within the property limits and future waste placement is generally within the 50 m buffer zone from the landfill property boundary. The existing perimeter access road around the toe of the landfill will remain in place to maintain a cleared buffer zone between the landfill and property line.
- The landfill will remain a natural attenuation site.
- The landfill is designed to cover all historically landfilled areas (shown in Figure 4) to ensure all these areas are closed and capped once final grade is reached.

The final contours of the landfill design of the Thorsen Creek landfill are presented in Figure 4. The design was developed based on the general design criteria listed above, the airspace analysis, and landfill capacity / remaining life presented in Section 5.3 below. The preliminary design is intended to provide a basic design concept and guidance for filling operations. The design does not include a detailed design of the phasing, surface water works or other landfill features.

Limit Of Waste

Sedimentation Pond (If Required)

Site Entrance

Landfill Access Road 10% Max.

Refer To Figure 5 For Cell Development

Proposed Future Expansion Area (If Required)

Borrow Area 1

Borrow Area 2

Perimeter Access Road

3:1

10:1

Legend:

- Property Line
- 50m Buffer
- Extent Of Waste
- Existing Fence
- New Fence
- Edge Of Access Road
- Crest Ditch
- Toe Ditch
- Down Chute

MORRISON HERSHFIELD

1:1000 0 10 30 50m

CCRD Operations & Fill Plan
Figure 4 - Final Landfill Design

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Oct 16, 2023

Plotted: by Warren Pare

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5.2 Proposed Future Expansion Area

The phasing plan and final design for the landfill shown in Figure 4 has been developed to maximize the available airspace for areas where historical landfilling is known.

The area outlined in a dashed line on Figure 4, entitled “Proposed Future Expansion Area” includes the area where the existing septic pits are located. Should the landfill need to be operated beyond the estimated 30 years, then consideration should be given to expanding the landfill footprint to this area. Preferably this decision would be made prior to filling Phase 2b (in approximately 18 years) so landfilling can be expanded to this area during that phase.

This expansion would provide approximately 70,000 m^3 in additional space for future landfilling. The 70,000 m^3 will give the landfill lifespan approximately 30 additional years at 2,364 m^3 annual volumetric consumption for Scenario 2, the 3:1 waste to cover ratio.

However, for the purpose of the current DOCP, the expansion area is not included as part of the planning phase for the landfill. Further detailed review will be required for a complete analysis of the expansion area, so long as this is decided prior to filling Phase 2b.

5.3 Phased Fill Plan

The final contour landfill design is presented in Figure 4. It was developed based on the annual airspace consumption and the general design criteria presented in Section 5.1. The landfill is designed with a remaining capacity of approximately 72,500 m^3 (based on September 2020 landfill surface). The highest proposed point of the landfill is a north-to-south ridge at a maximum elevation of 43 masl (top of waste).

Filling is proposed in three phases. Table 5 (scenario 1) and Table 7 (scenario 2) shows the available capacity of each landfill phase as well as estimated remaining life of each phase.

The proposed landfill phasing is shown in Figure 5. The landfill is divided into three major phases (phases 1, 2a-2b, and 3), with approximately 9, 11 and 11 years of capacity respectively (based on Scenario 2). Filling is generally proposed at the north end of the landfill (Phases 1 and 2a), moving south (Phase 2b), and finally filling the area of the old public drop-off area to bring the landfill to the final proposed elevation (Phase 3). Generally, the top of each phase will be developed to match the final surface of the landfill (side slopes and plateau). Cross sections of the final topography and phased filling are shown in Figure 6.

Filling will continue at the current MSW active face at the toe of the existing fill area and progress northwards in 1.5 m lifts until the design elevation in Phase 1 has been reached. The interior slopes of Phase 1 will be developed at a 3H:1V (33%) slopes. Thereafter, the landfill phasing is designed for progressive filling into the existing C&D area (Phase 2a), piggybacking onto the east interior slopes established in the Phase 1 filling area to reach the final design elevation of 41 masl. Access to Phase 1 will be via the existing temporary and perimeter access roads, or from the new access road located at the north end of the landfill entering the site adjacent to the current C&D landfill area and septic pits. Once filling transitions to Phase 2a, access will be primarily provided by the existing perimeter access road. A new section of

perimeter access road is proposed around the toe of Phase 2a slopes, which will be an extension of the existing access road. It is understood that there is currently an eagle nest located at the toe of the NE slope of Phase 1 that cannot be disturbed. For this reason, the new perimeter access road is shown to end at this location. In the second half of filling Phase 1, the existing electric fence will need to be relocated.

Phase 2b is a southern extension of Phase 2a and will involve filling on the existing over-steepened east slopes of the landfill. The final slopes of Phase 2a are designed at a 3H:1V slope which will provide an additional 2 years of airspace in this area while addressing the over steepened slopes. The top elevation of Phase 2b will match the existing landfill peak of approximately 40 masl. The existing perimeter access road currently located along the toe of the east slopes will need to be shifted approximately 15 m east to accommodate the new toe of the Phase 2b fill area. Access to Phase 2b will be via the existing perimeter access road.

The Phase 3 fill area is generally within the area of the old public drop-off area and will be developed to match the final plateau of the landfill at a maximum proposed elevation of 43 m (top of waste). Prior to filling in Phase 3, the existing tire stockpile and equipment/material storage structures will need to be removed or relocated. Based on assumed fill rate (at a 3:1 waste to cover ratio), it is estimated that removal/relocation of these materials and structures will be required in about 19 years. Filling in Phase 3 may begin along the southern toe of the existing landfill slopes (north of the existing tire stockpile) and progress in a NW direction. Alternatively, filling can begin at the south end of Phase 1 in the current depression between the two existing peaks. Phase 3 forms the majority of the proposed landfill plateau beginning at an elevation of 40 masl and graded at a 10H:1V slope to a maximum elevation of 43 masl. Phase 3 will initially be accessed using the existing temporary access road. As the area is filled and brought to design grades, a permanent access road will be required to facilitate filling in this area and to provide access to the crest of the landfill. A permanent access road is proposed along the SW slopes of Phase 3. This road would split off the existing landfill entrance access road and would be constructed at a maximum slope of 10% to gain access to the crest of the landfill.

Limit Of Phase 1
Filling

Phase 1
Fill Volume: ~18,000m³

Limit Of Phase 2a
Filling

Phase 2a
Fill Volume: ~22,000m³

Limit Of Phase 2b
Filling

Phase 2b
Fill Volume: ~5,500m³

Landfill Access
Road (Max. 10%)

Limit Of Phase 3
Filling

Phase 3
Fill Volume: ~27,000m³

1:2000 0 20 60 100m

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Legend:

New Access Road
Existing Access Road
Existing Fence
New Fence

CCRD Operations & Fill Plan
Figure 5 - Landfill Phasing

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Oct 16, 2023

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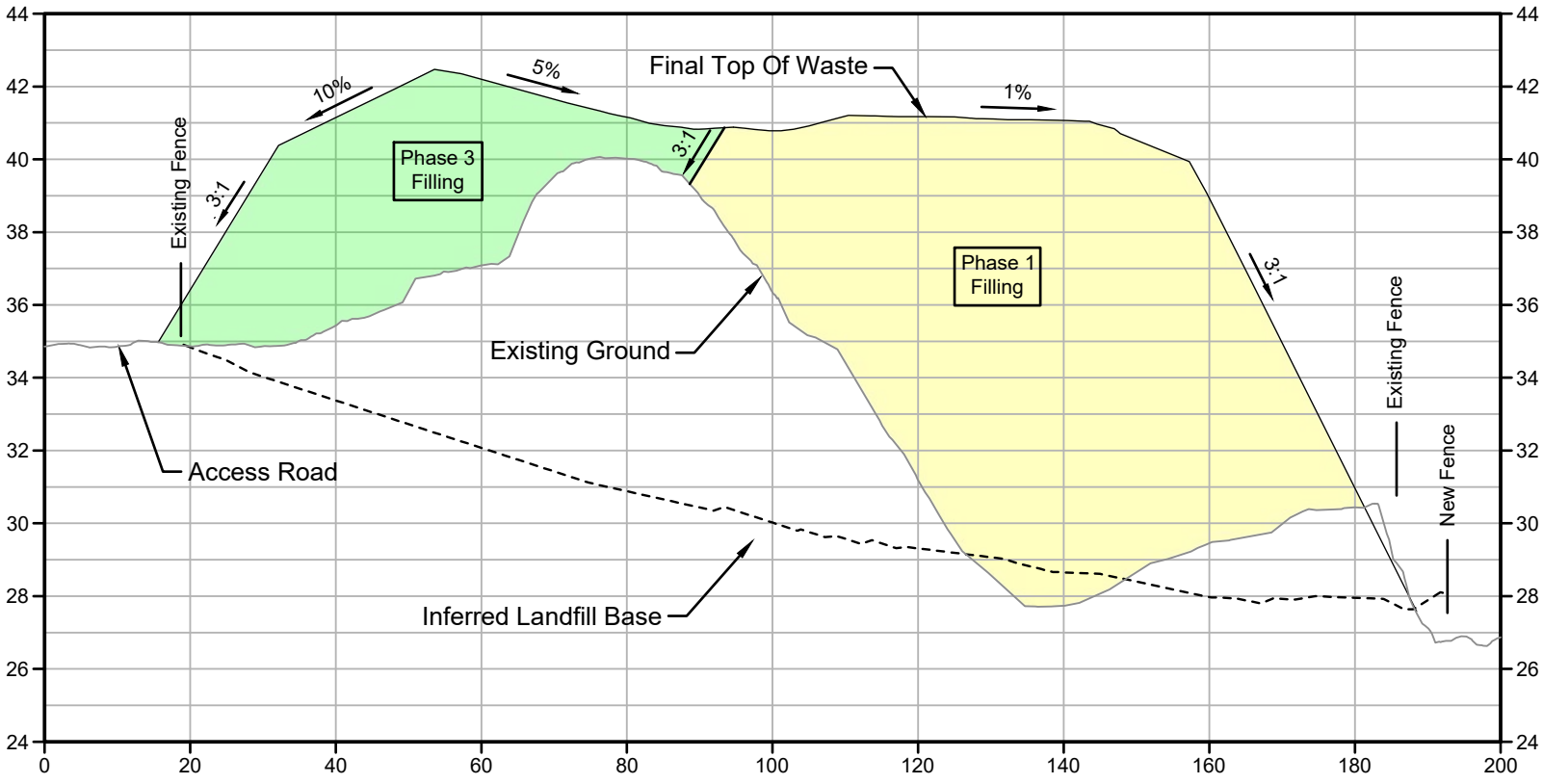
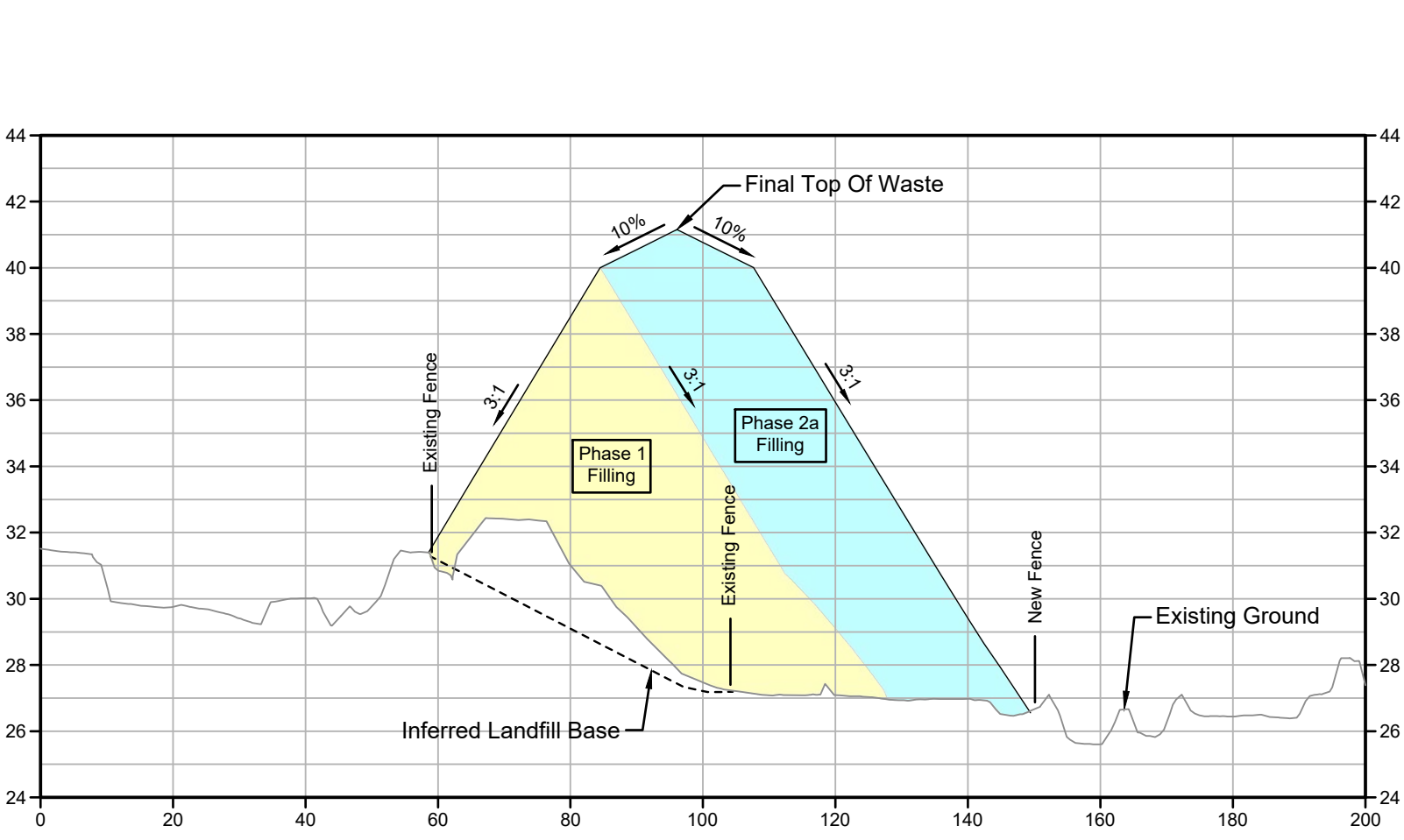


Section 'A'



Section 'B'

Section 'C'

MORRISON HERSHFIELD

1:1000 H 0 10 30 50m

1:200 V 0 2 6 10m

CCRD Operations & Fill Plan
Figure 6 - Cross Sections

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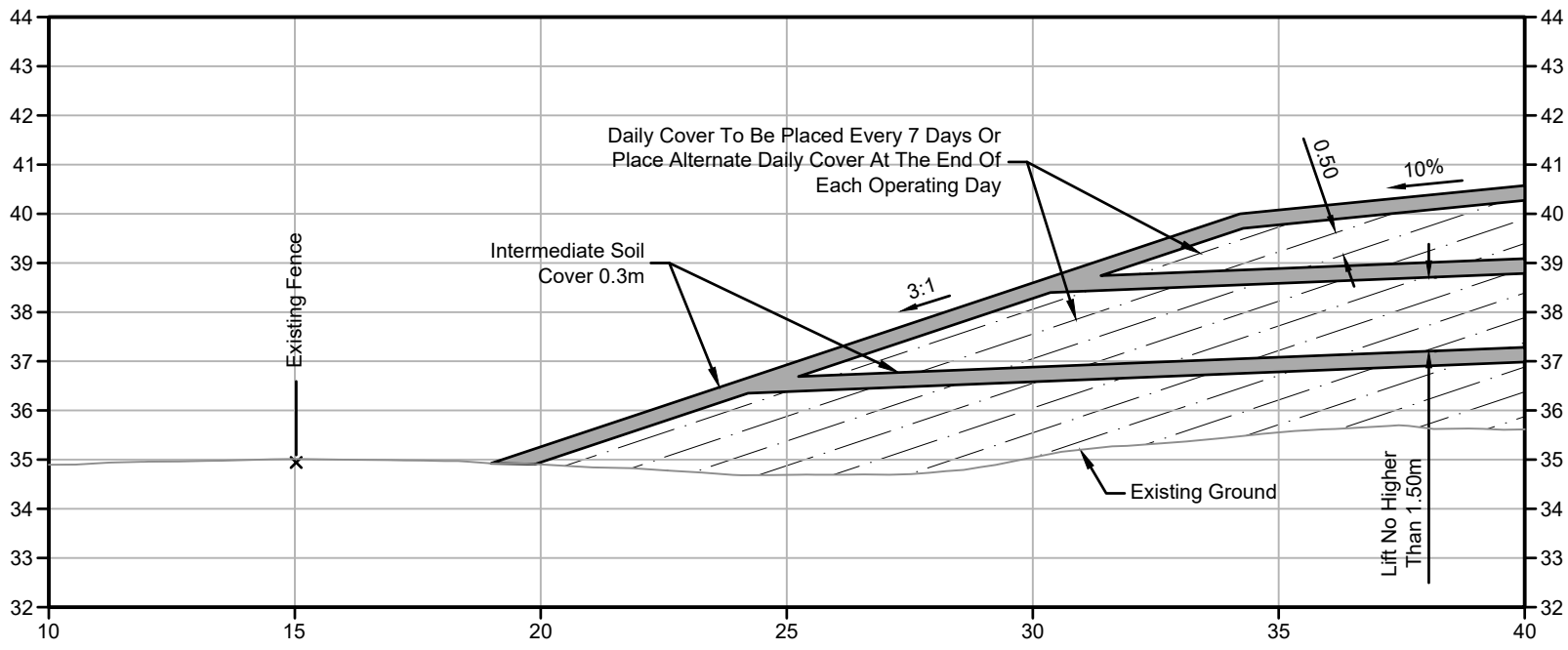
5.4 Detailed Fill Plan

For the purposes of this DOCP, the proposed detailed filling plan for the next 5 years was developed using the annual airspace consumption of 2,364 m^3 (3:1 waste to cover ratio). The proposed cell development is shown in Figure 7 and the detailed fill plan is shown in Figure 8.

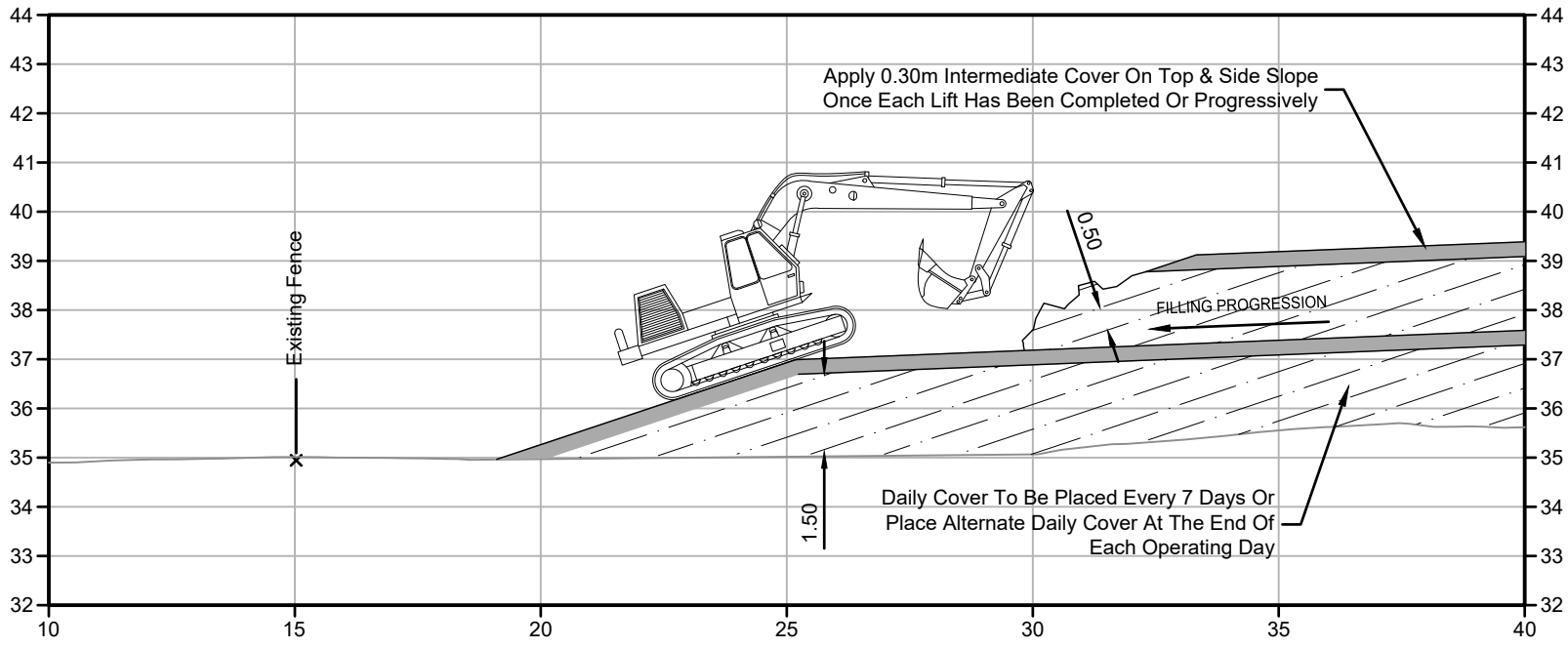
The first year is shown to be developed by piggybacking against the slope and previously filled areas up to elevation 30 masl. Access to this lift can be from the top (push-down) or bottom (push-up). In general, push-down landfilling is more efficient than push-up, but not always possible as filling progresses. It is understood that the current operations contractor did not want to utilize the lower northern access road during poor weather. If that continues to be the case, it is recommended that some effort be applied to improve this access road for efficiency of landfilling the lower portion of Phase 1.

The second year of landfilling will complete the lower lift of Phase 1 of the landfill up to 30 masl. And the second lift will start by piggybacking against the landfill slope and filling to the northeast up to 31.5 masl. Once lift 1 is complete there will be a flat working area at about 30 masl for filling to continue in 1.5 metre lifts. Years 3, 4 and 5 will continue in this method up to elevation 33 masl.

The lower access road could be maintained to allow for a secondary access if required. Temporary access roads can be graded at 10% to 12% and then when no longer required, filled in during the next landfill Phase. The dashed line in Figure 8 shows the potential temporary access road alignment if required.



Detail 1



Detail 2

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1:150 0 1.5 4.5 7.5m

CCRD Operations & Fill Plan
Figure 7 - Cell Development

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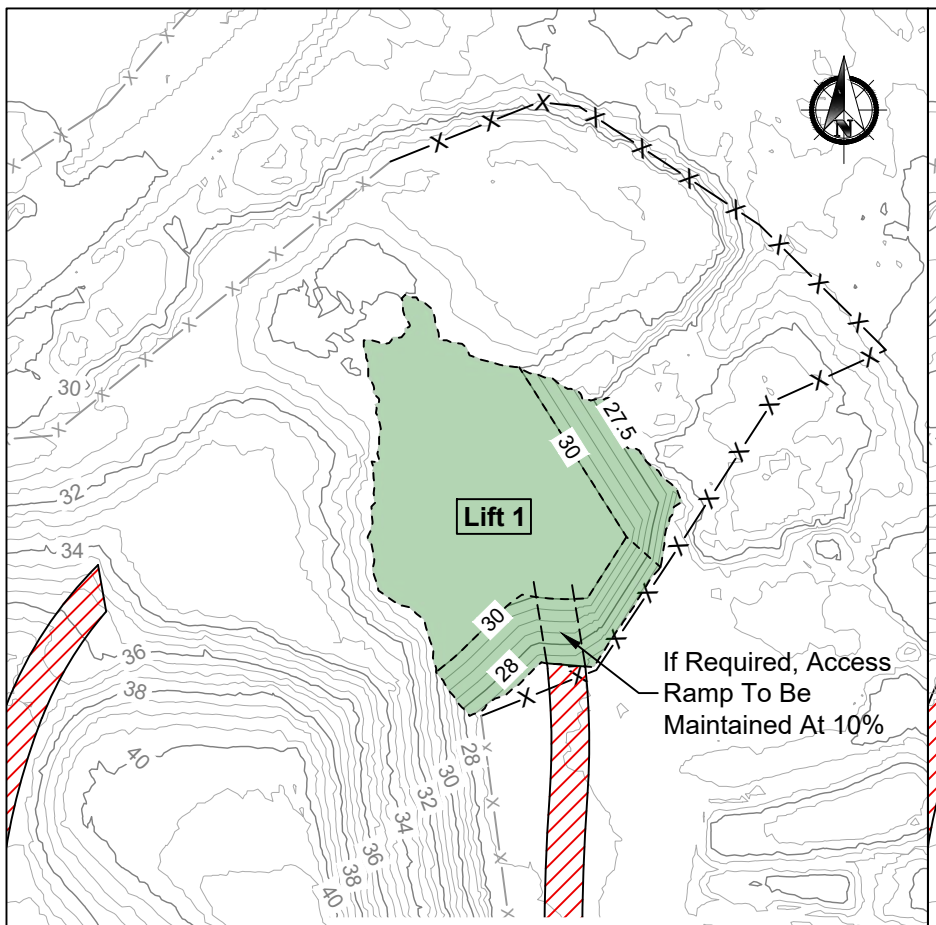
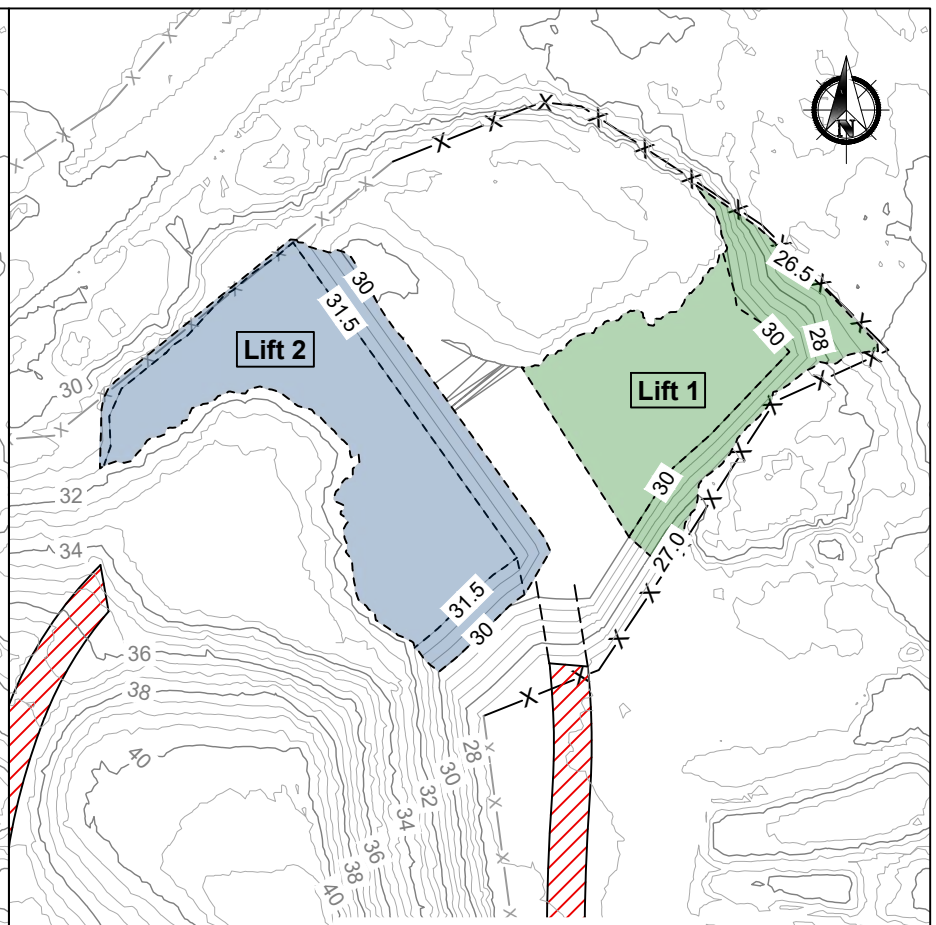


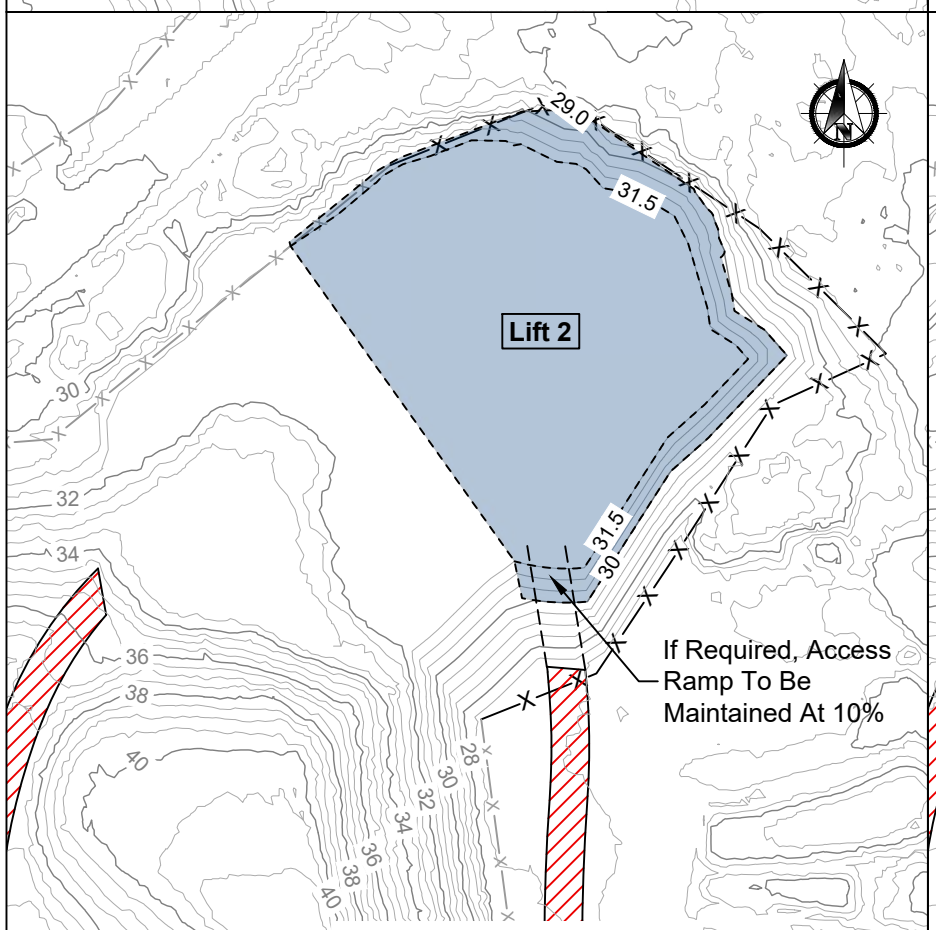
Year 1

Annual Volume = 2,364m³



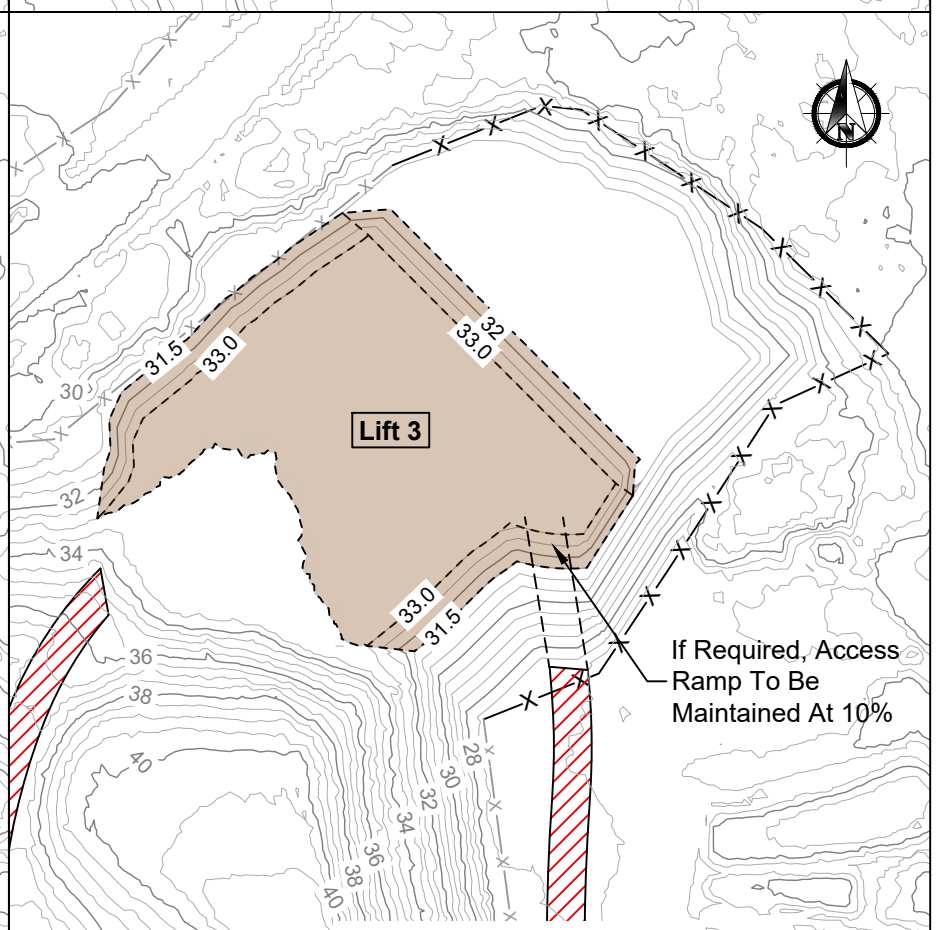
Year 2

Annual Volume = 2,364m³



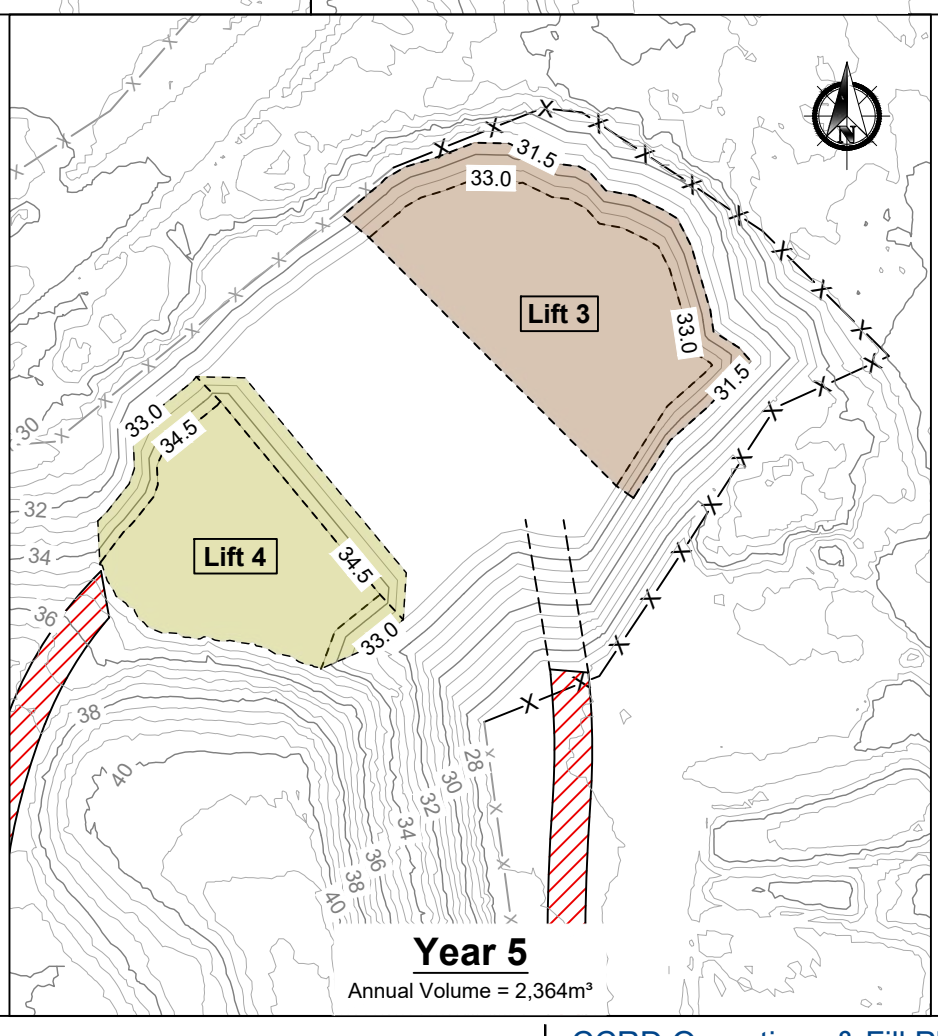
Year 3

Annual Volume = 2,364m³



Year 4

Annual Volume = 2,364m³



Year 5

Annual Volume = 2,364m³

LEGEND:

- EXISTING ACCESS ROAD
- MAJOR FILL CONTOUR
- MINOR FILL CONTOUR
- MAJOR EXISTING CONTOUR
- MINOR EXISTING CONTOUR

MORRISON HERSHFIELD

1:1000 0 10 30 50m

CCRD Operations & Fill Plan
Figure 8 - Detailed Fill Plan - Year 1-5

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Oct 16, 2023

x:\Proj\2021\210629400-ccrd landfill engineering services\09. cad\09 sketches\2023 DOCP\Figure 8 Detailed Fill Plan - Year 1-5.dwg Plotted: by Warren Pare

5.5 Materials Management Plan

As described in Section 5.1, the estimated volume of cover soil used per year is 1,800 m^3, which equates to approximately 37,800 m^3 over the life of the landfill. It is recommended that cover soil use be decreased and a target waste to cover ratio of 3:1 is achieved, at 600 m^3 of cover soil needed per year, which equates to 18,000 m^3 over the life of the landfill.

There are currently two areas where soil has been sourced from as shown in Figure 1. Borrow Area 2 is no longer being used as the slope has extended beyond the property line. Borrow Area 1 can be extended to the north and west. An analysis was completed to determine the approximate volume available in the area southwest of the landfill and 30,000 m^3 are estimated to be available. It is understood that additional soil can be sourced if the CCRD chooses to excavate down in this area as well.

There appears to be sufficient soil available for operations of the landfill, however there is always a need for additional soil and aggregates for landfill closure. It is recommended that the CCRD consider sourcing potential soil resources in the area, such as topsoil. Additional materials management recommendations and analysis will be completed as part of the landfill closure plan.

In addition, the area located to the east of the landfill footprint (south of septic pits) may have available soil and could be investigated in the future.

6. CLOSURE PLAN

Final closure of a waste disposal facility is required under the Landfill Criteria for Municipal Solid Waste set by the BC Ministry of Environment and Climate Change Strategy. Landfill cells or phases should be closed and capped once capacity has been reached as part of a progressive closure strategy. The final cover is to be designed to minimize infiltration of water into the landfill cells and thus limit the generation of leachate. The slope and surface are to be contoured to promote surface water runoff. The cover can also be designed to help manage landfill gas.

The CCRD is required to include the Closure Plan as part of the DOCP prepared for the Thorsen Creek Landfill site. It should be updated when the landfill has at least two years of remaining site life or when the landfill site is planned to undergo significant changes that may impact its operational lifespan. The Closure Plan is prepared to identify a specific post-closure land use proposed for the landfill site. The Closure Plan must document how the facility will be operated and maintained after closure to ensure that all required environmental control systems will continue to function and all perfomance criteria will be met.

Though this DOCP includes the elements required for the detailed closure plan, MH recommends that a separate plan be developed by a qualified professional closer to the anticipated closure date. The separate closure plan would include a detailed closure strategy and the selected cover system.

6.1 Landfill Cover Elements

A landfill final cover is constructed of layers of different materials with different properties and purposes. The typical layers of a final cover system are briefly described below followed by a proposed cover system for the Thorsen Creek Landfill.

6.1.1 Vegetation and Surface Layer

The surface layer of the landfill should be constructed of a minimum 0.15 m thick vegetated topsoil as per the recommendations in the Landfill Criteria closure requirements. The main purpose of this layer is to prevent erosion and protect the underlying layers. The topsoil also acts as a moisture buffer by storing moisture and releasing it through transpiration and evaporation. Established vegetation improves the aesthetics of the site and creates habitat for animals and insects.

There is limited availability of topsoil in the TCWRC area, especially in the quantities needed for final closure of the landfill. Importing topsoil can be expensive. A fabricated soil may be suitable for the local conditions and can be made with local materials. It is important that a fabricated soil contain sufficient nutrients to promote vegetation growth and that the soil has a relatively good water holding capacity. Alternatives to topsoil include a soil mix with compost, peat or biosolids. Hence, it is recommended that segregation of yard and garden waste and wood waste is continued and that the potential to establish composting operations are reviewed.

6.1.2 Cushion/Subsoil Layer

Sometimes a layer of soil is applied just below the topsoil (sometimes with a filter layer, in the form of a geotextile, in between). The purpose of this layer is to protect the underlying cover layers, create depth for root growth and provide additional water holding capacity.

The cushion / subsoil layer can be constructed using many different types of soils and is often selected based on soil type available onsite or locally. The selection of soil and the thickness thereof is more site-specific and depends on the post-closure end-use development planned for the site. For example, the required subsoil layer would be different if the post-closure end use was for short rotation coppice cultivation or a recreational park. The seed mix for final closure should be selected with consideration to root depth particularly if the final cover is constructed without a cushion/subsoil layer.

The onsite borrow material is recommend for the cushion/subsoil layer at the Thorsen Creek Landfill considering the shortage of onsite soil available and the higher cost to import material.

6.1.3 Drainage Layer

A drainage layer is commonly constructed above the barrier layer. The purpose of this layer is to facilitate the channeling of infiltrated water, especially on the side slopes, to a surface water ditch or other collection system, thereby reducing pressure head buildup in the barrier layer. Excessive head buildup in any cover layer can lead to failure of the cover system. Without a

drainage layer there is also a risk that the topsoil and cushion/subsoil layers become saturated which can lead to slumping and erosion.

Drainage layers are either constructed using geonets (drainage geosynthetics) or cohesion-less soils such as gravel and sand. It is important to prevent clogging of the drainage layer which can be achieved by selecting vegetation with shallow roots, installing the cushion/subsoil layer with sufficient thickness and/or by using a geotextile or sand as a filter between the drainage layer and the overlying layers.

6.1.4 Barrier Layer

The barrier layer is either constructed using a low permeability soil, a geomembrane or a geosynthetic clay liner (GCL). The purpose of the barrier layer is to prevent surface water from percolating through the waste in the landfill and generating leachate. It also prevents air infiltration in the waste and landfill gas system (if a part of the landfill cover system) and aims to minimize the release of landfill gas emissions.

The Landfill Criteria specifies the guidelines for the final cover system. The final cover must at a minimum consist of a 0.6 m thick low permeability soil cover with a hydraulic conductivity of $1x10^{-7}$ cm/s for landfill sites located in non-arid regions when compacted to 95% of Standard Proctor. Alternatively, a geomembrane liner can be used as a barrier layer.

Where locally available, clay is a common soil cover material due to its low permeability. A clay liner is installed in small uniform vertical lifts using uncontaminated clay (free from debris and large clods) and prepared to proper moisture content. The goal is to create a homogenous, uniform and low permeability layer. Clay liners (unlike geomembranes) allow some water to infiltrate into the waste which increases the rate of waste stabilization as well as landfill gas generation. This is particularly important at landfills where an active landfill gas collection system is installed. The benefit with a clay liner is that it has self-healing properties, and the clay will show minimal deterioration over time.

Geomembranes are factory made polymeric membranes used for final landfill cover systems but also have other applications. There are several different geomembranes on the market with different properties (e.g., thickness, smooth vs. textured, and density) selected based on its intended application. The most common geomembrane categories include high density polyethylene (HDPE), linear low-density polyethylene (LLDPE) and polyvinyl chloride (PVC). LLDPE liners are commonly used in British Columbia however the selection of geomembrane should always be made specific to the application and site-specific conditions and the overall closure and post-closure objectives and plans.

Geomembranes are generally more tolerant to settlement and changing environmental conditions (temperature and moisture) than a clay liner however they are more susceptible to puncture and damage. Geomembranes become brittle at colder temperatures and proper quality control during installation is essential to minimize liner defects and to ensure good long-term performance of the liner. Underlying soils should be selected and placed to minimize the risk of damage to the liner. A thick geotextile is often placed immediately below the geomembrane to create a cushion and to protect the liner system.

Geomembranes consume little airspace compared to a soil cover which is especially important where airspace is limited. Assuming a good quality installation with minimal installation defects, geomembranes can be considered relatively impermeable and offer superior containment of landfill gas and waste (water infiltration barrier). A certain number of manufacturing and installation defects should be expected, as these affect the performance of the liner system.

GCLs combine geosynthetics with a layer of sodium bentonite clay. The benefit of a GCL compared to a clay liner is the airspace savings, potential cost savings and ease of installation.

The barrier layer is the most important part of a traditional final landfill cover system and most of the other layers in the cover system aim to protect or enhance the performance of the barrier.

6.1.5 Landfill Gas Collection/Venting Layer

The layer directly below the barrier layer is constructed to create a pathway for landfill gas (and leachate if there is a breakout). For either an active or passive landfill gas system, the LFG collection/venting layer reduces the risk of pressure build up under the barrier layer due to LFG. The layer is generally constructed using a high permeability soil or an engineered geosynthetic. A network of perforated gas collection pipes is placed within this layer to collect and direct the landfill gas to passive vents or active collection wells.

6.1.6 Foundation Layer/Intermediate Cover

An intermediate cover is placed on top of the waste once final grade has been reached. The intermediate cover is a temporary landfill cover and is placed to prevent litter, rodent, and vector related issues. The intermediate cover also forms a protective layer between the waste and the final cover system. The final contours of the landfill side slopes and crests are created through placement of the foundation layer/intermediate cover.

6.2 Recommended Final Cover System - Geomembrane

A geomembrane cover system meets the Landfill Criteria and is recommended for final closure of the Thorsen Creek Landfill. The barrier layer is comprised of an engineered geomembrane, which consumes considerably less airspace compared to a traditional soil liner. The geomembrane is protected by an underlying geotextile placed on top of the intermediate cover. A geocomposite, comprised of a drainage net sandwiched between two layers of geotextile, will be placed on top of the geomembrane before a 0.15 m thick layer of topsoil is placed and seeded. This type of cover system does not allow for passive landfill gas venting; therefore, a network of perforated landfill gas collection pipes should be installed below the barrier layer to prevent uplift of the geomembrane. Passive landfill gas vents will be required at the high points in the landfill, which will penetrate through the geomembrane cover system.

6.3 Progressive Closure

MH recommends progressive closure and capping as the capacity and final grade of each phase are reached. The benefits of progressive closure are to minimize leachate generation, facilitate clean runoff diversion and spread the capital costs of closure over the life of the landfill.

Once the final elevation of each phase has been reached, the side slopes and crest should be graded and covered with 300 mm of intermediate cover soil (or approved alternative), as specified in the Criteria. The intermediate cover thickness may include the daily cover thickness (0.15 mm of soil or approved alternative). The placement of intermediate cover is a preliminary step of progressive landfill closure, which aims to protect the side slopes, prevent stormwater infiltration and control litter/vectors until final cover has been placed.

7. OPERATIONS PLAN

7.1 Hours of Operation, Staffing and Equipment

The facility is open two days during the week on Wednesday and Saturday with the following hours of operation:

- 8:30 AM – 5:30 PM

The facility is closed for all Statutory Holidays.

The facility staffing generally includes the following:

- **One transfer station attendant** - the transfer station attendant is present at the transfer station area. The attendant's task includes caretaker services of the transfer station site, collecting tipping fees, and operating the compactor truck. This staff operates under the CCRD and arrives on both operating days before the 8:30 AM opening hours.
- **One landfill operator** - the landfill operator is only present at the landfill to compact the MSW collected on those two days. A 20-tonne excavator and a D6 dozer is present for the operator to handle the MSW safely and compact them. This staff operates on a contract basis retained by the CCRD and arrives at end of Wednesday and Saturday to compact the MSW collected and place cover soil.
- **One public works operations manager** - the public works operations manager oversees all aspects of the operation and planning of the landfill and solid waste management in the region.

7.2 Current Tipping Fees and Waste Acceptance

Household garbage contained in black garbage bags can be disposed free of charge. Construction and demolition debris, large items (mattresses, furniture, etc.), yard waste, metals and appliances are accepted at the TCWRC and subject to tipping fees. There is no scale at the Thorsen Creek Landfill and tipping fees are applied based on volume or quantity basis. The applied tipping fees are outlined in bylaw no. 523 titled "Solid Waste Disposal Rates and Charges" available on the CCRD website. Unbagged residential refuse, as well as commercial, institutional, or industrial refuse are charged at $41 per m^3. Clean wood waste and yard and garden waste are also charged at $41 per m^3, while construction and demolition waste and land clearing debris are charged at $54 per m^3. Additional tipping fees are specified in the bylaw no. 523.

A transfer station attendant is on site during the hours of operation to oversee and direct the sorting of waste. All customers are to report to the attendant for any non-household garbage. Disposal of items such as vehicles, boats, trailers, asbestos waste, treated poles/pilings must be arranged ahead of time through the CCRD office or landfill attendant.

7.3 Active Face Operating Procedures

MH recommends eliminating the C&D active face and directing all loads to the MSW active face. As a best practice, the active face should be confined to the smallest practical surface area. A smaller surface area of exposed waste minimizes cover material requirements, lessens the time required to maintain the active face, allows for easier compliance and provides more effective control of litter, vectors and stormwater infiltration. Safety and operational considerations are the biggest constraints on reducing the active face size. The active face should be kept as small as possible with the width not exceeding 6 m as per the Operating Certificate. However, the width of the active face should be determined taking the width required to accommodate the average number of vehicles unloading simultaneously during peak use into consideration.

The operator should compact the active face at the end of each operating day, in the case of CCRD, every end of Wednesday and Saturday. The best practice for efficient compaction is to compact 300 mm thick layers of waste, and the typical rule for sufficient compaction is four to size passes over the active face. The recommended cell development is shown in Figure 7.

The angle measured on the active face slope was approximately 15 degrees, which equates to roughly 4H:1V (4 horizontal to 1 vertical). The active face should be sloped to provide storm water drainage away from the cell. However, it is best practice to maintain the active face at a slope no greater than 3H:1V to ensure effective compaction. MH recommends the active face is kept close to 3H:1V.

The waste should be placed in lifts about 1.5 m high (not exceeding 2 m), no more than 300 mm thick, and a daily cover should be applied once every 7 days as per the Operating Certificate.

7.4 Cover Placement

Daily and intermediate cover layers are barriers that help to contain the waste and help reduce impacts on the surrounding environment. Daily cover can be used to enclose cells on a daily basis or as required under applicable operating certificate, or an alternative daily cover can be used, and cells can be enclosed with soil at the end of a specified operation period.

A form of daily cover should be placed on the active face at the end of each operating day to control vectors, wildlife, dust, litter, odour, stormwater infiltration and manage the risk of fire. The active face should be graded to achieve the smoothest surface possible before applying the daily or intermediate cover in order to reduce material requirements. As specified in the Operational Certificate, the permittee shall cover the top surface and the working face of the active face with a minimum of 15 cm of clean fill no less than once per week.

Soil is a common material used for daily cover operations and can be considered as clean fill. However, there are several disadvantages associated with using this material, including landfill airspace consumption, transportation costs, and low permeability that can restrict leachate and landfill gas flow.

The landfill footprint should be kept as small as possible, therefore it is recommended that the active face is constructed horizontally and on top of the previous landfill cell. Once the outside of a landfill cell is complete, a layer of intermediate cover should be applied over the outside of the cell. Soil should be utilized only as required for landfill cover.

The use of alternative daily covers (ADCs) may help reduce certain operational challenges. It is recommended that a trial period is conducted to ensure an alternative material is suitable under site-specific conditions, prior to permanent implementation. The following alternative daily cover options may be applicable to Thorsen Creek Landfill.

7.4.1 Geosynthetic Covers

Geosynthetic covers are re-usable materials such as tarps or rubber belts. Suppliers can manufacture the covers with perimeter attachments used to anchor the cover over the active face surface. This is a common method that has been successfully implemented in several facilities across Canada. Photo 1 shows a geosynthetic daily cover used by the Regional District of Fraser Fort George (RDFFG) at the Foothill Boulevard Regional Landfill in Prince George.

Photo 1: Alternative Daily Cover at the Foothills Blvd Landfill (Prince George)

Geosynthetic covers are deployed and removed each operating day, so there is no airspace consumption and no restriction to landfill gas and leachate flow. There are relatively low costs associated with geosynthetic covers, as the material is re-usable. Another benefit is the speed of deployment and removal, which can be done by hand or equipment. Disadvantages include difficulty deploying covers in adverse weather conditions (windy), employee exposure to waste and potential tearing of the material. Specialized deployment equipment can be purchased to

improve safety and speed, however there are high capital and maintenance costs associated with this equipment.

7.4.2 Steel Plate Covers

Similar to geosynthetic covers, steel plate covers used as an alternative daily cover for active landfill faces serve as a temporary barrier to prevent the dispersion of waste and to control odours, vectors, and litter on the exposed waste surfaces. This cover is typically applied at the end of each operational day or as needed to maintain proper landfill management.

Key features and benefits of using a steel plate cover as an alternative daily cover include:

1. **Durability**: Steel plates are robust and durable, able to withstand the weight of heavy machinery and vehicles that may traverse the active landfill area.
2. **Sealing Effect**: The steel plate cover provides an effective seal over the waste materials, helping to reduce the release of odorous gases, dust, and litter into the surrounding environment.
3. **Odour and Vector Control**: By containing odours and preventing the access of scavengers and vectors, the cover helps maintain a cleaner and more controlled environment.
4. **Reduction in Soil Usage**: Traditional daily cover methods often involve using soil, which is a valuable and finite resource. Utilizing steel plates as an alternative reduces the need for soil cover.
5. **Efficiency**: Applying steel plate covers can be more efficient than transporting and spreading soil daily. It saves time and resources while still fulfilling the requirement for daily cover.
6. **Long-Term Savings**: While the initial investment in steel plates might be higher than using soil, the long-term cost savings due to reduced soil usage and improved operational efficiency can be significant.
7. **Reusability**: Steel plates are reusable, making them a more sustainable option compared to materials like soil.

It is important to note that while steel plate covers offer several benefits, they may also have limitations and drawbacks. These can include potential noise generated by heavy machinery moving over the plates, the need to properly secure the plates to prevent displacement by wind, the potential maintenance requirements to address issues like corrosion, and additional operator training and oversight.

Ultimately, the choice of using a steel plate cover as an alternative daily cover for active landfill faces should be based on the specific needs, regulations, and conditions of the landfill site.

7.5 Routine Inspections and Maintenance

The Operational Certificate requires the permittee to conduct inspections and maintenance activities that include the following tasks:

- Vegetation around the site, especially adjacent to the electrical fence, be trimmed or removed.
- Electric fence be inspected at least once every seven days and voltage of fencing measured at several points along the fencing and at each gate using proper electric fence voltmeter to ensure a minimum 6,000 volts.
- Maintenance may be required based on the deficiencies noted during inspections.
- Any deficiencies that have been addressed should be noted in the following inspection report.
- All maintenance and inspections should be recorded and kept on file.

7.6 Safety and Training Recommendations

Site operators and any personnel conducting work on site are required to complete the following training:

- Basic first aid
- Workplace Hazardous Materials Information Systems (WHMIS)

Additionally, it is recommended that all operators complete the following training:

- Solid Waste Association of North America's (SWANA's) Manager of Landfill Operations (MOLO) course, Landfill Operations Basics (LOB) course or similar

At a minimum, all employees should receive appropriate training to carry out the Operational Certificate requirements.

8. ENVIRONMENTAL CONTROLS

8.1 Surface Water Management Plan

Precipitation typically infiltrates into the alluvial fan material, but runoff does occur from the landfill site and higher areas during high precipitation events. Old logging trails above the landfill collect some of the precipitation and convey it to the southwest corner of the site, where it flows down the excavated slope and onto the landfill.

No significant drainage issues have been observed on site however all surface water runoff should be conveyed around the landfill (away from all active landfill areas) using appropriately sized ditches and swales around the toe of the landfill slopes and around the landfill perimeter.

Surface water management on the active face is also important to minimize infiltration and leachate generation. Surface water runoff should be directed away from the active face with grading away from the active face. Temporary ditches should also be used where standing water or ponding is observed. Limiting the size of the active face will also minimize the amount of surface water runoff that contributes to leachate generation.

Surface water management during the post-closure period should be included in the detailed closure plan prepare prior to landfill closure. Figure 4 incudes a conceptual surface water management plan which includes ditches along the toe and crest of the landfill as well as down chutes along the finished landfill slopes, and a potential location for a sedimentation pond.

8.2 Landfill Gas Management Plan

It is understood that landfill gas (LFG) has not been monitored at the Thorsen Creek Landfill. Based on the annual landfilled tonnages and climate, it is assumed that LFG generation is relatively low and therefore monitoring has not been warranted. Enclosed spaces are potentially at risk of landfill gas migration. Therefore, it is recommended that landfill gas migration monitoring is conducted along the toe of the slope at the northwest face of the landfill. Soil vapour probes should be installed and monitored for any indications of lateral LFG movement.

Landfill gas monitoring should be conducted for three years following landfill closure. If soil vapour sampling indicates LFG is within acceptable concentrations for the duration of the monitoring period, landfill gas monitoring will not be required after three years. However, a new landfill gas monitoring plan will be required if gas emission exceedances are encountered in the three-year monitoring period following landfill closure.

The on-site offices and other enclosed buildings should be equipped with methane gas sensors that notify occupants when methane concentrations reach 20 percent of the lower explosive limit of methane (1% by volume).

8.3 Contaminating Lifespan

Contaminating lifespan means the period of time during which the landfilled waste has the potential to produce effluent or air contaminants, as defined in the Environmental Management Act, including at least 30 years after installation of final cover over the entire landfill footprint. At a minimum, the contaminating lifespan is assumed to be at least 30 years when determining the requirements for post-closure operation and maintenance and the amount of financial security required for the landfill site.

There are no historical records or data available to accurately estimate how much waste is in the Thorsen Creek Landfill to date. To identify the amount of waste in the landfill, an inferred landfill base was assumed beneath the existing disturbed ground to estimate the amount of waste occupied in the landfill. Figure 6 shows the inferred landfill base contour drawing (cross sections).

Based on the difference in contours from the inferred landfill base and the existing ground, the volume calculated was 72,000 m^3. From Section 5.1, the waste to cover ratio currently is 1:1,

thus estimating the waste in the landfill to be 36,000 m^3. With the compaction rate assumed at 500 kg/m^3, the estimated tonnage is 18,000 tonnes.

Assuming that the landfill development follows the 3:1 waste to cover ratio (by volume) until the site is at maximum capacity (without expanding to the east side), the landfill will occupy an additional ~ 72,500 m^3. Of this total volume, 54,400 m^3 would be occupied by waste. With the compaction rate assumed at 500 kg/m^3, the estimated tonnage is 27,200 tonnes.

In total, the landfill will have approximately 45,200 tonnes of waste when filled to maximum capacity.

According to the Landfill Criteria, under Section 8.3 Post-Closure Period, "…a lifespan of 50 years shall be used for landfills with less than 100,000 tonnes of MSW in place." With the current landfill estimated to have less than 100,000 tonnes of MSW in place, the post closure period will be for 50 years after final closure.

9. ENVIRONMENTAL MONITORING PLAN

The purpose of the Environmental Monitoring Plan (EMP) is to specify how groundwater and surface water quality will be monitored at and in the vicinity of the site in order to identify potential waste management related impacts to the receiving environment.

The EMP is site specific and is based on site geology, hydrogeology, leachate indicator parameters and monitoring results. The following section presents a summary, rationale and recommendations for the EMP. Further information related to site environmental conditions and monitoring locations is available in Appendix A.

The requirements of the EMP should align with the monitoring requirements specified in the latest Operational Certificate for the landfill.

9.1 Monitoring Criteria

The site is governed by Operational Certificate MR-4223 (dated April 12, 2006). Regulatory considerations under the *Environmental Management Act* that are applicable to this site include the following:

- BC Contaminated Sites Regulation (CSR) (B.C. Reg. 179/2021, July 7, 2021)
- BC Approved Water Quality Guidelines (AWQG) (BC MOE, January 2023)

Groundwater quality at the site is compared to the potentially applicable regulatory requirements and guidelines under the *Environmental Management Act,* including the BC Contaminated Sites Regulation (CSR) (B.C. Reg. 179/2021, July 7, 2021) standards for Aquatic Life (AW) and Drinking Water (DW) use. The BC CSR (Protocol 21, Effective November 1, 2017) specifies that AW standards apply to all groundwater located within 500 m of an aquatic receiving environment, unless it can be demonstrated that the groundwater does not flow to that receiving environment. Thorsen Creek and Noohalk Creek are both located within 500 m of the site's property boundary, so there is a potential pathway for leachate migration to these two water

bodies, and the groundwater standards for AW apply to this site. No drinking water wells or surface water intakes were identified within 500 m of the site boundaries. However, as outlined in Protocol 21 of the BC CSR (2017), consideration of future drinking water use is required for saturated geological units with suitable hydraulic properties and natural water quality to support a single-family domestic water supply. Initial sampling results and subsurface investigations have not demonstrated that the geological unit is unsuitable. Therefore, the aquifer must be considered as having potential for future drinking water use and the groundwater standards for DW apply to this site.

Surface water quality at the site is compared to the BC Approved Water Quality Guidelines and the BC Working Water Quality Guidelines for protection of Aquatic Life (Freshwater). These guidelines are applicable for better understanding potential impacts to surface water quality in the area inferred to be downgradient of the site.

A description of how these guidelines were identified as applicable is available in Appendix A.

9.1.1 Indicator Parameters

Leachate indicator parameters are compounds that are reliable indicators of groundwater impacts from waste disposal, but in and of themselves may not be a contaminant of concern. The landfill is a natural attenuation landfill so raw leachate sampling is not applicable. Thus, leachate indicator parameters for the site have been determined based on common leachate indicator parameters for landfills. Those assessed for the site include the following:

- chloride,
- conductivity,
- hardness,
- sulfate, and
- iron and manganese.

The key parameter of potential concern at landfill sites is ammonia (which can be toxic to aquatic life if it reaches an aquatic receptor at high enough concentrations). Other parameters of concern, may include the presence of:

- hydrocarbons and/or volatile organic compounds, and
- possibly elevated concentration of heavy metals associated with waste disposal.

Water quality results for groundwater and surface water at the site are assessed against the applicable regulatory criteria, as well as with respect to trends in leachate indicator parameters. As regular monitoring continues at the site, changes to indicator parameters with time, if occurring, can also be assessed. The first groundwater samples were collected in November 2022 (after new groundwater monitoring wells were installed in October and November 2022).

9.2 Recommended Monitoring Program

A description of the results of the initial groundwater and surface water monitoring program, initiated in 2022 with the installation of new groundwater wells, is provided in Section 3, as well in Appendix A. With consideration of the results of this program, the following recommendations are made for the EMP for the CCRD's Thorsen Creek Landfill site with respect to monitoring locations and frequency:

- Groundwater sampling is recommended to continue twice annually at the site (once in the spring/summer and once in the fall) in order to develop a basis for year-to-year comparison of data and trends. Measurement of depth to groundwater in all wells is also recommended to occur twice annually at a minimum, to identify any seasonal variation in groundwater flow direction.
- Due to the distance between the landfill site and Noohalk Creek (approximately 400 m), and the potential influence of properties and interference between the two, there are multiple factors that could affect the surface water quality at this sampling location (including the landfill) and it is not possible to determine the source of impacts with confidence if exceedances are identified. It is therefore proposed that sampling of Noohalk Creek be discontinued and replaced with spring water sampling.
- To establish a more representative surface water sampling location, it is recommended that the CCRD undertake a conductivity survey of spring locations located to the northeast of the landfill where groundwater is observed to be daylighting (measurements taken with a field conductivity probe). A sampling location should be established at the location measured as having the highest field conductivity (for analysis of all surface water parameters, including dissolved metals and total metals in this initial sample). Sampling of the spring is intended to assess whether this location would be a suitable replacement as a long-term receiving environment monitoring point.

The following recommendations are made with respect to monitoring parameters for the EMP:

- Samples are recommended to be collected from all five of the above locations and analyzed for field and laboratory parameters as outlined in the OC for the site, including:
  - Field parameters:
    - pH
    - Conductivity
    - Temperature
    - Water elevation
  - Laboratory parameters:
    - Dissolved metals (in groundwater) and total metals (in surface water)
    - Hardness
    - Alkalinity
    - Total Dissolved Solids
    - Ammonia
    - Nitrate, Nitrite, and Nitrate + Nitrite

    - Dissolved Organic Carbon
- Although included in the OC, Biochemical Oxygen Demand (BOD) and Chemical Oxygen Demand (COD) are recommended to be excluded from future sampling, as these indicators are typically most useful when assessing information related to leachate collection and treatment, when raw leachate is sampled. For this site operating as a natural attenuation landfill, the leachate is relatively dilute and these parameters provide no value in managing the environmental conditions of the site.
- Select parameters related to hydrocarbons were sampled from wells in November of 2022 as part of a one-time investigation into potential hydrocarbon presence in groundwater and surface water at the site. These parameters included Volatile Organic Compounds (VOCs), Extractable and Volatile Hydrocarbons (EPH & VH), BTEX, and Polycyclic Aromatic Hydrocarbons (PAHs). No detectable hydrocarbons were identified in any groundwater samples, therefore these parameters are not recommended to be included in the EMP.

10. FIRE SAFETY, EMERGENCY RESPONSE PLAN AND CONTINGENCY PLAN

10.1 Fire Safety Plan & Emergency Response Plan

The most common causes of landfill fires include malfunctioning equipment, or disposal of burning or smoldering material. The spread of landfill fires is largely impacted by landfill operations, such as active face compaction, application of cover material and the types of landfilled material. Measures that should be taken to prevent landfill fires include:

- Proper use and maintenance of daily and intermediate covers.
- Implementing progressive closure.
- Conducting regular inspections, including load inspections of incoming waste at the scales and general inspections of site.
- Separating recyclable material such as tires, white goods, wood and hazardous waste from the landfill active face.

Proper compaction and cover material application restrict oxygen supply to the cell and act as a fire break, reducing the risk of fire.

A fire safety and emergency response plan for the facility should be developed and maintained.

MH has prepared a fire safety and emergency response plan copy for staff in Appendix B. This plan must be reviewed and updated at least once annually. The plan includes landfill fire response procedures and relevant emergency contact information. Copies must be provided to the staff at visible, easy to reach and known storage places, ideally in the following locations:

- In the transfer station building
- In the staff vehicle

MH understands that the CCRD has access to a fire truck with its own water supply from the community. With the access to a fire truck present, MH recommends that the CCRD contact the fire authorities and responding fire department for review of the drafted fire safety and emergency response plan for Thorsen Creek Landfill.

The Fire Safety and Emergency Response Plan must be submitted to the appropriate fire authorities and the responding fire departments initially and upon the completion of significant changes.

10.2 Contingency Plan

As defined by the Landfill Criteria, a Contingency Plan is required as part of the DOCP document. A Contingency Plan covers:

- Possible failure and non-compliance scenarios of the leachate, surface water, and landfill gas management facilities.
- Practical and implementable contingency measures to address any failure or non-compliance with the performance criteria.

If the CCRD suddenly has to close the landfill either due to a non-compliance or in the event of a failure with the Site's performance criteria, the CCRD will be sending their collected waste to the Cariboo Regional District's (CRD) landfill. The CRD is located directly east of the CCRD and is accessible by road from Bella Coola. The CRD owns the Central Cariboo Landfill, which is located approximately 45 km north of Williams Lake. The total haul time from the Thorsen Creek Landfill to the Cariboo Central landfill is estimated to be 14 hours roundtrip, including bin pick up and drop off.

11. FINANCIAL SECURITY PLAN

The amount of financial security will be calculated as the sum of the following costs:

- Cost of emergency closure or planned closure, whichever cost is greater.
- Cost of post-closure operation, maintenance, monitoring and reporting for the contaminating lifespan.
- Cost of implementing contingency measures.

As outlined in the Landfill Criteria, each task or activity associated with closure and post-closure care shall be detailed and estimated in performing financial security calculations. Estimates include costs associated with administration, engineering assessment and construction oversight.

As part of landfill planning work completed in 2020, the CCRD retained a consultant to estimate the liability associated with the Thorsen Creek landfill, including the estimated closure and post-closure costs. The estimated landfill lability was reported as per Public Sector Accounting Board PS 3280 (asset retirement obligations). The estimated closure and post-closure costs, and associated liability, is reported under separate cover. MH recommends that the CCRD retain a qualified professional to review and update the landfill liability calculations at a minimum once

every five years with the latest information on remaining landfill lifespan, inflation and discount rates, updated closure and post-closure costs, and other financial and site-specific assumptions.

11.1 Closure Costs

Activities that are considered in the closure costs include:

- Compaction and grading of the landfill surface area
- Final cover and vegetation
- Completing facilities for:
  - Surface water management (drainage control features)
  - Leachate monitoring
  - Water quality monitoring
  - Landfill gas monitoring

11.2 Post-Closure Costs

Activities that are considered in the post-closure cost estimate are:

- Water quality monitoring
- Ongoing maintenance of various control systems, drainage systems and final cover

As noted above, the estimated landfill liability should form the basis of a financial security plan for the site. Post-closure costs have been estimated and are reported in the landfill liability estimates noted above.

12. RECOMMENDATIONS

Based on the findings from MH's site visits, review of current operations and as part of the development of this DOCP, the following recommendations are provided:

- MSW and C&D wastes are currently landfilled separately. However, there are operational challenges associated with having more than one active face, such as reduced tipping oversight and increased equipment and manpower time required. Two active faces also increase leachate generation due to the larger area. MH recommends eliminating the C&D active face and directing all loads to the MSW active face. It is understood that this will be a change to the current operations and there may need to be an adjustment period for the operator to get used to managing all materials in one area. If the active faces are combined, the operator may need to temporarily allocate areas for receiving larger loads of C&D material during certain times of the year.
- MH understands that there are challenges associated with acquiring a scale in order to help with keeping records of waste tonnages entering into the landfill. A scale would however provide the CCRD with the ability to track the quantity of waste entering into the landfill, track the sources of waste, and to track soil consumption used during operations. MH recommends improving the current method of keeping track of the materials entering

into the landfill. This might include more detailed record keeping of the number of bins transferred from the transfer station to the landfill (and approximate size and fullness) and tracking the number of commercial vehicles and approximate size tipping at the active face.

- Based on the two surveys completed for the Thorsen Creek Landfill, the current waste to cover ratio is estimated at approximately 1:1 by volume. This is most likely due to the soil cover used to cover the active faces at end of each working day (twice a week). MH recommends decreasing the amount of cover soil used daily. The ideal waste to cover ratio is 3:1 by volume and achieving that will extend the lifespan of the landfill.
- An alternative daily cover (ADC), either with a geosynthetic cover or a steel plate cover, would significantly reduce the amount of cover soil used for operations. MH recommends the CCRD investigate the feasibility of using ADC. The operator could attempt a short-term trial using ADC to assess the benefits and challenges with different options. The CCRD could contact similar sized communities/landfills that have used or are currently using a form of ADC.
- In addition to the safety training required under the operational certificate, it is recommended that all operators and managers complete the following training:
  - Solid Waste Association of North America's (SWANA's) Manager of Landfill Operations (MOL) course, Landfill Operations Basics (LOB) course or similar
- The phased and detailed fill plan provided in this DOCP should be reviewed with the landfill operator to obtain feedback and to ensure the operator understands the short- and long-term development plan for the site, and the rationale for the fill plan. Active face operations, as outlined in this DOCP, should also be reviewed with the landfill operator on a regular basis.
- Groundwater sampling is recommended to continue twice annually at the site (once in the spring/summer and once in the fall) in order to develop a basis for year-to-year comparison of data and trends. Measurement of depth to groundwater in all wells is also recommended to occur twice annually at a minimum, to identify any seasonal variation in groundwater flow direction. The parameters identified in the EMP in Section 9 should be included in each monitoring event.
- Due to the distance between the landfill site and Noohalk Creek (approximately 400 m), and the potential influence of properties and interference between the two, there are multiple factors that could affect the surface water quality at this sampling location (including the landfill) and it is not possible to determine the source of impacts with confidence if exceedances are identified. It is therefore proposed that sampling of Noohalk Creek be discontinued and replaced with spring water sampling.
- To establish a more representative surface water sampling location, it is recommended that the CCRD undertake a conductivity survey of spring locations located to the northeast of the landfill where groundwater is observed to be daylighting (measurements taken with a field conductivity probe). A sampling location should be established at the location measured as having the highest field conductivity (for analysis of all surface water parameters, including dissolved metals and total metals in this initial sample).

Sampling of the spring is intended to assess whether this location would be a suitable replacement as a long-term receiving environment monitoring point.

- The septic pits proximity to the landfill may be influencing the landfill's downgradient water quality. It is therefore recommended to relocate the pits in order to mitigate their potential impact and ensure that they are not influencing the overall compliance of the landfill to the OC and the DOCP.

13. CLOSURE

CCRD retained Morrison Hershfield now Stantec to conduct the work described in this report, and this report has been prepared solely for this purpose.

This document, the information it contains, the information and basis on which it relies, and factors associated with implementation of suggestions contained in this report are subject to changes that are beyond the control of the author. The information provided by others is believed to be accurate and may not have been verified.

Morrison Hershfield now Stantec does not accept responsibility for the use of this report for any purpose other than that stated above and does not accept responsibility to any third party for the use, in whole or in part, of the contents of this document. This report should be understood in its entirety, since sections taken out of context could lead to misinterpretation.

We trust the information presented in this report meets Client's requirements. If you have any questions or need addition details, please do not hesitate to contact one of the undersigned.

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APPENDIX A: 2022 Environmental Monitoring Summary Report

MORRISON HERSHFIELD

Thorsen Creek Landfill

Environmental Monitoring Summary Report 2022

Presented to:

Ken McIlwain

Central Coast Regional District
Box 186
Bella Coola, BC V0T 1C0

Central Coast
REGIONAL DISTRICT
That we may be good people together

Report No. **210629400**

November 21, 2024

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APPENDICES

1. INTRODUCTION

Morrison Hershfield was retained by the Central Coast Regional District (CCRD) to complete an environmental investigation and monitoring program at the Thorsen Creek landfill (the landfill), located approximately 6 km east of Bella Coola, BC. The following tasks were completed at the landfill between October 31 and November 2, 2022:

1. A drilling program, including borehole advancement and groundwater well installation.
2. Groundwater sample collection.
3. Surface water sample collection.

This summary report presents the findings of the drilling, groundwater monitoring, and surface water monitoring programs completed in fall of 2022.

1.1 Program Objectives

The overall purpose of the Thorsen Creek Landfill monitoring program is to assess the potential effects to the surrounding environment due to the landfill, and to assess the effectiveness of the natural attenuation system. The field program undertaken in 2022 was intended to advance this overall purpose through the following objectives:

- Install groundwater monitoring wells in key locations around the site to facilitate long-term groundwater monitoring.
- Collect water table measurements at each groundwater monitoring well to support development of an updated hydrogeological assessment, and confirm the inferred direction of groundwater flow through the Thorsen Creek Landfill site (as established in the 1993 hydrogeological assessment for the site).
- Conduct in-situ monitoring and collect samples for laboratory analysis to assess landfill impacts to local groundwater and surface water quality.
- Compile site information, environmental data, and recommendations to support development of a revised Environmental Monitoring Plan (EMP) for the site.

The monitoring activities conducted in fall of 2022, as well as associated findings and recommendations, are intended to inform the development of an updated EMP to be incorporated into the new Design, Operations, and Closure Plan (DOCP) for the site.

1.2 Report Purpose

The purpose of this report is to summarize the environmental monitoring completed at the Thorsen Creek Landfill site in 2022, as well as the topographic site survey and groundwater well surveys completed in spring of 2023. Based on results of this work, recommendations have been made, including identifying additional work or information required, to support

development of an updated EMP for the site. The updated EMP will be part of the Landfill DOCP for the site, and will determine annual monitoring required for the landfill going forward.

Annual reporting is proposed as future monitoring activities for the landfill site are conducted. Future annual monitoring reports for the site will be completed in a format similar to this report to fulfill the environmental monitoring requirements of the facility's updated EMP, DOCP, and Landfill Operational Certificate (MR-4223).

2. SITE DESCRIPTION

2.1 Location

The landfill site is located approximately 6 km east of Bella Coola, BC, as shown in Figure 1. The site is located close to the end of Thorsen Road, southbound off Highway 20, between Grant Road and K Road after passing over a small river connecting to the Bella Coola River. The Thorsen Creek Landfill is located across Thorsen Road from CCRD's Thorsen Creek Waste and Recycling Centre, which offers a wide range of free recycling services and a transfer station for household garbage/municipal solid waste (MSW), construction and demolition (C&D) waste, yard waste, appliances, and metals. The Thorsen Creek Waste and Recycling Centre serves as the primary facility for solid waste management in the Bella Coola Valley. MSW and C&D waste, as well as some other materials collected at the Thorsen Creek Waste and Recycling Center, are transferred for final disposal at the Thorsen Creek Landfill.

X:\Proj\2021\210629400\ccrd\landfill engineering services\09_cad\09 sketches\Figure 1 Location Plan.dwg Plotted: by Warren Pare

MORRISON HERSHFIELD

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CCRD Operations & Fill Plan
Figure 1 - Location Plan

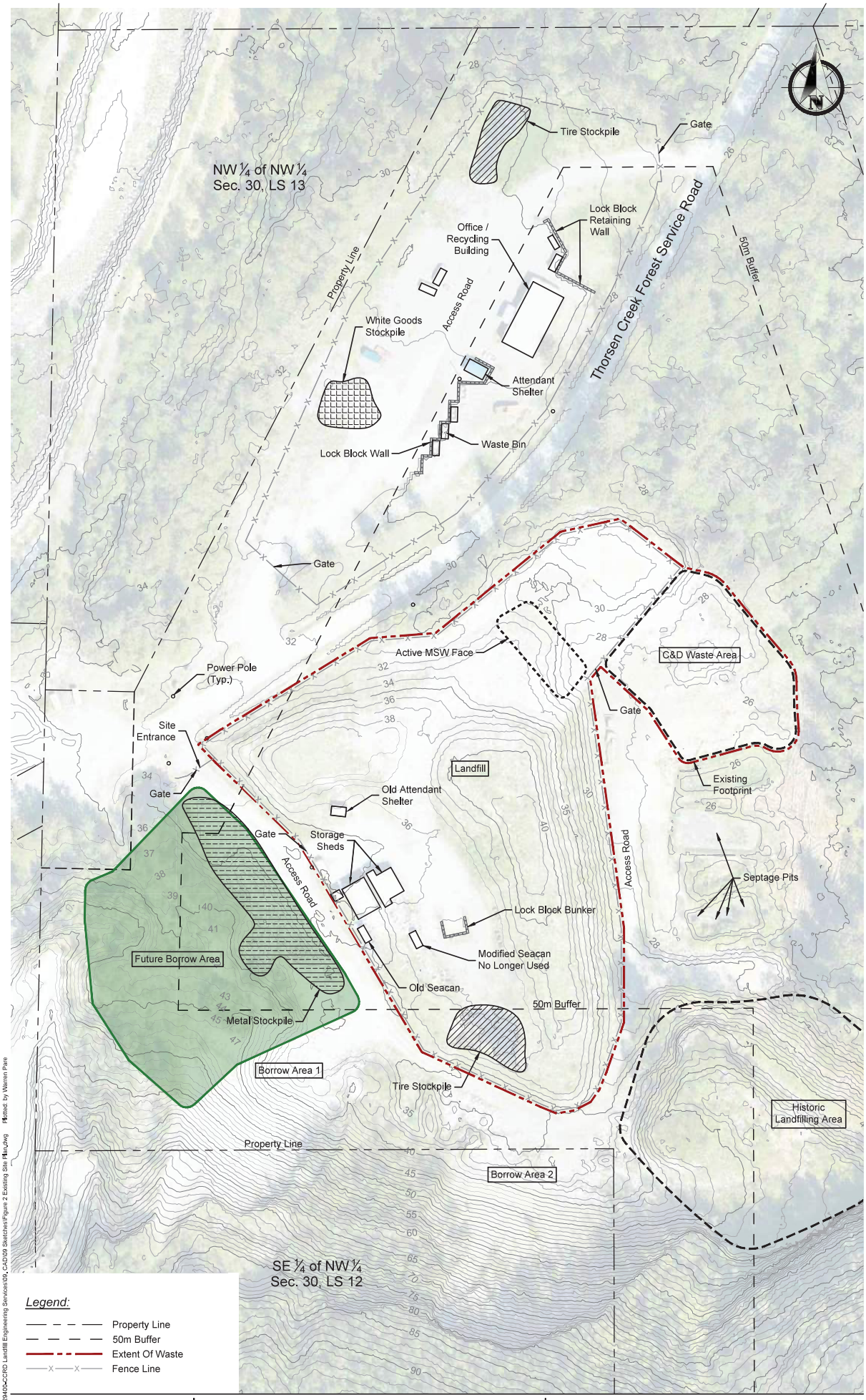
210629400
May 04, 2022

2.2 Landfill

The Thorsen Creek Landfill accepts waste from residential, commercial, and construction/demolition sources. The landfill is operated as a natural attenuation site, such that waste is placed on native ground without an engineered soil or geomembrane basal liner to capture leachate for treatment. Daily cover material is sourced from a gravel pit located at the south end of the landfill property. The landfill is shown in Figure 2 and includes the following primary features:

- The active area for disposal of MSW (subject to daily cover using on-site gravelly soils)
- Electric fencing around the active filling area to deter bears from entering the site
- A scrap metal storage area
- A tire storage area
- An area for burnable wood
- An area for burnable commercial cardboard
- A fill area for inert C&D waste (e.g., concrete, asphalt shingles, etc.)

A series of septage pits are also located at the east end of the landfill site, south of the C&D active face, but is operated under a different operating certificate.



X:\Proj\2021\210629400\CCRD Landfill Engineering Services\09_CAD\09 Sketches\Figure 2 Existing Site Plan.dwg Plotted: by Warren Pare

MORRISON HERSHFIELD

1:1250 0 12.5 37.5 62.5m

CCRD Operations & Fill Plan
Figure 2 - Existing Site Plan

210629400
May 12, 2022

2.3 Hydrological Conditions

The Thorsen Creek Landfill site is located on an alluvial fan associated with Thorsen Creek and was previously operated as a gravel pit. Daily cover is still obtained from the excavated face to the southwest of the landfill.

Precipitation typically infiltrates into the alluvial fan material, but runoff does occur from the landfill site and surrounding areas during high precipitation events. Old logging trails above the landfill collect some of the precipitation and convey it to the southwest corner of the site, where it flows down the excavated slope and onto the landfill. Surface runoff eventually flows into the tributaries of Noohalk Creek, located to the north of the landfill and east of the access road. A number of springs discharge on the low ground to the north of the landfill, between the landfill and Noohalk Creek, and these sustain baseflows in Noohalk Creek during the summer months. Noohalk Creek eventually flows into Thorsen Creek, shortly before Thorsen Creek flows into the Bella Coola River.

Homes located to the north and northeast of the landfill are serviced by a Water District and are not supplied from a local well or creek source. There are some water licenses for withdrawal from surrounding creeks as well as groundwater wells in the area surrounding the site; most of these are located either upgradient of the landfill, or on the west side of Thorsen Creek in the opposite direction of inferred leachate seepage.

2.4 Geological Conditions

The site is underlain by greenstone and schist bedrock (Baer, 1973). Based on logs for wells drilled on the west side of Thorsen Creek, bedrock is overlain by greater than 15 m of sand and gravel alluvial sediments. Observations during the 2022 drilling program confirmed sand and gravel, with occasional boulders, to a depth greater than 8.5 m. Additionally, the water supply well drilled within the Thorsen Creek Landfill site in 2013 encountered sand and gravel to depths up to 18 m, and the water supply well drilled at the Thorsen Creek Waste and Recycling Center site in 2017 encountered sand to a depth of approximately 60 m, underlain by clay to a depth of 85 m. Bedrock must rise to near surface at the east end of the site, where it is exposed in the valley wall. The sediments are typically a bedded sand and gravel with trace silt and many cobbly zones. Some interbeds of deltaic silty sand were noted in the adjacent gravel pit, but the sediments can be generally characterized as granular and free draining.

The raised alluvial and deltaic sediments on the valley walls above the landfill are interpreted to have been deposited by Thorsen Creek when sea level was higher than present. Alluvial sediments on the valley bottom have been deposited by the Bella Coola River and by the present day Thorsen Creek, which has cut down through the raised alluvial fan.

The existing landfill is located on a gently sloping alluvial fan and is underlain by competent granular sediments. The excavated slope above the landfill is estimated to be in the order of 20 to 30 m high. Some localized slumping is occurring on the slope due to borrowing of cover material at the toe.

2.5 Hydrogeological Conditions

A hydrogeological assessment of the Thorsen Creek Landfill was completed by Piteau Associates in December 1993, in which test pits TP 93-1, 93-2 and 93-3 were advanced. Piteau Associates inferred that groundwater flows in a northerly direction towards Noohalk Creek and estimated a total discharge from Noohalk tributaries (which rise downgradient of the landfill) at 8 L/s. The water table was estimated to be about 2 to 4 m below the base of the landfill in the late summer, in which findings of water levels upgradient from springs rise during winter months on the order of 1 to 2 m. Springs in the area downgradient (northeast) of the landfill site where groundwater daylights prior to discharge to Noohalk Creek were observed during the 2022 site visit.

Based on review of nearby well completion data (available on BC Water Resources Atlas) and the 1993 hydrogeological assessment, it is understood that the site is underlain by a single unconfined aquifer consisting of sand and gravel alluvial sediments (single flow system). Observations collected during the drilling program completed in 2022 for monitoring well installation support this understanding, as described in Section 5.1.

A survey was completed of the site in June of 2023, which included survey of the groundwater monitoring wells installed during the 2022 field program, existing onsite water wells, and surface water levels at a number of water bodies in the vicinity of the site (including Thorsen Creek and several springs northeast of the site). Based on groundwater elevations measured at the time of the survey, groundwater flow in general appears to be to the northeast, which is generally consistent with the assumed historical direction of flow. Further information on groundwater flow interpretation is provided in Section 5.2.

2.6 Climate

Bella Coola is located in a moderate oceanic climate due to its proximity to the Pacific Ocean, falling on the borderline with the warm-summer humid continental climate and close to warm-summer Mediterranean climate and the warm-summer continental Mediterranean climate. Daily mean temperatures from month to month range from 0.2 °C to 17.3 °C. Average precipitation per month ranges from 42.3 mm during the summer months to 204.9 mm during wetter months in fall and winter, with average annual precipitation of approximately 1,199.1 mm (Environment and Climate Change Canada, Canadian Climate Normals 1981-2010).

2.7 Potential Receptors

The potential receptors within the local area of the landfill include both natural and human receptors. Water bodies and water users within a 2 km radius of the site are listed below, along with their distance from the landfill site.

Surface water bodies located near the site include the following:

- Thorsen Creek (approximately 100 m northwest of the landfill).
- Noohalk Creek (approximately 400 m northeast of the landfill).

- Bella Coola River (approximately 1 km northwest of the landfill).

Groundwater wells located near the site include the following:

Table 1: Project area groundwater well locations

Groundwater Well No.	Water Use	Approximate Distance from Landfill Property (km)	Location with Respect to Inferred Groundwater Flow Direction
107900	Water Supply System (owned by CCRD)	**Within landfill property** (located at the MSW landfill toe)	Upgradient of landfill, within site
113191	Commercial & Industrial (owned by CCRD)	**<0.1** (located within the Thorsen Creek Waste and Recycling Centre site)	Cross-gradient west of site
36791	Private Domestic	**0.9**	Upgradient west of site (separated from landfill by Thorsen Creek)
37163	Private Domestic	**0.9**	Upgradient west of site (separated from landfill by Thorsen Creek)
37853	Unknown Well Use	**0.9**	Upgradient west of site (separated from landfill by Thorsen Creek)
37923	Unknown Well Use	**0.8**	Upgradient west of site (separated from landfill by Thorsen Creek)
37938	Unknown Well Use	**0.9**	Upgradient west of site (separated from landfill by Thorsen Creek)
37939	Unknown Well Use	**0.9**	Upgradient west of site (separated from landfill by Thorsen Creek)
37970	Unknown Well Use	**0.7**	Upgradient west of site (separated from landfill by Thorsen Creek)
40422	Unknown Well Use	**0.8**	Upgradient west of site (separated from landfill by Thorsen Creek)
46273	Private Domestic	**1.0**	Upgradient west of site (separated from landfill by Thorsen Creek)
60837	Private Domestic	**0.8**	Upgradient west of site (separated from landfill by Thorsen Creek)
60838	Private Domestic	**0.8**	Upgradient west of site (separated from landfill by Thorsen Creek)
60839	Private Domestic	**0.8**	Upgradient west of site (separated from landfill by Thorsen Creek)
75742	Water Supply System	**1.0**	Upgradient west of site (separated from landfill by Thorsen Creek)
85508	Water Supply System	**1.0**	Upgradient west of site (separated from landfill by Thorsen Creek)

88139	Water Supply System	**1.0**	Upgradient west of site (separated from landfill by Thorsen Creek)
38178	Unknown Well Use (owned by BC Hydro)	**1.7**	Upgradient west of site (separated from landfill by Thorsen Creek)
33074	Private Domestic	**0.8**	Cross-gradient northwest of site (separated from landfill by Thorsen Creek)
98794	Private Domestic	**0.7**	Cross-gradient north of site (separated from landfill by Thorsen Creek)

Other water licences within a 2 km radius of the site include the following:

Table 2: Project area surface water licence locations

Water Licence No.	Water Use	Approximate Distance from Landfill Property (km)	Location with Respect to Inferred Groundwater Flow Direction
C058860	Domestic - primary licensee: Indian & Northern Affairs Canada	**1.2**	Upstream (located on Thorsen Creek)
C132209	Transportation Management (dust control) – primary licensee: Ministry of Transportation & Infrastructure	**0.6**	Cross-gradient north of site (located on Thorsen Creek)
C063238	Irrigation	**1.2**	Cross-gradient (located on a tributary to the Bella Coola River, upstream of convergence with Thorsen Creek)

3. MONITORING REQUIREMENTS

As per the Operational Certificate (MR-4223) for the Thorsen Creek Landfill, the certificate holder must collect samples from the listed locations and analyze for the required parameters as outlined in the Operational Certificate.

The following documents form the basis of landfill planning and monitoring. They are referenced throughout this report.

- Landfill Operational Certificate MR-4223 (B.C. Ministry of Environment, 2006).
- Preliminary Hydrogeological and Geotechnical Assessment for Stage 1 Solid Waste Management Plan (Piteau Associates, 1993).
- Central Coast Regional District Solid Waste Management Plan (Carey McIver & Associates, 2017).
- Draft Thorsen Creek Landfill Operations and Fill Plan (Morrison Hershfield, 2022).

In addition to the documents listed above, a revised version of the DOCP for the Thorsen Creek Landfill was prepared in 2023, which includes a revised EMP. The revised EMP will include surface water and groundwater monitoring components to identify potential environmental impacts of discharge to the receiving environment. The program requirements include installation and maintenance of groundwater monitoring wells.

A summary of the monitoring program undertaken in fall 2022 is provided in Table 3.

Table 3: Monitoring Program Summary for Groundwater and Surface Water

Monitoring Program	Sampling Locations	Sampling Parameters
Groundwater	MW22-01 MW22-02 MW22-03 MW22-04 MW22-05	Field Measurements: pH, conductivity, temperature, water elevation Laboratory Analysis: pH, conductivity, specific conductance, total suspended solids (TSS), total dissolved solids (TDS), total alkalinity (as CaCO3), bromide, chloride, fluoride, sulphate, hardness, biochemical oxygen demand (BOD), chemical oxygen demand (COD), ammonia, nitrate + nitrite, nitrate, nitrite, orthophosphate, and dissolved metals.
Surface Water	Noohalk Creek upstream of Landfill (E245136 or Noohalk Creek Upstream) Noohalk Creek upstream of Highway 20 (E239642 or Noohalk Creek Downstream)	Field Measurements: pH, conductivity, temperature, water elevation Laboratory Analysis: pH, conductivity, specific conductance, total suspended solids (TSS), total dissolved solids (TDS), total alkalinity (as CaCO3), bromide, chloride, fluoride, sulphate, hardness, biochemical oxygen demand (BOD), chemical oxygen demand (COD), ammonia, nitrate + nitrite, nitrate, nitrite, orthophosphate, and total metals.

3.1 Applicable Standards & Guidelines

Regulatory considerations under the *Environmental Management Act* that are applicable to this site include the following:

- BC Contaminated Sites Regulation (CSR) (B.C. Reg. 179/2021, July 7, 2021)
- BC Approved Water Quality Guidelines (AWQG) (BC MOE, January 2023)

Rationale for the selection of standards and guidelines that are applicable to the Thorsen Creek Landfill is provided in this section. The BC CSR standards are applied for the groundwater compliance assessment, with the BC AWQG used to assess compliance in ambient surface water bodies (i.e., Noohalk Creek).

3.1.1 Groundwater

The BC CSR water use categories include the following:

- Aquatic Life (AW)
- Irrigation (IW)
- Livestock (LW)
- Drinking Water (DW)

The BC CSR (Protocol 21, Effective November 1, 2017) specifies that AW standards apply to all groundwater located within 500 m of an aquatic receiving environment, unless it can be demonstrated that the groundwater does not flow to that receiving environment. AQ applies to groundwater located beyond 500 m of an aquatic receiving environment if the groundwater contains substances with concentrations above the AW standards and has the potential to migrate within 500 m of the aquatic receiving environment.

As identified in Section 2.7, two water bodies are located within 500 m of the landfill, including Thorsen Creek (approximately 100 m) and Noohalk Creek (approximately 450 m). There is a potential pathway for leachate migration to these two water bodies, and the groundwater standards for AW apply to this site.

IW and LW standards do not apply to groundwater at this site as no irrigation or livestock watering wells or surface water intakes are located within 500 m from the site's property boundary (based on MOE water well and iMapBC search, conducted January 2023), as described in Section 2.7. The only two water wells located within 500 m from the Thorsen Creek Landfill's property boundary are those owned by the CCRD.

A search to identify groundwater wells and surface water licences in the area surrounding the Thorsen Creek Landfill site was conducted in January 2023. This search included the Ministry of Environment's Groundwater Wells and Aquifers Well Search tool, as well as water licenses listed on iMap BC. No drinking water wells or surface water intakes are located within 500 m of the site boundaries, as described in Section 2.7. Current drinking water use is therefore not considered applicable at the site. However, as outlined in Protocol 21 of the BC CSR (2017), consideration of future drinking water use is required for saturated geological units with suitable

hydraulic properties and natural water quality to support a single-family domestic water supply, in the absence of a natural confining barrier. A yield greater than or equal to 1.3 L/min is considered capable of supporting a single family domestic water supply (although future drinking water use does not apply to saturated unconsolidated geological units with hydraulic conductivities less than 1 x 10^{-6} m/s). Based on initial groundwater sampling results, aquifer natural water quality has not been demonstrated to be unsuitable for use as a domestic water supply as per Protocol 21 of the BC CSR (2017). Based on material encountered during the drilling program, and yield records of wells in the area as listed on iMap BC (CCRD wells 107900 and 113191), it is expected that the yield of the aquifer in the area is much higher than 1.3 L/min. Therefore, the aquifer must be considered as having potential for future drinking water use and the groundwater standards for DW apply to this site.

Groundwater data is therefore compared to the BC CSR standards for Aquatic Life and Drinking Water use.

A summary of the groundwater quality results is provided in Section 5.2.

3.1.2 Surface Water

Approved water quality guidelines in BC are protective of ambient surface water quality for six water uses as follows:

- Drinking Water
- Aquatic Life (freshwater and marine)
- Wildlife
- Recreation and Aesthetics
- Agriculture (irrigation and livestock watering)
- Industrial

Surface water data collected from Noohalk Creek was compared to the freshwater aquatic life guidelines. These guidelines are applicable for better understanding potential impacts to surface water quality in the area inferred to be downgradient of the site. The guidelines for drinking water or agriculture were not included in this comparison for the same reasons described in discussion of groundwater standards in Section 3.1.1.

A summary of the groundwater quality results is provided in Section 5.2.

4. METHODOLOGY

4.1 Overview of Drilling, Monitoring Well Installation & Well Development

Groundwater monitoring wells were installed as part of the 2022 field program in order to establish sampling locations for groundwater quality at the Thorsen Creek Landfill site.

The field drilling program involved advancing boreholes using a track mounted ODEX air rotary drill rig and recording sub-surface information including field borehole logs for each location, based on observations of material recovered from the casing annulus. The boreholes were advanced until groundwater was reached, to a final depth based on groundwater observations and the type of soil encountered.

Once target depth was reached, groundwater monitoring wells were constructed and installed in accordance with the BC Field Sampling Manual, Standard Operating Procedure for Monitoring Well Construction & Installation (SOP-E2-01) and BC Contaminated Sites Regulation Technical Guidance 8 Groundwater Investigation and Characterization.

The monitoring wells were constructed with 2” diameter new Schedule 40 PVC pipe. Screen intervals were constructed with 50 mm (2”) diameter #10 (0.25 mm) slotted PVC screens typically 1.5 m. The screen depth and length of each well was selected in the field based on observations made during drilling (full borehole logs including well installation details are included in Appendix A). Filter sand was placed around the screened interval to form a filter pack. Hydrated bentonite chips and/or pellets were then used to fill the well annulus from the filter sand to the surface, to create a seal to prevent infiltration of surface water into the well. Wells were installed with an approximately 1 m stickup, J-plug cap, and a metal well casing.

Following installation, each monitoring well was developed (prior to sample collection, as outlined in Section 4.2.1). Monitoring wells were developed manually using Waterra tubing and a foot valve with surge block to clear any fine sediments within the screen interval. A minimum of three well bore volumes was removed from each well during development activities.

4.1.1 Geodetic Survey

Following the installation of new groundwater monitoring wells and subsequent groundwater and surface water sampling completed in fall of 2022, a geodetic site survey was completed in spring of 2023 by Exton & Dodge Land Surveying Inc. This included survey of the following:

- All groundwater monitoring locations listed in Table 4 as well as the existing onsite water well within the landfill (Well No. 107900 in Table 1). Well surveys included ground surface and top of casing elevation at each well.
- Surface water level at three locations along Thorsen Creek, and a number of surface water spring locations where daylighting was observed to the northeast of the site at the time of the survey.

- Topographic survey of the landfill area.

Static water levels were measured within each of the groundwater wells surveyed again at the time of the survey. The geodetic groundwater and surface water levels measured at the time of the survey are presented in Figure 3.

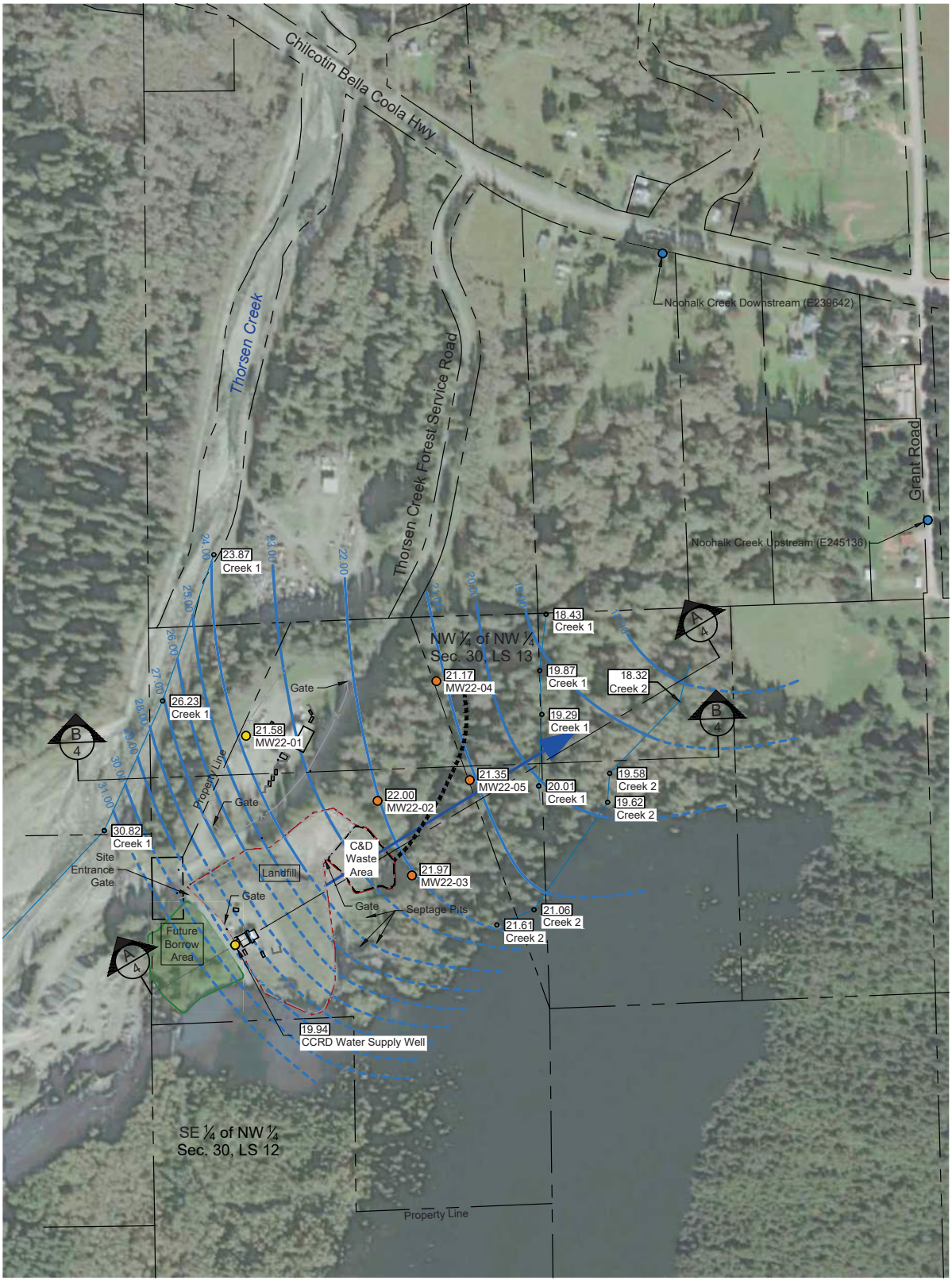
4.2 Overview of Water Sampling Locations & Schedule

Groundwater and surface water monitoring locations are shown in Figure 3.

Groundwater monitoring locations are identified as MW (monitoring well) and a number indicating the year of installation, followed by an additional number to indicate the specific well's ID (e.g., MW22-03, MW22-05). Surface water sample locations sampled in 2022 are previously established sites on Noohalk Creek, with one located upstream of the landfill site (E245136/Noohalk Creek Upstream) and the second located upstream of the bridge across Highway 20, but downstream of the landfill site (E239642/Noohalk Creek Downstream).

Field parameters were measured at all surface water and groundwater monitoring locations. The field parameters measured include pH, temperature, dissolved oxygen, and conductivity. Field parameters were measured using a YSI model 556 multi-probe meter. At groundwater monitoring wells, static water levels were also measured prior to purging the wells. Samples were collected in laboratory-provided containers for all laboratory-analyzed parameters and stored either in a refrigerator or in coolers with ice prior to delivery to the laboratory.

The 2022 groundwater and surface water monitoring program was completed by Morrison Hershfield staff, with onsite assistance provided by Ken McIlwain of the CCRD. Samples were collected between October 31 and November 2, 2022.



Legend:

- Property Line
- Extent Of Waste
- Fence Line
- Extent Of C&D Waste
- Future Borrow Area
- Surface Water Sampling Location
- 2022 Groundwater Monitoring Well Location
- Existing CCRD Groundwater Monitoring Well Location
- Interpreted Groundwater Flow Direction (June 2023)
- Surface Water Survey Location
- 21.61 Surveyed Water Level (June 2023, masl)
- Groundwater Elevation
- Interpreted Groundwater Elevation
- Approximate Access Road Location

MORRISON HERSHFIELD

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CCRD Environmental Monitoring
Figure 3 - Water Quality Monitoring Locations

210629400
Oct 10, 2023

X:\Proj\2021\210629400-CCRD Landfill Engineering Services\08. CAD\09 Sketches\CCRD Environmental Monitoring\Figure 3 Water Quality Monitoring.dwg Plotted: by Warren Pare

4.2.1 Groundwater Monitoring

Four monitoring wells were installed during the 2022 field program (MW22-02, MW22-03, MW22-04, and MW22-05); well installation was completed on November 1 and 2, 2022, as described in Section 4.1.

The groundwater monitoring wells were installed at locations assumed to be cross-gradient or down-gradient of the landfill to monitor the potential migration of leachate and associated impacts. In addition to the four new monitoring wells installed, two water supply wells owned by the CCRD were already in place on the site: one located within the Thorsen Creek Landfill site (adjacent to access road along the site sea can and storage sheds), and one located within the Thorsen Creek Waste and Recycling Centre area, near the free shed (referred to as MW22-01). Both existing wells had water levels measured from the top of the well casings during the 2022 site visit. Due to drill refusal at the originally planned location of a fifth monitoring well representing up-gradient/background conditions, the existing well MW22-01 was sampled as a background well.

Table 4 provides a summary of groundwater well details from the 2022 program. Locations for each well were identified based on the assumed direction of groundwater flow, derived from historical site observations (see Section 2.5 for additional information). The groundwater flow gradient and location of each well with respect to this gradient was later confirmed by a site survey in June of 2023.

Table 4: Groundwater Well Installation Locations

Site	Site Description
MW22-01	Existing well, located cross-gradient from the landfill mass
MW22-02	Installed in 2022, located immediately down-gradient of the northern extent of the MSW landfill footprint
MW22-03	Installed in 2022, located immediately down-gradient of the C&D landfill footprint
MW22-04	Installed in 2022, located down-gradient of the landfill, at the property boundary
MW22-05	Installed in 2022, located down-gradient of the landfill, at the property boundary

Static water levels were measured in all groundwater wells and recorded following installation, after which newly installed wells were developed using dedicated HDPE tubing and foot valves equipped with surge blocks.

Following development, wells were allowed time to recharge to static water elevations and samples were collected using the same dedicated tubing and foot valves. The existing well MW22-01 was also purged and sampled as a background well. The purge of MW22-01 was completed using the built-in purge pump equipped for maintenance purposes.

All groundwater samples collected for dissolved metals analysis were filtered through a 0.45 micron in-line filter and preserved using laboratory-supplied preservatives in the field. Samples were stored in coolers packed with ice. In addition to collecting samples for laboratory analysis,

field parameters were also measured using a YSI model 556 multi-probe meter. The static water level depth in each well was also measured prior to sample collection. Laboratory analyses for all of the samples were performed by ALS Environmental in Burnaby, BC. Appendix B provides a summary of the analytical results associated with groundwater monitoring.

4.2.2 Surface Water Monitoring

Surface water samples were collected from the two sampling locations identified in the Operational Certificate, both located on Noohalk Creek. Table 5 provides a summary of the two surface water sampling locations. The provided description of each location is based on the assumed direction of surface and groundwater flow, derived from historical site observations (see Section 2.3 and 2.5 for additional information).

Table 5: Surface Water Sampling Locations

Site	Site Description
Noohalk Creek Upstream (E245136)	Small creek, located upstream of surface/groundwater flow path leaving the landfill site. Sample was collected from the upstream side of a bridge along Grant Road, south of Highway 20.
Noohalk Creek Downstream (E239642)	Small creek, located downstream of surface/groundwater flow path leaving the landfill site. Sample was collected from the upstream side of a bridge along Highway 20. Just upstream of a bridge along Highway 20, Noohalk Creek (draining from the southeast) joins another tributary (draining from the southwest). Sample was collected from Noohalk Creek just upstream of the convergence with the other tributary.

All surface water samples were preserved in the field as required and stored in coolers packed with ice. In addition to collecting samples for laboratory analysis, field parameters were also measured using a YSI model 556 multi-probe meter. Laboratory analyses for all of the samples were performed by ALS Environmental in Burnaby, BC. Appendix B provides detailed analytical results associated with surface water monitoring.

4.3 Quality Assurance and Quality Control (QA/QC)

In addition to using an accredited laboratory, QA/QC measures were applied to the monitoring program to assess the accuracy and precision of the field results and the laboratory testing procedures. During the 2022 surface and groundwater sampling program, a field blank was collected and submitted for analysis. Field blanks are prepared using laboratory-provided de-ionized water and are used to confirm that contamination of samples has not been introduced as a result of the sample collection process. A duplicate sample was also collected from one monitoring location during the field program. The samples were transported in laboratory supplied coolers, remained closed, and were only reopened in the laboratory for analysis.

5. RESULTS AND DISCUSSION

Water quality monitoring at the Thorsen Creek Landfill included a broad suite of parameters, including the following groups of parameters as outlined in the Operational Certificate for the facility:

- Dissolved & total metals
- Hardness
- Alkalinity
- Total Suspended Solids
- Total Dissolved Solids
- Ammonia
- Nitrate, Nitrite, and Nitrate + Nitrite
- Chemical Oxygen Demand (COD)
- Biochemical Oxygen Demand (BOD)

In addition to the above parameters as required by the Operational Certificate, select parameters related to hydrocarbons were sampled from each location; these additional parameters were intended as a one-time investigation into potential hydrocarbon presence in groundwater and surface water at the site, and are not proposed to be incorporated into future monitoring programs. These additional parameters included the following:

- Volatile Organic Compounds (VOCs)
- Extractable and Volatile Hydrocarbons (EPH & VH)
- BTEX
- Polycyclic Aromatic Hydrocarbons (PAHs)

There are a limited number of key parameters that have been reviewed as both landfill related *indicator* parameters and parameters of potential concern:

Indicator parameters are compounds that are reliable indicators of groundwater impacts from waste disposal, but in of themselves may not be a compound of concern. For the purposes of this water quality review, the landfill-related indicator parameters assessed include:

- chloride,
- conductivity,
- hardness,
- sulfate, and
- iron and manganese.

Parameters of potential concern at landfill sites consist primarily of ammonia (which can be toxic to aquatic life if it reaches an aquatic receptor at high enough concentrations). Other parameters of concern, may include presence of:

- hydrocarbons and/or volatile organic compounds, and
- possibly elevated concentration of heavy metals.

5.1 Monitoring Well Installation

Site reconnaissance was performed by Morrison Hershfield and CCRD on October 31, 2022 to confirm the locations of proposed groundwater monitoring wells with respect to access for the drill rig. Drilling was completed over the course of two days (November 1 and 2, 2022) and supervised by Morrison Hershfield's field engineer. During drilling, subsurface conditions were recorded on field forms, which are available in Appendix A.

A summary of well completion information is provided in Table 6 below.

Table 6: Well completion details

Site	Total Depth (mbgs[1])	Approximate Water Table Depth (Nov. 2023; mbgs[1])	Approximate Water Table Elevation (Nov. 2023; masl[2])	Screen Interval (mbgs[1])
MW22-01[3]	7.3 (first location) 8.8 (second location)	N/A	N/A	N/A
MW22-02	7.6	2.7	24.0	6.1 – 7.6
MW22-03	5.8	4.3	20.7	3.8 – 5.3
MW22-04	5.5	3.0	20.9	4.0 – 5.5
MW22-05	5.8	1.8	21.6	4.3 – 5.8

The originally proposed location of monitoring well MW22-01 was at the southwest corner of the landfill site, outside the site entrance gate and near the west property boundary. This location

[1] Units of mbgs refer to "meters below ground surface".

[2] Units of masl refer to "meters above sea level"

[3] In Table 7 and Appendix A, MW22-01 refers to the attempted drilling locations where a new background well was proposed; however, well installation could not be completed due to ground conditions, so all other references to MW22-01 refer to the existing onsite water supply well at the Thorsen Creek Waste and Recycling Center, from which samples were collected to represent background conditions.

would be considered the background monitoring well as it is located upgradient of the landfill. However, drilling was attempted in two locations in this area, and in both cases, substantial subsurface rocks and boulders caused the drill casing to stick and drilling had to be terminated prior to encountering the groundwater table. As such, no monitoring well could be installed in the originally proposed MW22-01. Sampling was instead conducted from an existing water supply well located at the Thorsen Creek Waste and Recycling Center site (as described in Section 4.2.1 and shown in Figure 3).

5.2 Groundwater

MW22-01 is located cross-gradient to the landfill and is used to represent the local background conditions for the area, to provide a method to identify parameters that occur at natural or background elevated levels in the local groundwater environment.

MW22-02 and MW22-03 are located immediately adjacent to the landfill footprint and are intended to provide indicators for parameters immediately down-gradient of the waste material. MW22-04 and MW22-05 are located further down-gradient, along the property line of the landfill site, to provide an indication of the groundwater quality at the landfill property boundary. These two locations are considered the landfill compliance locations.

A summary of the groundwater quality results compared to the applicable standards and guidelines are provided in Table 8 and Table 9. Detailed laboratory results are provided in Appendix B.

The following summarizes the groundwater exceedances of the guidelines adopted for the monitoring program conducted in 2022 (see Section 3.1.1 for an explanation of guidelines used).

BC Contaminated Sites Regulation, Schedule 3.2 (Aquatic Life & Drinking Water)

- No parameters exceeded the BC CSR standards for freshwater Aquatic Life in 2022.
- Cobalt at MW22-05 exceeded the BC CSR standard for Drinking Water in 2022.

5.2.1 Discussion

Monitoring wells MW22-04 and MW22-05 are situated at the approximate property boundary between the landfill site and adjacent properties. All BC CSR standards were met at these two wells, with the exception of the cobalt standard for Drinking Water in MW22-05, which was exceeded (with a concentration of 0.00455 mg/L compared to the standard of 0.001 mg/L). There were no exceedances of the BC CSR at any other wells onsite.

Although not in exceedance of the BC CSR standards, ammonia is elevated particularly at wells MW22-02 and MW22-05. Ammonia is a parameter that would be expected to be elevated in association with the septage pits located at the east end of the site, and it is probable that these pits are influencing groundwater conditions in their vicinity. The location of the septage pits in

relation to the landfill makes it difficult to differentiate the ammonia concentration contributed by each of these potential sources.

Chloride and hardness are considered indicator parameters for landfill leachate. Both chloride and hardness are elevated at wells MW22-02 and MW22-05 compared to other locations, suggesting that landfill leachate has influenced groundwater quality at both of these wells.

Sulfate in groundwater at landfill sites can be indicative of drywall in the waste stream. Although sulfate is not in exceedance of the BC CSR standards at any of the groundwater wells sampled, it is elevated at MW22-05 compared to other locations on site, indicating influence of leachate at this location.

No detectable hydrocarbons were identified in any groundwater samples.

In general, groundwater sampling results at the site indicate some influence of landfill leachate on groundwater, which is expected. The highest level of impacts based on 2022 sampling is associated with wells MW22-02 and MW22-05. Comparatively lower concentrations of indicator parameters were observed in MW22-03, which is located approximately upgradient of MW22-05 based on the observed direction of groundwater flow from the landfill site. The location of impacts and the gradient of static water level elevations suggests that Thorsen Creek is a groundwater recharge zone, and flow may be occurring in a slightly more easterly direction as it passes through the site, before diverging more to the northeast due to the influence of topography to the southeast of the site. Groundwater contours and interpreted flow direction (including consideration of nearby surface water elevations) is shown in Figure 3.

Although MW22-01 (existing well) and the existing landfill water supply well (Well No. 107900) were also surveyed and its static water level measured during the 2023 survey, results at these well were not included in groundwater contour development and flow mapping. The water table observed at these well was lower than other wells at the site, which is expected to be a result of the wells' deeper installation depths compared to newly installed wells, and influence of a stronger downward gradient at these locations nearer to Thorsen Creek. These observations support the understanding of Thorsen Creek as a groundwater recharge site.

Given the observations at other surveyed locations and the topography surrounding the site, groundwater flow is still expected to occur in an east/northeast direction. There may also be seasonal variability in flow direction in order for impacts to be detected in both MW22-02 and MW22-05, but not MW22-03, as observed.

5.3 Surface Water

The surface water monitoring locations outlined in the Operational Certificate for the Thorsen Creek Landfill are both located on Noohalk Creek. Based on the assumed direction of groundwater flow leaving the Thorsen Creek Landfill site, the surface water monitoring locations were selected with the intention of one being situated upstream of any leachate impacts reporting to the creek, and one being situated downstream of any such impacts. Samples were collected from both locations in 2022. Historical water quality data is also available from previous sampling of the two surface water locations. Table 7 below presents a comparison of

select parameters from the two surface water monitoring locations between samples collected in 2013 and 2022.

Table 7: Surface water quality historical comparison

Parameter	Units	Noohalk Creek Upstream of Landfill (E245136)		Noohalk Creek Downstream of Landfill (E239642)	
		Dec. 18, 2013	Oct. 31, 2022	Dec. 18, 2013	Oct. 31, 2022
Field Parameters					
Temperature	°C	6.1	6.1	6.1	5.8
pH	N/A	7.1	5.8	6.7	6.3
Conductivity	uS/cm	36.4	36.2	47.4	18.4
Laboratory Parameters					
Hardness	mg/L	11.6	10.9	15.1	12.6
Total Alkalinity ($CaCO_3$)	mg/L	7.51	5.6	10.9	7.0
Sulphate	mg/L	3.89	2.29	4.01	2.91
Chloride	mg/L	0.91	<0.50	2.4	1.22
Nitrate	mg/L	0.530	0.740	0.474	0.763
Nitrite	mg/L	<0.0050	<0.0010	<0.0050	0.0010
Nitrate + Nitrite	mg/L	0.530	0.740	0.474	0.764
Orthophosphate	mg/L	<0.0050	<0.0010	<0.0050	0.0012

A summary of the surface water monitoring results compared to the applicable standards and guidelines is provided in Table 10 and Table 11. Detailed laboratory results is provided in Appendix B.

The following summarizes the surface water exceedances of the guidelines noted in the samples collected in 2022 (see Section 3.1.2 for an explanation of guidelines used).

BC Ambient Water Quality Guidelines

- Aluminum concentrations exceeded the BC AWQG at both the upstream and downstream Noohalk Creek locations in 2022.
- Iron concentration exceeded the guideline at the downstream Noohalk Creek location in 2022.

5.3.1 Discussion

The only landfill leachate indicator with concentrations above guidelines for surface water in 2022 was iron at the Noohalk Creek downstream location. Though the downstream sample was the only location which exceeded the guideline, upstream and downstream concentrations were still only slightly different (downstream iron concentration of 0.33 mg/L versus upstream iron

concentration of 0.28 mg/L). Although not considered an indicator parameter, aluminum was above guidelines at both the upstream and downstream surface water locations in 2022. No other guideline exceedances were identified in surface water samples collected in 2022, and no detectable hydrocarbons were identified in any surface water samples. No metals samples were collected in 2013 so comparison to historical results is only available for the parameters listed in Table 7.

In both 2013 and 2022, there was a slight elevation in concentrations of chloride, conductivity, hardness and sulphate at the downstream Noohalk Creek sampling location compared to the upstream location. As with iron, the differences in upstream and downstream concentrations of the conductivity, hardness and sulphate were slight, with downstream concentrations only in the order of 10-30% higher than upstream. Chloride was below laboratory detection limits in the upstream sample, but found in a concentration of 1.2 mg/L downstream in 2022.

Between the northeast end of the landfill and Noohalk Creek, several groundwater springs (where groundwater daylights to surface) have been observed. Spring sites that were visible in June 2023 were surveyed and incorporated into groundwater flow mapping, and supported the inferred direction of groundwater flow generally being to the northeast. Based on the groundwater flow direction, samples from the groundwater springs may be more representative and provide a better option for sampling. The current surface water sampling locations at Noohalk Creek are a greater distance away from the landfill (approximately 400 m) compared to these groundwater springs (approximately 100-200 m range). The Noohalk Creek sampling points are separated from the landfill site by several residences and other factors which have the potential to influence surface water quality in Noohalk Creek; it is therefore difficult to isolate the impacts of the landfill on this creek from other sources of interference.

5.4 Quality Assurance and Quality Control (QA/QC)

A QA/QC program was implemented for water quality sampling which included collection of a duplicate water quality sample from one of the groundwater monitoring locations (MW22-02). This duplicate sample was submitted for the same analyses as the primary sample.

The Relative Percent Difference (RPD) is an indicator of measurement precision for analyzed parameters, calculated as follows:

$$RPD\ (\%) = \frac{2(X1 - X2)}{X1 + X2} x\ 100\%$$

Where X1 is the original sample's analytical result and X2 is that of the duplicate sample.

Where the concentrations of a parameter for one or both samples was less than five times the laboratory's reported method detection limit (MDL) for that parameter, the RPD value was not calculated, as increased error is associated with measurements in this range. The BC Environmental Laboratory Manual recommends an RPD of 20% for metals and general inorganics in water, and an RPD of 30% for organics in water, where concentrations greater than five times the MDL (B.C Ministry of Environment and Climate Change Strategy, 2020). RPD values greater than 50% can indicate intrinsic variability and potential issues in analytical results for the parameter.

For the groundwater duplicate sample collected, two parameters were outside of the 20% RPD recommendation: Total Suspended Solids (RPD of 23%) and Dissolved Aluminum (RPD of 120%). All other analytes were below the acceptability criteria. Overall, these results suggest that sampling produced reproducible results. The potential exception to this is dissolved aluminum in the duplicate; although analytical results for this parameter demonstrated a high level of variability between the duplicate and primary sample, neither result was within an order of magnitude of the BC CSR Drinking Water standard for aluminum (there is no BC CSR Aquatic Life standard for aluminum), and therefore this variability is not expected to impact the conclusions and recommendations of the sampling program.

6. CONCLUSIONS AND RECOMMENDATIONS

Conclusions with respect to groundwater and surface water monitoring at the site during the 2022 program include the following:

- Indicators of leachate-influenced groundwater appear at this time in locations down-gradient of the landfill, including chloride, hardness, and sulfate. Impacts appear to be most prevalent at MW22-05 (located near the site property line), and at MW22-02 (located adjacent to the current C&D waste cell).
- Cobalt exceeded the BC CSR standard for Drinking Water use in the sample collected from MW22-05 in 2022.
- Ammonia concentrations were also high in MW22-02 and MW22-05 compared to other groundwater monitoring wells, which is possibly due to the influence of the septage pits located at the east end of the site.
- Surface water quality results from Noohalk Creek in 2022 were relatively consistent with the data obtained from 2013 sampling.
- In surface water from Noohalk Creek, aluminum (upstream and downstream) and iron (downstream) marginally exceeded the BC AWQG in 2022.

Recommendations for further work at the CCRD's Thorsen Creek Landfill site to obtain additional information that will be used to inform the detailed EMP for the new DOCP include the following:

- To develop a basis for year-on-year comparison of data and trends (particularly to confirm the exceedance of cobalt in MW22-05), monitoring at the five groundwater wells should be continued. Twice annual sampling is recommended (once in the spring/summer and once in the fall).
- Measurement of groundwater elevations in all onsite wells should occur twice annually at a minimum, to identify any seasonal variation in groundwater flow direction.
- Discontinue sampling of BOD and COD in both groundwater and surface water, as these indicators are typically most useful when assessing information related to leachate collection and treatment, when raw leachate is sampled. For this site operating as a natural attenuation landfill, the leachate is relatively dilute and in our opinion these parameters provide little value.
- Due to the distance between the landfill site and Noohalk Creek (approximately 400 m), and the potential influence of properties and interference between the two, there are multiple factors that could affect the surface water quality at this sampling location (including the landfill) and it is not possible to determine the source of impacts with confidence if exceedances are identified. It is therefore proposed that sampling of Noohalk Creek be discontinued.
- In order to establish a more representative surface water sampling location, it is recommended that CCRD undertake a conductivity survey of spring locations

located to the northeast of the landfill where groundwater is observed to be daylighting (measurements taken with a field conductivity probe). A sample should be collected from the location measured as having the highest field conductivity (for analysis of all surface water parameters, including dissolved metals in addition to total metals in this initial sample). Sampling of the spring is intended to assess whether this location would be a suitable replacement as a long-term receiving environment monitoring point.

7. DISCLAIMER

CCRD retained Morrison Hershfield to conduct the work described in this report, and this report has been prepared solely for this purpose.

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8. CLOSURE

We trust the information presented in this report meets your requirements. If you have any further questions or need addition details, please do not hesitate to contact one of the undersigned.

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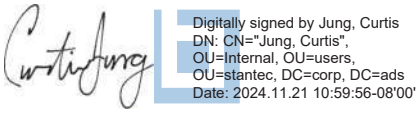

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TABLE 8: 2022 GROUNDWATER QUALITY - GENERAL CHEMISTRY AND DISSOLVED METALS

					MW22-01	MW22-02	MW22-03	MW22-04	MW22-05
					2-Nov-22	2-Nov-22	2-Nov-22	2-Nov-22	2-Nov-22
Analyte	**Units**	**LOR**	**Sch. 3.2 Water FAW***	**Sch. 3.2 Water DW****					
Field Parameters									
Field Conductivity	uS/cm	-	-	-	219.0	141.1	124.6	96.3	177.7
Temperature	C	-	-	-	6.1	7.4	7.4	6.4	8.3
pH	-	-	-	-	6.55	6.34	6.77	7.4	6.17
Dissolved Oxygen	mg/L	-	-	-	8.32	1.74	1.9	2.05	1.73
Oxidation Reduction Potential	-	-	-	-	116.9	46.5	80.3	19.7	57.2
General Chemistry									
Conductivity	uS/cm	2	-	-	31.5	207	173	169	257
Hardness (as CaCO3)	mg/L	0.5	-	-	11.2	74.1	61.8	41.7	72.3
pH	pH	0.1	-	-	6.93	7.34	7.29	7.54	7.37
Total Dissolved Solids	mg/L	1	-	-	29	114	111	120	148
Total Suspended Solids	mg/L	3	-	-	<3.0	181	104	1120	179
BOD	mg/L	2	-	-	<2.0	12.2	7.1	4.0	45.6
COD	mg/L	10	-	-	<10	51	48	135	91
TOC	mg/L	0.5	-	-	<0.50	13.8	8.95	44.8	27.6
Anions and Nutrients									
Alkalinity, Total (as CaCO3)	mg/L	1.0	-	-	7.60	90.40	60.40	82.80	77.10
Ammonia, Total (as N)	mg/L	0.0050	pH & Temp based 1.31 @ pH >= 8.5 3.7 @ pH 8.0-8.5 11.3 @ pH 7.5-8.0 18.5 @ pH 7.0-7.5 18.4 @ pH < 7.0	-	<0.0050	3.69	1.80	0.02	3.65
Bromide (Br)	mg/L	0.050	-	-	<0.050	<0.050	<0.050	<0.050	<0.050
Chloride (Cl)	mg/L	0.50	1500	250	<0.50	0.99	8.44	1.23	4.09
Fluoride (F)	mg/L	0.020	H based 2 @ H < 50 3 @ H >= 50	1.5	<0.040	0.096	0.063	0.067	<0.060
Nitrate and Nitrite (as N)	mg/L	0.0051	400	10	0.268	0.0076	0.826	0.210	<0.0051
Nitrate (as N)	mg/L	0.0050	400	10	0.268	0.0050	0.822	0.210	<0.0050
Nitrite (as N)	mg/L	0.0010	Cl based 0.2 @ Cl < 2 mg/L 0.4 @ Cl 2-4 mg/L 0.6 @ Cl 4-6 mg/L 0.8 @ Cl 6-8 mg/L 1.0 @ Cl 8-10 mg/L 1.2 @ Cl > 10 mg/L	1	<0.0010	0.0026	0.0044	<0.0010	<0.0010
Ortho-phosphate (P)- Dissolve	mg/L	0.0010	-	-	<0.0010	0.0014	0.0022	0.0020	<0.0010
Sulfate (SO4)	mg/L	0.30	H based 1280 @ H <= 30 2180 @ H 31-75 3090 @ H 76-180 4290 @ H >180	500	4.73	9.93	6.50	8.60	39.1
Dissolved Metals									
Aluminum (Al)-Dissolved	mg/L	0.0010	-	9.5	0.0022	0.0389	0.0204	0.0314	0.257
Antimony (Sb)-Dissolved	mg/L	0.00010	0.09	0.006	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Arsenic (As)-Dissolved	mg/L	0.00010	0.05	0.010	<0.00010	0.00137	0.00012	<0.00010	0.00050
Barium (Ba)-Dissolved	mg/L	0.00010	10	1	0.00568	0.0638	0.0564	0.0298	0.0878
Beryllium (Be)-Dissolved	mg/L	0.00010	0.0015	0.008	<0.000100	<0.000100	<0.000100	<0.000100	<0.000100
Bismuth (Bi)-Dissolved	mg/L	0.000050	-	-	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Boron (B)-Dissolved	mg/L	0.010	12	5	<0.010	0.163	0.055	<0.010	0.272
Cadmium (Cd)-Dissolved	mg/L	0.0000050	H based 0.0005 @ H <30 0.0015 @ H 30-<90 0.0025 @ H 90-<150 0.0035 @ H 150-<210 0.004 @ H >= 210	0.005	<0.0000050	0.0000154	0.0000194	0.0000138	0.0000206
Calcium (Ca)-Dissolved	mg/L	0.050	-	-	3.98	25.7	20.8	15.1	24.1
Cesium (Cs)-Dissolved	mg/L	0.000010	-	-	<0.000010	0.000035	0.000032	<0.000010	0.000080
Chromium (Cr)-Dissolved	mg/L	0.00010	0.01	0.05	<0.00050	<0.00050	<0.00050	<0.00050	0.00085
Cobalt (Co)-Dissolved	mg/L	0.00010	0.04	0.001	<0.00010	0.00052	0.00067	0.00020	0.00455
Copper (Cu)-Dissolved	mg/L	0.00020	H based 0.02 @ H < 50 0.03 @ H 50 - <75 0.04 @ H 75 - <100 0.05 @ H 100 - < 125 0.06 @ H 125 - <150 0.07 @ H 150 - < 175 0.08 @ H 175 - <200 0.09 @ H >= 200	1.5	0.00257	0.00144	0.00221	0.00045	0.00192
Iron (Fe)-Dissolved	mg/L	0.010	-	6.5	<0.010	0.037	0.012	0.053	4.01
Lead (Pb)-Dissolved	mg/L	0.000050	H based 0.04 @ H <50 0.05 @ H 50 - <100 0.06 @ H 100 - <200 110 @ H 200 - <300 160 @ H >= 300	0.01	0.000064	<0.000050	<0.000050	<0.000050	<0.000050
Lithium (Li)-Dissolved	mg/L	0.0010	-	0.008	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Magnesium (Mg)-Dissolved	mg/L	0.0050	-	-	0.303	2.41	2.40	0.980	2.94
Manganese (Mn)-Dissolved	mg/L	0.00010	-	1.5	0.00102	0.221	0.147	0.0438	0.547
Mercury (Hg)-Dissolved	mg/L	0.0000050	0.00025	0.001	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Molybdenum (Mo)-Dissolved	mg/L	0.000050	10	0.25	0.00110	0.00402	0.00120	0.000807	0.00142

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TABLE 8: 2022 GROUNDWATER QUALITY - GENERAL CHEMISTRY AND DISSOLVED METALS

					MW22-01	MW22-02	MW22-03	MW22-04	MW22-05
					2-Nov-22	2-Nov-22	2-Nov-22	2-Nov-22	2-Nov-22
Analyte	**Units**	**LOR**	**Sch. 3.2 Water FAW***	**Sch. 3.2 Water DW****					
Nickel (Ni)-Dissolved	mg/L	0.00050	H based 0.25 @ H < 60 0.65 @ H 60 - <120 1.1 @ H 120 - < 180 1.5 @ H >= 180	0.08	<0.00050	0.00059	0.00107	<0.00050	0.00189
Phosphorus (P)-Dissolved	mg/L	0.050	-	-	<0.050	<0.050	<0.050	<0.050	<0.050
Potassium (K)-Dissolved	mg/L	0.050	-	-	0.817	5.41	3.59	1.21	4.19
Rubidium (Rb)-Dissolved	mg/L	0.00020	-	-	0.00088	0.00559	0.00443	0.00107	0.00830
Selenium (Se)-Dissolved	mg/L	0.000050	0.02	0.01	0.000060	0.000070	0.000151	0.000138	0.000096
Silicon (Si)-Dissolved	mg/L	0.050	-	-	2.92	3.43	4.44	3.38	3.40
Silver (Ag)-Dissolved	mg/L	0.000010	H based 0.0005 @ H <= 100 0.015 @ H > 100	0.02	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)-Dissolved	mg/L	0.050	-	200	0.801	5.82	7.47	7.35	13.9
Strontium (Sr)-Dissolved	mg/L	0.00020	-	2.5	0.0221	0.0905	0.0682	0.0600	0.0942
Sulfur (S)-Dissolved	mg/L	0.50	-	-	1.45	3.84	2.40	2.52	13.7
Tellurium (Te)-Dissolved	mg/L	0.00020	-	-	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Thallium (Tl)-Dissolved	mg/L	0.000010	0.003	-	<0.000010	0.000042	0.000041	<0.000010	0.000065
Thorium (Th)-Dissolved	mg/L	0.00010	-	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Tin (Sn)-Dissolved	mg/L	0.00010	-	2.5	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)-Dissolved	mg/L	0.00030	1	-	<0.00030	0.00043	<0.00030	<0.00090	0.00837
Tungsten (W)-Dissolved	mg/L	0.00010	-	0.003	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Uranium (U)-Dissolved	mg/L	0.000010	0.085	0.02	<0.000010	0.000277	0.000096	0.000175	0.000134
Vanadium (V)-Dissolved	mg/L	0.00050	-	0.02	<0.00050	0.00368	<0.00050	<0.00050	0.00240
Zinc (Zn)-Dissolved	mg/L	0.0010	H based 0.075 @ H <90 0.15 @ H 90 -<100 0.9 @ H 100 - <200 1.65 @ H 200 - <300 2.4 @ H 300 - <400	3	0.0011	0.0012	<0.0010	<0.0010	0.0033
Zirconium (Zr)-Dissolved	mg/L	0.000020	-	-	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020

***Standard: British Columbia Contaminated Sites Regulation (July, 2021) - Schedule 3.2 Water Standards Freshwater Aquatic Life**

****Standard: British Columbia Contaminated Sites Regulation (July, 2021) - Schedule 3.2 Water Standards Drinking Water**

*****Guideline: British Columbia Approved and Working Water Quality Guidelines (August, 2019) - BCAWWQG - Freshwater Aquatic Life**

Color Key: Exceeds CSR Standard - FAW | Exceeds CSR Standard - DW

MORRISON HERSHFIELD

TABLE 9: 2022 GROUNDWATER QUALITY - PETROLEUM HYDROCARBONS

					MW22-01	MW22-02	MW22-03	MW22-04	MW22-05
					2-Nov-22	2-Nov-22	2-Nov-22	2-Nov-22	2-Nov-22
Analyte	**Units**	**LOR**	**Sch. 3.2 Water FAW***	**Sch. 3.2 Water DW****					
Volatile Organic Compounds									
Benzene	mg/L	0.00050	0.4	0.005	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Bromodichloromethane	mg/L	0.00050	-	0.1	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Bromoform	mg/L	0.00050	-	0.1	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Carbon Tetrachloride	mg/L	0.00050	0.13	0.002	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Chlorobenzene	mg/L	0.00050	0.013	0.08	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Dibromochloromethane	mg/L	0.00050	-	0.1	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Chloroethane	mg/L	0.00050	-	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Chloroform	mg/L	0.00050	0.02	0.1	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Chloromethane	mg/L	0.0050	-	-	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
1,2-Dichlorobenzene	mg/L	0.00050	0.007	0.2	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
1,3-Dichlorobenzene	mg/L	0.00050	1.5	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
1,4-Dichlorobenzene	mg/L	0.00050	0.26	0.005	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
1,1-Dichloroethane	mg/L	0.00050	-	0.03	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
1,2-Dichloroethane	mg/L	0.00050	1	0.005	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
1,1-Dichloroethylene	mg/L	0.00050	-	0.014	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
cis-1,2-Dichloroethylene	mg/L	0.00050	-	0.008	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
trans-1,2-Dichloroethylene	mg/L	0.00050	-	0.08	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Dichloromethane	mg/L	0.0010	0.98	0.05	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
1,2-Dichloropropane	mg/L	0.00050	-	0.0045	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
cis-1,3-Dichloropropylene	mg/L	0.00050	-	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
trans-1,3-Dichloropropylene	mg/L	0.00050	-	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
1,3-Dichloropropene (cis & trans)	mg/L	0.00075	-	0.0015	<0.00075	<0.00075	<0.00075	<0.00075	<0.00075
Ethylbenzene	mg/L	0.00050	2	0.14	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Methyl t-butyl ether (MTBE)	mg/L	0.00050	34	0.095	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Styrene	mg/L	0.00050	0.72	0.8	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
1,1,1,2-Tetrachloroethane	mg/L	0.00050	-	0.006	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
1,1,2,2-Tetrachloroethane	mg/L	0.00020	-	0.0008	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Tetrachloroethylene	mg/L	0.00050	1.1	0.03	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Toluene	mg/L	0.00040	0.005	0.06	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040
1,1,1-Trichloroethane	mg/L	0.00050	-	8	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
1,1,2-Trichloroethane	mg/L	0.00050	-	0.003	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Trichloroethylene	mg/L	0.00050	0.2	0.005	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Trichlorofluoromethane	mg/L	0.00050	-	1	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Vinyl Chloride	mg/L	0.00040	-	0.002	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040
ortho-Xylene	mg/L	0.00030	-	-	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
meta- & para-Xylene	mg/L	0.00040	-	-	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040
Xylenes	mg/L	0.00050	0.3	0.09	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
4-Bromofluorobenzene (SS)	%	Surrogate	-	-	83.6	86.0	88.2	88.5	84.4
1,4-Difluorobenzene (SS)	%	Surrogate	-	-	103	102	105	103	103
Hydrocarbons									
EPH10-19	mg/L	0.25	5	5	<0.250	<0.250	<0.250	<0.250	<0.250
EPH19-32	mg/L	0.25	-	-	<0.250	<0.250	<0.250	<0.250	<0.250
LEPH	mg/L	0.25	0.5	-	<0.250	<0.250	<0.250	<0.250	<0.250
HEPH	mg/L	0.25	-	-	<0.250	<0.250	<0.250	<0.250	<0.250
2-Bromobenzotrifluoride	%	Surrogate	-	-	90.2	100	98.7	93.9	89.7
Polycyclic Aromatic Hydrocarbons									
Acenaphthene	mg/L	0.000010	0.06	0.250	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Acenaphthylene	mg/L	0.000010	-	-	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Acridine	mg/L	0.000010	0.0005	-	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Anthracene	mg/L	0.000010	0.001	1.0	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Benz(a)anthracene	mg/L	0.000010	0.001	0.00007	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Benzo(a)pyrene	mg/L	0.0000050	0.0001	0.00001	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Benzo(b&j)fluoranthene	mg/L	0.000010	-	0.00007	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Benzo(b+j+k)fluoranthene	mg/L	0.000015	-	-	<0.000015	<0.000015	<0.000015	<0.000015	<0.000015
Benzo(g,h,i)perylene	mg/L	0.000010	-	-	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Benzo(k)fluoranthene	mg/L	0.000010	-	-	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Chrysene	mg/L	0.000010	0.001	0.007	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Dibenz(a,h)anthracene	mg/L	0.0000050	-	0.00001	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Fluoranthene	mg/L	0.000010	0.002	0.15	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Fluorene	mg/L	0.000010	0.12	0.15	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Indeno(1,2,3-c,d)pyrene	mg/L	0.000010	-	-	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
1-Methylnaphthalene	mg/L	0.000010	-	0.0055	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
2-Methylnaphthalene	mg/L	0.000010	-	0.015	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Naphthalene	mg/L	0.000050	0.01	0.08	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Phenanthrene	mg/L	0.000020	0.003	-	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
Pyrene	mg/L	0.000010	0.0002	0.1	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Quinoline	mg/L	0.000050	0.034	0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Chrysene d12	%	Surrogate	-	-	90.4	70.9	83.0	76.1	79.9
Naphthalene d8	%	Surrogate	-	-	91.1	85.5	99.1	89.0	89.2
Phenanthrene d10	%	Surrogate	-	-	100	96.0	109	98.4	96.4

***Standard: British Columbia Contaminated Sites Regulation (July, 2021) - Schedule 3.2 Water Standards Freshwater Aquatic Life**

****Standard: British Columbia Contaminated Sites Regulation (July, 2021) - Schedule 3.2 Water Standards Drinking Water**

*****Guideline: British Columbia Approved and Working Water Quality Guidelines (August, 2019) - BCAWWQG - Freshwater Aquatic Life**

Color Key: Exceeds CSR Standard - FAW | Exceeds CSR Standard - DW

MORRISON HERSHFIELD

TABLE 10: 2022 SURFACE WATER QUALITY - GENERAL CHEMISTRY AND METALS

			Sample ID	Noohalk Creek Upstream	Noohalk Creek Downstream
			Date Sampled	31-Oct-22	31-Oct-22
Analyte	**Units**	**LOR**	**BCAWWQG-FAL****		
Field Parameters					
Field Conductivity	uS/cm	-	-	36.2	18.4
Temperature	C	-	-	6.1	5.8
pH	pH	-	-	5.75	6.33
Dissolved Oxygen	mg/L	-	-	3.92	3.99
Oxidation Reduction Potential	-	-	-	76.5	74.2
General Chemistry					
Conductivity	uS/cm	2	-	27.1	33.1
Hardness (as CaCO3)	mg/L	0.5	-	10.9	12.6
pH	pH	0.1	6.5 - 9.0	6.86	6.93
Total Dissolved Solids	mg/L		-	33	36
Total Suspended Solids	mg/L	3	-	11.1	10.9
BOD	mg/L		-	<2.0	<2.0
COD	mg/L		-	13	15
TOC	mg/L		-	4.20	5.73
Anions and Nutrients					
Alkalinity, Total (as CaCO3)	mg/L	1.0	Ca based <10 @ Ca < 4 mg/L 10-20 @ Ca 5-8 mg/L >20 @ Ca > 8 mg/L	5.6	7.0
Ammonia, Total (as N)	mg/L	0.0050	pH & Temp based 0.681 - 28.7	0.007	0.015
Bromide (Br)	mg/L	0.050	-	<0.050	<0.050
Chloride (Cl)	mg/L	0.50	600	<0.50	1.22
Fluoride (F)	mg/L	0.020	H based 0.4 @ H < 10 Equation @ H > 10	<0.020	<0.020
Nitrate and Nitrite (as N)	mg/L	0.0051	-	0.740	0.764
Nitrate (as N)	mg/L	0.0050	33	0.740	0.763
Nitrite (as N)	mg/L	0.0010	Cl based 0.06 @ Cl < 2 mg/L 0.12 @ Cl 2-4 mg/L 0.18 @ Cl 4-6 mg/L 0.24 @ Cl 6-8 mg/L 0.30 @ Cl 8-10 mg/L 0.60 @ Cl > 10 mg/L	<0.0010	0.0010
Ortho-phosphate (P)- Dissolve	mg/L		-	<0.0010	0.0012
Sulfate (SO4)	mg/L	0.30	H based 128 @ H <= 30 218 @ H 31-75 309 @ H 76-180 429 @ H >180	2.29	2.91
Total Metals					
Aluminum (Al)-Total	mg/L	0.0010	pH based 0.1 @ pH >= 6.5 Equation @ pH < 6.5	0.282	0.325
Antimony (Sb)-Total	mg/L	0.00010	-	<0.00010	<0.00010
Arsenic (As)-Total	mg/L	0.00010	0.005	<0.00010	<0.00010
Barium (Ba)-Total	mg/L	0.00010	1	0.0228	0.0202
Beryllium (Be)-Total	mg/L	0.00010	0.00013	<0.000100	<0.000100
Bismuth (Bi)-Total	mg/L	0.000050	-	<0.000050	<0.000050
Boron (B)-Total	mg/L	0.010	1.2	<0.010	<0.010
Cadmium (Cd)-Total	mg/L	0.0000050	H based 0.00002 @ H < 7 mg/L Equation @ H > 7 mg/L	<0.0000050	<0.0000050
Calcium (Ca)-Total	mg/L	0.050	-	3.74	4.21
Cesium (Cs)-Total	mg/L	0.000010	-	0.000010	0.000011
Chromium (Cr)-Total	mg/L	0.00010	0.001	<0.00050	<0.00050
Cobalt (Co)-Total	mg/L	0.00010	0.11	0.00029	0.00034

			Sample ID	Noohalk Creek Upstream	Noohalk Creek Downstream
			Date Sampled	31-Oct-22	31-Oct-22
Analyte	Units	LOR	BCAWWQG-FAL**		
Copper (Cu)-Total	mg/L	0.00020	H based (0.094(H)+2) / 1000	0.00174	0.00188
Iron (Fe)-Total	mg/L	0.010	0.35	0.325	0.465
Lead (Pb)-Total	mg/L	0.000050	0.003	<0.000050	<0.000050
Lithium (Li)-Total	mg/L	0.0010	-	<0.0010	<0.0010
Magnesium (Mg)-Total	mg/L	0.0050	-	0.373	0.518
Manganese (Mn)-Total	mg/L	0.00010	H based 0.01102*H +0.54	0.0146	0.0197
Mercury (Hg)-Total	mg/L	0.0000050	0.00001	<0.0000050	<0.0000050
Molybdenum (Mo)-Total	mg/L	0.000050	2	0.000341	0.000388
Nickel (Ni)-Total	mg/L	0.00050	0.025	<0.00050	<0.00050
Phosphorus (P)-Total	mg/L	0.050	-	<0.050	<0.050
Potassium (K)-Total	mg/L	0.050	-	0.858	0.947
Rubidium (Rb)-Total	mg/L	0.00020	-	0.00108	0.00121
Selenium (Se)-Total	mg/L	0.000050	0.002	<0.000050	<0.000050
Silicon (Si)-Total	mg/L	0.050	-	2.85	3.22
Silver (Ag)-Total	mg/L	0.000010	0.00005	<0.000010	<0.000010
Sodium (Na)-Total	mg/L	0.050	-	0.753	1.27
Strontium (Sr)-Total	mg/L	0.00020	-	0.0178	0.0230
Sulfur (S)-Total	mg/L	0.50	-	0.74	0.97
Tellurium (Te)-Total	mg/L	0.00020	-	<0.00020	<0.00020
Thallium (Tl)-Total	mg/L	0.000010	0.0008	<0.000010	<0.000010
Thorium (Th)-Total	mg/L	0.00010	-	<0.00010	<0.00010
Tin (Sn)-Total	mg/L	0.00010	-	<0.00010	<0.00010
Titanium (Ti)-Total	mg/L	0.00030	-	0.00946	0.0105
Tungsten (W)-Total	mg/L	0.00010	-	<0.00010	<0.00010
Uranium (U)-Total	mg/L	0.000010	0.0085	0.000125	0.000129
Vanadium (V)-Total	mg/L	0.00050		0.00084	0.00104
Zinc (Zn)-Total	mg/L	0.0010	H based 0.033 @ H =< 90 Equation @ H > 90	<0.0030	<0.0030
Zirconium (Zr)-Total	mg/L	0.000020	-	<0.00020	<0.00020
**Guideline: British Columbia Approved and Working Water Quality Guidelines (August, 2019) - BCAWWQG - Freshwater Aquatic					
Color Key:	Exceeds BC AWWQG Guideline				

MORRISON HERSHFIELD

TABLE 11: 2022 SURFACE WATER QUALITY - PETROLEUM HYDROCARBONS

			Sample ID	Noohalk Creek Upstream	Noohalk Creek Downstream
			Date Sampled	31-Oct-22	31-Oct-22
Analyte	**Units**	**LOR**	**BCAWWQG-FAL****		
Volatile Organic Compounds					
Benzene	mg/L	0.00050	0.04	<0.00050	<0.00050
Bromodichloromethane	mg/L	0.00050	-	<0.00050	<0.00050
Bromoform	mg/L	0.00050	-	<0.00050	<0.00050
Carbon Tetrachloride	mg/L	0.00050	0.0133	<0.00050	<0.00050
Chlorobenzene	mg/L	0.00050	0.0013	<0.00050	<0.00050
Dibromochloromethane	mg/L	0.00050	-	<0.00050	<0.00050
Chloroethane	mg/L	0.00050	-	<0.00050	<0.00050
Chloroform	mg/L	0.00050	0.0018	<0.00050	<0.00050
Chloromethane	mg/L	0.0050	-	<0.0050	<0.0050
1,2-Dichlorobenzene	mg/L	0.00050	0.0007	<0.00050	<0.00050
1,3-Dichlorobenzene	mg/L	0.00050	0.15	<0.00050	<0.00050
1,4-Dichlorobenzene	mg/L	0.00050	0.026	<0.00050	<0.00050
1,1-Dichloroethane	mg/L	0.00050	-	<0.00050	<0.00050
1,2-Dichloroethane	mg/L	0.00050	0.1	<0.00050	<0.00050
1,1-Dichloroethylene	mg/L	0.00050	-	<0.00050	<0.00050
cis-1,2-Dichloroethylene	mg/L	0.00050	-	<0.00050	<0.00050
trans-1,2-Dichloroethylene	mg/L	0.00050	-	<0.00050	<0.00050
Dichloromethane	mg/L	0.0010	0.0981	<0.0010	<0.0010
1,2-Dichloropropane	mg/L	0.00050	-	<0.00050	<0.00050
cis-1,3-Dichloropropylene	mg/L	0.00050	-	<0.00050	<0.00050
trans-1,3-Dichloropropylene	mg/L	0.00050	-	<0.00050	<0.00050
1,3-Dichloropropene (cis & trans)	mg/L	0.00075	-	<0.00075	<0.00075
Ethylbenzene	mg/L	0.00050	0.2	<0.00050	<0.00050
Methyl t-butyl ether (MTBE)	mg/L	0.00050	3.4	<0.00050	<0.00050
Styrene	mg/L	0.00050	0.072	<0.00050	<0.00050
1,1,1,2-Tetrachloroethane	mg/L	0.00050	-	<0.00050	<0.00050
1,1,2,2-Tetrachloroethane	mg/L	0.00020	-	<0.00020	<0.00020
Tetrachloroethylene	mg/L	0.00050	0.11	<0.00050	<0.00050
Toluene	mg/L	0.00040	0.0005	<0.00040	<0.00040
1,1,1-Trichloroethane	mg/L	0.00050	11.1	<0.00050	<0.00050
1,1,2-Trichloroethane	mg/L	0.00050	0.021	<0.00050	<0.00050
Trichloroethylene	mg/L	0.00050	-	<0.00050	<0.00050
Trichlorofluoromethane	mg/L	0.00050	-	<0.00050	<0.00050
Vinyl Chloride	mg/L	0.00040	-	<0.00040	<0.00040
ortho-Xylene	mg/L	0.00030	-	<0.00030	<0.00030
meta- & para-Xylene	mg/L	0.00040	-	<0.00040	<0.00040
Xylenes	mg/L	0.00050	0.03	<0.00050	<0.00050
4-Bromofluorobenzene (SS)	%	Surrogate	-	84.4	78.4
1,4-Difluorobenzene (SS)	%	Surrogate	-	105	102
Hydrocarbons					
EPH10-19	mg/L	0.25	-	<0.250	<0.250
EPH19-32	mg/L	0.25	-	<0.250	<0.250
LEPH	mg/L	0.25	-	<0.250	<0.250
HEPH	mg/L	0.25	-	<0.250	<0.250
2-Bromobenzotrifluoride	%	Surrogate	-	78.3	95.6
Polycyclic Aromatic Hydrocarbons					
Acenaphthene	mg/L	0.000010	0.006	<0.000010	<0.000010
Acenaphthylene	mg/L	0.000010	-	<0.000010	<0.000010
Acridine	mg/L	0.000010	0.00005	<0.000010	<0.000010
Anthracene	mg/L	0.000010	0.0001	<0.000010	<0.000010
Benz(a)anthracene	mg/L	0.000010	0.0001	<0.000010	<0.000010
Benzo(a)pyrene	mg/L	0.0000050	0.00001	<0.0000050	<0.0000050
Benzo(b&j)fluoranthene	mg/L	0.000010	-	<0.000010	<0.000010
Benzo(b+j+k)fluoranthene	mg/L	0.000015	-	<0.000015	<0.000015
Benzo(g,h,i)perylene	mg/L	0.000010	-	<0.000010	<0.000010
Benzo(k)fluoranthene	mg/L	0.000010	-	<0.000010	<0.000010
Chrysene	mg/L	0.000010	-	<0.000010	<0.000010
Dibenz(a,h)anthracene	mg/L	0.0000050	-	<0.0000050	<0.0000050
Fluoranthene	mg/L	0.000010	0.0002	<0.000010	<0.000010
Fluorene	mg/L	0.000010	0.012	<0.000010	<0.000010
Indeno(1,2,3-c,d)pyrene	mg/L	0.000010	-	<0.000010	<0.000010
1-Methylnaphthalene	mg/L	0.000010	-	<0.000010	<0.000010
2-Methylnaphthalene	mg/L	0.000010	-	<0.000010	<0.000010
Naphthalene	mg/L	0.000050	0.001	<0.000050	<0.000050
Phenanthrene	mg/L	0.000020	0.0003	<0.000020	<0.000020
Pyrene	mg/L	0.000010	0.00002	<0.000010	<0.000010
Quinoline	mg/L	0.000050	0.0034	<0.000050	<0.000050
Chrysene d12	%	Surrogate	-	83.6	101
Naphthalene d8	%	Surrogate	-	74.4	87.7
Phenanthrene d10	%	Surrogate	-	82.3	99.6

****Guideline: British Columbia Approved and Working Water Quality Guidelines (August, 2019) - BCAWWQG - Freshwater Aquatic Life**

Color Key: Exceeds BC AWWQG Guideline

APPENDIX A: Geotechnical Drilling and Monitoring Well Installation Field Logs

GEO-ENVIRONMENTAL FIELD BOREHOLE LOG

Project Number:	**Project Site:** CCRO Bella Coola LF	**Borehole No.:** MW22-01	
Start Date & Time: Nov 2/22 - 1400	**Completion Date & Time:**	**Weather:** Clear / Sunny	
Drilling Contractor: Geotech Drilling	**Drill Rig Type:** ODEX Track "Frost-e"	**Total Depth:**	
Borehole Location: N	**E**	**Gas Meter:**	

Depth (m or ft)	Graphic Log	Soil Description (Refer to Guide)	Sample Type	Sample Number	Recovery	Soil Vapour Reading CGI (ppm or LEL)	Soil Vapour Reading PID (ppm)	Monitoring Well
		- 0.5' organics / topsoil layer						
4'		Coarse medium Sand + gravel with some organics (roots), moist, gray						No well install
		Rock/boulder @ ~6'						
9'		Boulder @ ~8'						
		- Coarse-medium sand + gravel, moist, grey						
		Water @ 11'						
14'		Well graded sand w/ some gravel, trace silt, grey, moist						
		- Boulder/rock @ ~16'						
19'		- 18'						
		- 21'						
24'		End of Borehole @ 24'						
		- Casing getting stuck due to rocks.						

Technician: CJ

Borehole Log: Sheet 1 **of** 1

GEO-ENVIRONMENTAL FIELD BOREHOLE LOG

Project Number:	**Project Site:**	**Borehole No.:** MW22-01
Start Date & Time: Nov. 2/22 - 11:15	**Completion Date & Time:**	**Weather:** Clear
Drilling Contractor: Geotech	**Drill Rig Type:** 21 Track	**Total Depth:**
Borehole Location: N ,**E**		**Gas Meter:**

Depth (m or ft)	Graphic Log	Soil Description (Refer to Guide)	Sample Type	Sample Number	Recovery	Soil Vapour Reading: CGI (ppm or LEL)	Soil Vapour Reading: PID (ppm)	Monitoring Well
		Topsoil/organics ~1'						
		Sand + gravel, gray, moist						
		Rock @ 2'-4'						
4'		Boulder						
		- Boulder @ 8'						
9'								No well installed
		- medium-coarse sand w/ some gravel + cobbles, moist, grey						
		- Moist/water @ 10'						
		- Cobble @ 11'						
14'		Boulder						
		- medium-coarse sand & gravel, moist, grey						
19'								
		- Rock @ ~23" (approx. 1' thick)						
24'		Boulder						
29'		End of borehole @ 29'						
		(Casing getting stuck)						
		~~Abandoned~~ well installed						

Technician: CJ

Borehole Log: Sheet 1 of 1

GEO-ENVIRONMENTAL FIELD BOREHOLE LOG

Project Number: _____ **Project Site:** CRD Bella Coola Lt **Borehole No.:** MW22-02
Start Date & Time: Nov 1/2022 15:30 **Completion Date & Time:** Nov 1/22 - 17:15 **Weather:** Clear/Sunny
Drilling Contractor: Geotech **Drill Rig Type:** ODEX Track-Mounted. **Total Depth:** _____
Borehole Location: N _____ E _____ **Gas Meter:** _____

Depth (m or ft)	Graphic Log	Soil Description (Refer to Guide)	Sample Type	Sample Number	Recovery	Soil Vapour Reading: CGI (ppm or LEL)	Soil Vapour Reading: PID (ppm)	Monitoring Well
0		Coarse-medium grained sand w/ some gravel, moist, grey						Stick up (m/ft) w/ well protector
4'		Boulder @ 3-4'						
		Well graded sand (medium/coarse grain) w/ cobbles, moist, grey						
8'		- Boulder @ 6-7'						
		- Water @ 9' (driller observation)						
12'		Medium-coarse sand w/ cobbles, moist, grey						
16'		Coarse sand and gravel, moist, grey.						
20'		Medium/coarse sand w/ some gravel, wet, grey						
		- Water @ 20-21' (very wet water discharge).						
25'		End of borehole @ 25'						

(BENTONITE CHIPS to SURFACE)
(BENTONITE PELLETS 9'-16')
SAND PACK 10'-19'
5 ft screen
19'

Technician: CJ/ER **Borehole Log: Sheet** 1 **of** 1

GEO-ENVIRONMENTAL FIELD BOREHOLE LOG

Project Number: _____ **Project Site:** CRD Bella Coola LF **Borehole No.:** MW22-03
Start Date & Time: Nov. 2/22 - 8:50AM **Completion Date & Time:** 10:15 AM. **Weather:** Clear
Drilling Contractor: Geotech Drilling **Drill Rig Type:** Fraste track mounted CREX **Total Depth:** _____
Borehole Location: N_____, E_____ **Gas Meter:** _____

Depth (m or ft)	Graphic Log	Soil Description (Refer to Guide)	Sample Type	Sample Number	Recovery	Soil Vapour Reading		Monitoring Well
						CGI (ppm or LEL)	PID (ppm)	
		Organic woody material (branches)			Bentonite chips to surface			
4'		Coarse-medium sand & gravel, grey, moist.						
9'					Bentonite pellets 8'			8'
						Sand @ 10'11"		10'11"
		-More moist @ 13'			5' screen			
14'		-Wet @ 14'						
		-Coarse sand w/ some gravel, grey, wet.						
		Coarse sand & gravel, grey, wet				Sand		17'6"
19'		End of borehole @ 19' (18'8")			17'6" - 18'8"			19'

Technician: CJ

Borehole Log: Sheet 1 **of** 1

GEO-ENVIRONMENTAL FIELD BOREHOLE LOG

Project Number: _____ **Project Site:** CCRD Bella Costa LF **Borehole No.:** MW22-04
Start Date & Time: Nov. 1/2022-13:00 **Completion Date & Time:** 14:30 **Weather:** Partly cloudy / overcast
Drilling Contractor: Geotech Drilling **Drill Rig Type:** ODEX Track **Total Depth:** _____
Borehole Location: N _____, E _____ **Gas Meter:** _____

Depth (m or ft)	Graphic Log	Soil Description (Refer to Guide)	Sample Type	Sample Number	Recovery	Soil Vapour Reading: CGI (ppm or LEL)	Soil Vapour Reading: PID (ppm)	Monitoring Well
0		Coarse sand and cobbles, moist, grey			Bentonite chips to surface.			stick-up (1m) w/ well protector
4'					0-8' chips			
8'		Coarse sand w/ some gravel, moist, gray			Bentonite Pellets 9'-12'			8'
		-Water @ ~10'						
12'		-Coarse sand & gravel, wet, gray			Sand to 12'			12'
		11						5' screen
16'								
18'		End of Borehole @ 18' (18'3")			Screen 12-13'			18'

Technician: CJ/EA. **Borehole Log: Sheet** 1 of 1

GEO-ENVIRONMENTAL FIELD BOREHOLE LOG

Project Number: _____ **Project Site:** CCRD Bella Coola Landfill **Borehole No.:** MW22-05
Start Date & Time: Nov. 1/22 - 9:30AM **Completion Date & Time:** 12:45 PM. **Weather:** Overcast / Cloudy
Drilling Contractor: Geotech Drilling **Drill Rig Type:** ODEX **Total Depth:** _____
Borehole Location: N _____, E _____ **Gas Meter:** _____

Depth (m or ft)	Graphic Log	Soil Description (Refer to Guide)	Sample Type	Sample Number	Recovery	Soil Vapour Reading CGI (ppm or LEL)	Soil Vapour Reading PID (ppm)	Monitoring Well
		Organic topsoil/soil at surface.				Reference the CH2OS (3/8") to surface		n/a Stickup Grade Steel protector
4								
5 4.5		Coarse sand, moist/semi dry, grey						4
6ft	wet	- More wet near bottom. (wet around 6ft)						
8								8
8		Coarse sand, moist, grey.				Sand to 12'		12
								13
15								14
12		Coarse sand, wet, grey.						5ft Screen
20								18
16 4.9m		Fine sand, trace silt, wet, ~~moist~~ grey						End of borehole 19
25 7.5								
30 9.0								

Technician: CJ/ER **Borehole Log: Sheet** 1 **of** 1

APPENDIX B: Laboratory Analytical Results for Groundwater and Surface Water

ALS Canada Ltd.

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CERTIFICATE OF ANALYSIS

Work Order	: **VA22C6784**	Page	: 1 of 15
Amendment	: **1**		
Client	: **Morrison Hershfield Limited**	Laboratory	: Vancouver - Environmental
Contact	: Emily Rogal	Account Manager	: Ian Chen
Address	: 4321 Still Creek Dr Burnaby BC Canada V5C 6S7	Address	: 8081 Lougheed Highway Burnaby BC Canada V5A 1W9
Telephone	: ----	Telephone	: +1 604 253 4188
Project	: 210629400	Date Samples Received	: 03-Nov-2022 16:05
PO	: 20104530	Date Analysis Commenced	: 04-Nov-2022
C-O-C number	: 20-1016075	Issue Date	: 18-Nov-2022 14:51
Sampler	: CJ, ER		
Site	: ----		
Quote number	: ----		
No. of samples received	: 9		
No. of samples analysed	: 9		

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
- Surrogate Control Limits

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*
Alex Thornton	Analyst	Metals, Burnaby, British Columbia
Angelo Salandanan	Lab Assistant	Metals, Burnaby, British Columbia
Caitlin Macey	Team Leader - Inorganics	Inorganics, Burnaby, British Columbia
Cindy Tang	Team Leader - Inorganics	Inorganics, Burnaby, British Columbia
Cynthia Bauer	Organic Supervisor	Organics, Calgary, Alberta
Hamideh Moradi	Analyst	Metals, Burnaby, British Columbia
Jeanie Mark	Laboratory Analyst	Organics, Calgary, Alberta
Kim Jensen	Department Manager - Metals	Metals, Burnaby, British Columbia
Lindsay Gung	Supervisor - Water Chemistry	Inorganics, Burnaby, British Columbia
Maqsood UlHassan	Laboratory Analyst	Organics, Calgary, Alberta
Miles Gropen	Department Manager - Inorganics	Inorganics, Burnaby, British Columbia
Owen Cheng		Metals, Burnaby, British Columbia
Sorina Motea	Laboratory Analyst	Organics, Calgary, Alberta

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
µg/L	micrograms per litre
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.

Workorder Comments

Amendment (18/11/2022): This report has been amended and re-released to allow the reporting of additional analytical data.

Qualifiers

Qualifier	*Description*
DLCI	*Detection Limit Raised: Chromatographic interference due to co-elution.*
DLM	*Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).*
HTD	*Hold time exceeded for re-analysis or dilution, but initial testing was conducted within hold time.*
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	MW22-02	MW22-03	MW22-04	MW22-05
					Client sampling date / time	02-Nov-2022 18:00	02-Nov-2022 17:00	02-Nov-2022 17:30	02-Nov-2022 15:30	02-Nov-2022 15:15
						VA22C6784-001	VA22C6784-002	VA22C6784-003	VA22C6784-004	VA22C6784-005
						Result	Result	Result	Result	Result
Physical Tests										
conductivity	----	E100	2.0	µS/cm		31.5	207	173	169	257
hardness (as CaCO3), dissolved	----	EC100	0.60	mg/L		11.2	74.1	61.8	41.7	72.3
pH	----	E108	0.10	pH units		6.93	7.34	7.29	7.54	7.37
solids, total dissolved [TDS]	----	E162	10	mg/L		29	114	111	120	148
solids, total suspended [TSS]	----	E160	3.0	mg/L		<3.0	181	104	1120	179
alkalinity, total (as CaCO3)	----	E290	2.0	mg/L		7.6	90.4	60.4	82.8	77.1
Anions and Nutrients										
ammonia, total (as N)	7664-41-7	E298	0.0050	mg/L		<0.0050	3.69	1.80	0.0216	3.65
bromide	24959-67-9	E235.Br-L	0.050	mg/L		<0.050	<0.050	<0.050	<0.050	<0.050
chloride	16887-00-6	E235.Cl	0.50	mg/L		<0.50	0.99	8.44	1.23	4.09
fluoride	16984-48-8	E235.F	0.020	mg/L		<0.040 DLCI	0.096	0.063	0.067	<0.060 DLCI
nitrate (as N)	14797-55-8	E235.NO3-L	0.0050	mg/L		0.268	0.0050	0.822	0.210	<0.0050
nitrate + nitrite (as N)	----	EC235.N+N	0.0050	mg/L		0.268	0.0076	0.826	0.210	<0.0051
nitrite (as N)	14797-65-0	E235.NO2-L	0.0010	mg/L		<0.0010	0.0026	0.0044	<0.0010	<0.0010
phosphate, ortho-, dissolved (as P)	14265-44-2	E378-U	0.0010	mg/L		<0.0010	0.0014	0.0022	0.0020	<0.0010
sulfate (as SO4)	14808-79-8	E235.SO4	0.30	mg/L		4.73	9.93	6.50	8.60	39.1
Organic / Inorganic Carbon										
carbon, total organic [TOC]	----	E355-L	0.50	mg/L		<0.50	13.8	8.95	44.8	27.6
Dissolved Metals										
aluminum, dissolved	7429-90-5	E421	0.0010	mg/L		0.0022	0.0389	0.0204	0.0314	0.257
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		<0.00010	0.00137	0.00012	<0.00010	0.00050
barium, dissolved	7440-39-3	E421	0.00010	mg/L		0.00568	0.0638	0.0564	0.0298	0.0878
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	0.163	0.055	<0.010	0.272
cadmium, dissolved	7440-43-9	E421	0.0000050	mg/L		<0.0000050	0.0000154	0.0000194	0.0000138	0.0000206
calcium, dissolved	7440-70-2	E421	0.050	mg/L		3.98	25.7	20.8	15.1	24.1
cesium, dissolved	7440-46-2	E421	0.000010	mg/L		<0.000010	0.000035	0.000032	<0.000010	0.000080

Analytical Results

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

Analyte	CAS Number	Method	LOR	Unit	Client sample ID	MW22-01	MW22-02	MW22-03	MW22-04	MW22-05
					Client sampling date / time	02-Nov-2022 18:00	02-Nov-2022 17:00	02-Nov-2022 17:30	02-Nov-2022 15:30	02-Nov-2022 15:15
						VA22C6784-001	VA22C6784-002	VA22C6784-003	VA22C6784-004	VA22C6784-005
						Result	Result	Result	Result	Result
Dissolved Metals										
chromium, dissolved	7440-47-3	E421	0.00050	mg/L		<0.00050	<0.00050	<0.00050	<0.00050	0.00085
cobalt, dissolved	7440-48-4	E421	0.00010	mg/L		<0.00010	0.00052	0.00067	0.00020	0.00455
copper, dissolved	7440-50-8	E421	0.00020	mg/L		0.00257	0.00144	0.00221	0.00045	0.00192
iron, dissolved	7439-89-6	E421	0.010	mg/L		<0.010	0.037	0.012	0.053	4.01
lead, dissolved	7439-92-1	E421	0.000050	mg/L		0.000064	<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		0.303	2.41	2.40	0.980	2.94
manganese, dissolved	7439-96-5	E421	0.00010	mg/L		0.00102	0.221	0.147	0.0438	0.547
mercury, dissolved	7439-97-6	E509	0.0000050	mg/L		<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
molybdenum, dissolved	7439-98-7	E421	0.000050	mg/L		0.00110	0.00402	0.00120	0.000807	0.00142
nickel, dissolved	7440-02-0	E421	0.00050	mg/L		<0.00050	0.00059	0.00107	<0.00050	0.00189
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		0.817	5.41	3.59	1.21	4.19
rubidium, dissolved	7440-17-7	E421	0.00020	mg/L		0.00088	0.00559	0.00443	0.00107	0.00830
selenium, dissolved	7782-49-2	E421	0.000050	mg/L		0.000060	0.000070	0.000151	0.000138	0.000096
silicon, dissolved	7440-21-3	E421	0.050	mg/L		2.92	3.43	4.44	3.38	3.40
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		0.801	5.82	7.47	7.35	13.9
strontium, dissolved	7440-24-6	E421	0.00020	mg/L		0.0221	0.0905	0.0682	0.0600	0.0942
sulfur, dissolved	7704-34-9	E421	0.50	mg/L		1.45	3.84	2.40	2.52	13.7
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	0.000042	0.000041	<0.000010	0.000065
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		<0.00030	0.00043	<0.00030	<0.00090 DLM	0.00837
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	0.000277	0.000096	0.000175	0.000134
vanadium, dissolved	7440-62-2	E421	0.00050	mg/L		<0.00050	0.00368	<0.00050	<0.00050	0.00240
zinc, dissolved	7440-66-6	E421	0.0010	mg/L		0.0011	0.0012	<0.0010	<0.0010	0.0033
zirconium, dissolved	7440-67-7	E421	0.00020	mg/L		<0.00020	<0.00020	<0.00020	<0.00020	<0.00020

Analytical Results

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

Analyte	CAS Number	Method	LOR	Unit	Client sample ID	MW22-01	MW22-02	MW22-03	MW22-04	MW22-05
					Client sampling date / time	02-Nov-2022 18:00	02-Nov-2022 17:00	02-Nov-2022 17:30	02-Nov-2022 15:30	02-Nov-2022 15:15
						VA22C6784-001	VA22C6784-002	VA22C6784-003	VA22C6784-004	VA22C6784-005
						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	12.2	7.1	4.0	45.6
chemical oxygen demand [COD]	----	E559-L	10	mg/L		<10	51	48	135	91
Volatile Organic Compounds										
chlorobenzene	108-90-7	E611C	0.50	µg/L		<0.50	<0.50	<0.50	<0.50	<0.50
chloromethane	74-87-3	E611C	5.0	µg/L		<5.0	<5.0	<5.0	<5.0	<5.0
dichlorobenzene, 1,2-	95-50-1	E611C	0.50	µg/L		<0.50	<0.50	<0.50	<0.50	<0.50
dichlorobenzene, 1,3-	541-73-1	E611C	0.50	µg/L		<0.50	<0.50	<0.50	<0.50	<0.50
dichlorobenzene, 1,4-	106-46-7	E611C	0.50	µg/L		<0.50	<0.50	<0.50	<0.50	<0.50
dichloropropane, 1,2-	78-87-5	E611C	0.50	µg/L		<0.50	<0.50	<0.50	<0.50	<0.50
dichloropropylene, cis+trans-1,3-	542-75-6	E611C	0.75	µg/L		<0.75	<0.75	<0.75	<0.75	<0.75
dichloropropylene, cis-1,3-	10061-01-5	E611C	0.50	µg/L		<0.50	<0.50	<0.50	<0.50	<0.50
tetrachloroethane, 1,1,1,2-	630-20-6	E611C	0.50	µg/L		<0.50	<0.50	<0.50	<0.50	<0.50
tetrachloroethane, 1,1,2,2-	79-34-5	E611C	0.20	µg/L		<0.20	<0.20	<0.20	<0.20	<0.20
trichloroethane, 1,1,2-	79-00-5	E611C	0.50	µg/L		<0.50	<0.50	<0.50	<0.50	<0.50
trichlorofluoromethane	75-69-4	E611C	0.50	µg/L		<0.50	<0.50	<0.50	<0.50	<0.50
Volatile Organic Compounds [Drycleaning]										
carbon tetrachloride	56-23-5	E611C	0.50	µg/L		<0.50	<0.50	<0.50	<0.50	<0.50
chloroethane	75-00-3	E611C	0.50	µg/L		<0.50	<0.50	<0.50	<0.50	<0.50
dichloroethane, 1,1-	75-34-3	E611C	0.50	µg/L		<0.50	<0.50	<0.50	<0.50	<0.50
dichloroethane, 1,2-	107-06-2	E611C	0.50	µg/L		<0.50	<0.50	<0.50	<0.50	<0.50
dichloroethylene, 1,1-	75-35-4	E611C	0.50	µg/L		<0.50	<0.50	<0.50	<0.50	<0.50
dichloroethylene, cis-1,2-	156-59-2	E611C	0.50	µg/L		<0.50	<0.50	<0.50	<0.50	<0.50
dichloroethylene, trans-1,2-	156-60-5	E611C	0.50	µg/L		<0.50	<0.50	<0.50	<0.50	<0.50
dichloromethane	75-09-2	E611C	1.0	µg/L		<1.0	<1.0	<1.0	<1.0	<1.0
dichloropropylene, trans-1,3-	10061-02-6	E611C	0.50	µg/L		<0.50	<0.50	<0.50	<0.50	<0.50
tetrachloroethylene	127-18-4	E611C	0.50	µg/L		<0.50	<0.50	<0.50	<0.50	<0.50
trichloroethane, 1,1,1-	71-55-6	E611C	0.50	µg/L		<0.50	<0.50	<0.50	<0.50	<0.50

Analytical Results

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

Analyte	CAS Number	Method	LOR	Unit	Client sample ID	MW22-01	MW22-02	MW22-03	MW22-04	MW22-05
					Client sampling date / time	02-Nov-2022 18:00	02-Nov-2022 17:00	02-Nov-2022 17:30	02-Nov-2022 15:30	02-Nov-2022 15:15
						VA22C6784-001	VA22C6784-002	VA22C6784-003	VA22C6784-004	VA22C6784-005
						Result	Result	Result	Result	Result
Volatile Organic Compounds [Drycleaning]										
trichloroethylene	79-01-6	E611C	0.50	µg/L		<0.50	<0.50	<0.50	<0.50	<0.50
vinyl chloride	75-01-4	E611C	0.40	µg/L		<0.40	<0.40	<0.40	<0.40	<0.40
Volatile Organic Compounds [Fuels]										
benzene	71-43-2	E611C	0.50	µg/L		<0.50	<0.50	<0.50	<0.50	<0.50
ethylbenzene	100-41-4	E611C	0.50	µg/L		<0.50	<0.50	<0.50	<0.50	<0.50
methyl-tert-butyl ether [MTBE]	1634-04-4	E611C	0.50	µg/L		<0.50	<0.50	<0.50	<0.50	<0.50
styrene	100-42-5	E611C	0.50	µg/L		<0.50	<0.50	<0.50	<0.50	<0.50
toluene	108-88-3	E611C	0.40	µg/L		<0.40	<0.40	<0.40	<0.40	<0.40
xylene, m+p-	179601-23-1	E611C	0.40	µg/L		<0.40	<0.40	<0.40	<0.40	<0.40
xylene, o-	95-47-6	E611C	0.30	µg/L		<0.30	<0.30	<0.30	<0.30	<0.30
xylenes, total	1330-20-7	E611C	0.50	µg/L		<0.50	<0.50	<0.50	<0.50	<0.50
Volatile Organic Compounds [THMs]										
bromodichloromethane	75-27-4	E611C	0.50	µg/L		<0.50	<0.50	<0.50	<0.50	<0.50
bromoform	75-25-2	E611C	0.50	µg/L		<0.50	<0.50	<0.50	<0.50	<0.50
chloroform	67-66-3	E611C	0.50	µg/L		<0.50	<0.50	<0.50	<0.50	<0.50
dibromochloromethane	124-48-1	E611C	0.50	µg/L		<0.50	<0.50	<0.50	<0.50	<0.50
Hydrocarbons										
EPH (C10-C19)	----	E601A	250	µg/L		<250	<250	<250	<250	<250
EPH (C19-C32)	----	E601A	250	µg/L		<250	<250	<250	<250	<250
HEPHw	----	EC600A	250	µg/L		<250	<250	<250	<250	<250
LEPHw	----	EC600A	250	µg/L		<250	<250	<250	<250	<250
Hydrocarbons Surrogates										
bromobenzotrifluoride, 2- (EPH surr)	392-83-6	E601A	1.0	%		90.2	100	98.7	93.9	89.7
Volatile Organic Compounds Surrogates										
bromofluorobenzene, 4-	460-00-4	E611C	1.0	%		83.6	86.0	88.2	88.5	84.4
difluorobenzene, 1,4-	540-36-3	E611C	1.0	%		103	102	105	103	103
Polycyclic Aromatic Hydrocarbons										
acenaphthene	83-32-9	E641A	0.010	µg/L		<0.010	<0.010	<0.010	<0.010	<0.010
acenaphthylene	208-96-8	E641A	0.010	µg/L		<0.010	<0.010	<0.010	<0.010	<0.010
acridine	260-94-6	E641A	0.010	µg/L		<0.010	<0.010	<0.010	<0.010	<0.010

Analytical Results

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

Analyte	CAS Number	Method	LOR	Unit	Client sample ID	MW22-01	MW22-02	MW22-03	MW22-04	MW22-05
					Client sampling date / time	02-Nov-2022 18:00	02-Nov-2022 17:00	02-Nov-2022 17:30	02-Nov-2022 15:30	02-Nov-2022 15:15
						VA22C6784-001	VA22C6784-002	VA22C6784-003	VA22C6784-004	VA22C6784-005
						Result	Result	Result	Result	Result
Polycyclic Aromatic Hydrocarbons										
anthracene	120-12-7	E641A	0.010	µg/L		<0.010	<0.010	<0.010	<0.010	<0.010
benz(a)anthracene	56-55-3	E641A	0.010	µg/L		<0.010	<0.010	<0.010	<0.010	<0.010
benzo(a)pyrene	50-32-8	E641A	0.0050	µg/L		<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
benzo(b+j)fluoranthene	n/a	E641A	0.010	µg/L		<0.010	<0.010	<0.010	<0.010	<0.010
benzo(b+j+k)fluoranthene	n/a	E641A	0.015	µg/L		<0.015	<0.015	<0.015	<0.015	<0.015
benzo(g,h,i)perylene	191-24-2	E641A	0.010	µg/L		<0.010	<0.010	<0.010	<0.010	<0.010
benzo(k)fluoranthene	207-08-9	E641A	0.010	µg/L		<0.010	<0.010	<0.010	<0.010	<0.010
chrysene	218-01-9	E641A	0.010	µg/L		<0.010	<0.010	<0.010	<0.010	<0.010
dibenz(a,h)anthracene	53-70-3	E641A	0.0050	µg/L		<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
fluoranthene	206-44-0	E641A	0.010	µg/L		<0.010	<0.010	<0.010	<0.010	<0.010
fluorene	86-73-7	E641A	0.010	µg/L		<0.010	<0.010	<0.010	<0.010	<0.010
indeno(1,2,3-c,d)pyrene	193-39-5	E641A	0.010	µg/L		<0.010	<0.010	<0.010	<0.010	<0.010
methylnaphthalene, 1-	90-12-0	E641A	0.010	µg/L		<0.010	<0.010	<0.010	<0.010	<0.010
methylnaphthalene, 2-	91-57-6	E641A	0.010	µg/L		<0.010	<0.010	<0.010	<0.010	<0.010
naphthalene	91-20-3	E641A	0.050	µg/L		<0.050	<0.050	<0.050	<0.050	<0.050
phenanthrene	85-01-8	E641A	0.020	µg/L		<0.020	<0.020	<0.020	<0.020	<0.020
pyrene	129-00-0	E641A	0.010	µg/L		<0.010	<0.010	<0.010	<0.010	<0.010
quinoline	91-22-5	E641A	0.050	µg/L		<0.050	<0.050	<0.050	<0.050	<0.050
Polycyclic Aromatic Hydrocarbons Surrogates										
chrysene-d12	1719-03-5	E641A	0.1	%		90.4	70.9	83.0	76.1	79.9
naphthalene-d8	1146-65-2	E641A	0.1	%		91.1	85.5	99.1	89.0	89.2
phenanthrene-d10	1517-22-2	E641A	0.1	%		100	96.0	109	98.4	96.4

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

Analytical Results

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

Analyte	CAS Number	Method	LOR	Unit	Client sample ID	Field Blank	DUP	Noohalk Creek Upstream	Noohalk Creek Downstream	----
					Client sampling date / time	02-Nov-2022 12:00	02-Nov-2022 12:00	31-Oct-2022 17:30	31-Oct-2022 17:00	----
						VA22C6784-006	VA22C6784-007	VA22C6784-008	VA22C6784-009	--------
						Result	Result	Result	Result	----
Physical Tests										
conductivity	----	E100	2.0	µS/cm		<2.0	207	27.1	33.1	----
hardness (as CaCO3), dissolved	----	EC100	0.60	mg/L		<0.60	74.4	----	----	----
hardness (as CaCO3), from total Ca/Mg	----	EC100A	0.60	mg/L		----	----	10.9	12.6	----
pH	----	E108	0.10	pH units		5.36	7.49	6.86	6.93	----
solids, total dissolved [TDS]	----	E162	10	mg/L		<10	118	33	36	----
solids, total suspended [TSS]	----	E160	3.0	mg/L		<3.0	229	11.1	10.9	----
alkalinity, total (as CaCO3)	----	E290	2.0	mg/L		<2.0	90.2	5.6	7.0	----
Anions and Nutrients										
ammonia, total (as N)	7664-41-7	E298	0.0050	mg/L		<0.0050	3.80	0.0066	0.0149	----
bromide	24959-67-9	E235.Br-L	0.050	mg/L		<0.050	<0.050	<0.050	<0.050	----
chloride	16887-00-6	E235.Cl	0.50	mg/L		<0.50	1.00	<0.50	1.22	----
fluoride	16984-48-8	E235.F	0.020	mg/L		<0.020	0.039	<0.020	<0.020	----
nitrate (as N)	14797-55-8	E235.NO3-L	0.0050	mg/L		0.0478 HTD, RRV	0.0075	0.740	0.763	----
nitrate + nitrite (as N)	----	EC235.N+N	0.0050	mg/L		0.0478	0.0105	0.740	0.764	----
nitrite (as N)	14797-65-0	E235.NO2-L	0.0010	mg/L		<0.0010	0.0030	<0.0010	0.0010	----
phosphate, ortho-, dissolved (as P)	14265-44-2	E378-U	0.0010	mg/L		<0.0010	0.0011	<0.0010	0.0012	----
sulfate (as SO4)	14808-79-8	E235.SO4	0.30	mg/L		<0.30	10.4	2.29	2.91	----
Organic / Inorganic Carbon										
carbon, total organic [TOC]	----	E355-L	0.50	mg/L		<0.50	14.1	4.20	5.73	----
Total Metals										
aluminum, total	7429-90-5	E420	0.0030	mg/L		----	----	0.282	0.325	----
antimony, total	7440-36-0	E420	0.00010	mg/L		----	----	<0.00010	<0.00010	----
arsenic, total	7440-38-2	E420	0.00010	mg/L		----	----	<0.00010	<0.00010	----
barium, total	7440-39-3	E420	0.00010	mg/L		----	----	0.0228	0.0202	----
beryllium, total	7440-41-7	E420	0.000100	mg/L		----	----	<0.000100	<0.000100	----
bismuth, total	7440-69-9	E420	0.000050	mg/L		----	----	<0.000050	<0.000050	----
boron, total	7440-42-8	E420	0.010	mg/L		----	----	<0.010	<0.010	----
cadmium, total	7440-43-9	E420	0.0000050	mg/L		----	----	<0.0000050	<0.0000050	----
calcium, total	7440-70-2	E420	0.050	mg/L		----	----	3.74	4.21	----
cesium, total	7440-46-2	E420	0.000010	mg/L		----	----	0.000010	0.000011	----

Analytical Results

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

Analyte	CAS Number	Method	LOR	Unit	Client sample ID: Field Blank	DUP	Noohalk Creek Upstream	Noohalk Creek Downstream	----
					Client sampling date / time: 02-Nov-2022 12:00	02-Nov-2022 12:00	31-Oct-2022 17:30	31-Oct-2022 17:00	----
					VA22C6784-006	VA22C6784-007	VA22C6784-008	VA22C6784-009	--------
					Result	Result	Result	Result	----
Total Metals									
chromium, total	7440-47-3	E420	0.00050	mg/L	----	----	<0.00050	<0.00050	----
cobalt, total	7440-48-4	E420	0.00010	mg/L	----	----	0.00029	0.00034	----
copper, total	7440-50-8	E420	0.00050	mg/L	----	----	0.00174	0.00188	----
iron, total	7439-89-6	E420	0.010	mg/L	----	----	0.325	0.465	----
lead, total	7439-92-1	E420	0.000050	mg/L	----	----	<0.000050	<0.000050	----
lithium, total	7439-93-2	E420	0.0010	mg/L	----	----	<0.0010	<0.0010	----
magnesium, total	7439-95-4	E420	0.0050	mg/L	----	----	0.373	0.518	----
manganese, total	7439-96-5	E420	0.00010	mg/L	----	----	0.0146	0.0197	----
mercury, total	7439-97-6	E508	0.0000050	mg/L	----	----	<0.0000050	<0.0000050	----
molybdenum, total	7439-98-7	E420	0.000050	mg/L	----	----	0.000341	0.000388	----
nickel, total	7440-02-0	E420	0.00050	mg/L	----	----	<0.00050	<0.00050	----
phosphorus, total	7723-14-0	E420	0.050	mg/L	----	----	<0.050	<0.050	----
potassium, total	7440-09-7	E420	0.050	mg/L	----	----	0.858	0.947	----
rubidium, total	7440-17-7	E420	0.00020	mg/L	----	----	0.00108	0.00121	----
selenium, total	7782-49-2	E420	0.000050	mg/L	----	----	<0.000050	<0.000050	----
silicon, total	7440-21-3	E420	0.10	mg/L	----	----	2.85	3.22	----
silver, total	7440-22-4	E420	0.000010	mg/L	----	----	<0.000010	<0.000010	----
sodium, total	7440-23-5	E420	0.050	mg/L	----	----	0.753	1.27	----
strontium, total	7440-24-6	E420	0.00020	mg/L	----	----	0.0178	0.0230	----
sulfur, total	7704-34-9	E420	0.50	mg/L	----	----	0.74	0.97	----
tellurium, total	13494-80-9	E420	0.00020	mg/L	----	----	<0.00020	<0.00020	----
thallium, total	7440-28-0	E420	0.000010	mg/L	----	----	<0.000010	<0.000010	----
thorium, total	7440-29-1	E420	0.00010	mg/L	----	----	<0.00010	<0.00010	----
tin, total	7440-31-5	E420	0.00010	mg/L	----	----	<0.00010	<0.00010	----
titanium, total	7440-32-6	E420	0.00030	mg/L	----	----	0.00946	0.0105	----
tungsten, total	7440-33-7	E420	0.00010	mg/L	----	----	<0.00010	<0.00010	----
uranium, total	7440-61-1	E420	0.000010	mg/L	----	----	0.000125	0.000129	----
vanadium, total	7440-62-2	E420	0.00050	mg/L	----	----	0.00084	0.00104	----
zinc, total	7440-66-6	E420	0.0030	mg/L	----	----	<0.0030	<0.0030	----
zirconium, total	7440-67-7	E420	0.00020	mg/L	----	----	<0.00020	<0.00020	----

Analytical Results

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

Analyte	CAS Number	Method	LOR	Unit	Client sample ID: Field Blank	DUP	Noohalk Creek Upstream	Noohalk Creek Downstream	----
					Client sampling date / time: 02-Nov-2022 12:00	02-Nov-2022 12:00	31-Oct-2022 17:30	31-Oct-2022 17:00	----
					VA22C6784-006	VA22C6784-007	VA22C6784-008	VA22C6784-009	--------
					Result	Result	Result	Result	----
Dissolved Metals									
aluminum, dissolved	7429-90-5	E421	0.0010	mg/L	<0.0010	0.156	----	----	----
antimony, dissolved	7440-36-0	E421	0.00010	mg/L	<0.00010	<0.00010	----	----	----
arsenic, dissolved	7440-38-2	E421	0.00010	mg/L	<0.00010	0.00139	----	----	----
barium, dissolved	7440-39-3	E421	0.00010	mg/L	<0.00010	0.0642	----	----	----
beryllium, dissolved	7440-41-7	E421	0.000100	mg/L	<0.000100	<0.000100	----	----	----
bismuth, dissolved	7440-69-9	E421	0.000050	mg/L	<0.000050	<0.000050	----	----	----
boron, dissolved	7440-42-8	E421	0.010	mg/L	<0.010	0.162	----	----	----
cadmium, dissolved	7440-43-9	E421	0.0000050	mg/L	<0.0000050	0.0000138	----	----	----
calcium, dissolved	7440-70-2	E421	0.050	mg/L	<0.050	25.8	----	----	----
cesium, dissolved	7440-46-2	E421	0.000010	mg/L	<0.000010	0.000038	----	----	----
chromium, dissolved	7440-47-3	E421	0.00050	mg/L	<0.00050	<0.00050	----	----	----
cobalt, dissolved	7440-48-4	E421	0.00010	mg/L	<0.00010	0.00053	----	----	----
copper, dissolved	7440-50-8	E421	0.00020	mg/L	<0.00020	0.00160	----	----	----
iron, dissolved	7439-89-6	E421	0.010	mg/L	<0.010	0.080	----	----	----
lead, dissolved	7439-92-1	E421	0.000050	mg/L	<0.000050	<0.000050	----	----	----
lithium, dissolved	7439-93-2	E421	0.0010	mg/L	<0.0010	<0.0010	----	----	----
magnesium, dissolved	7439-95-4	E421	0.0050	mg/L	<0.0050	2.43	----	----	----
manganese, dissolved	7439-96-5	E421	0.00010	mg/L	<0.00010	0.221	----	----	----
mercury, dissolved	7439-97-6	E509	0.0000050	mg/L	<0.0000050	<0.0000050	----	----	----
molybdenum, dissolved	7439-98-7	E421	0.000050	mg/L	<0.000050	0.00387	----	----	----
nickel, dissolved	7440-02-0	E421	0.00050	mg/L	<0.00050	0.00061	----	----	----
phosphorus, dissolved	7723-14-0	E421	0.050	mg/L	<0.050	<0.050	----	----	----
potassium, dissolved	7440-09-7	E421	0.050	mg/L	<0.050	5.37	----	----	----
rubidium, dissolved	7440-17-7	E421	0.00020	mg/L	<0.00020	0.00534	----	----	----
selenium, dissolved	7782-49-2	E421	0.000050	mg/L	<0.000050	0.000067	----	----	----
silicon, dissolved	7440-21-3	E421	0.050	mg/L	<0.050	3.34	----	----	----
silver, dissolved	7440-22-4	E421	0.000010	mg/L	<0.000010	<0.000010	----	----	----
sodium, dissolved	7440-23-5	E421	0.050	mg/L	<0.050	5.82	----	----	----
strontium, dissolved	7440-24-6	E421	0.00020	mg/L	<0.00020	0.0902	----	----	----
sulfur, dissolved	7704-34-9	E421	0.50	mg/L	<0.50	3.47	----	----	----

Analytical Results

Sub-Matrix: Water (Matrix: Water)					Client sample ID	Field Blank	DUP	Noohalk Creek Upstream	Noohalk Creek Downstream	----
					Client sampling date / time	02-Nov-2022 12:00	02-Nov-2022 12:00	31-Oct-2022 17:30	31-Oct-2022 17:00	----
Analyte	CAS Number	Method	LOR	Unit		VA22C6784-006	VA22C6784-007	VA22C6784-008	VA22C6784-009	--------
						Result	Result	Result	Result	----
Dissolved Metals										
tellurium, dissolved	13494-80-9	E421	0.00020	mg/L		<0.00020	<0.00020	----	----	----
thallium, dissolved	7440-28-0	E421	0.000010	mg/L		<0.000010	0.000046	----	----	----
thorium, dissolved	7440-29-1	E421	0.00010	mg/L		<0.00010	<0.00010	----	----	----
tin, dissolved	7440-31-5	E421	0.00010	mg/L		<0.00010	<0.00010	----	----	----
titanium, dissolved	7440-32-6	E421	0.00030	mg/L		<0.00030	0.00272	----	----	----
tungsten, dissolved	7440-33-7	E421	0.00010	mg/L		<0.00010	<0.00010	----	----	----
uranium, dissolved	7440-61-1	E421	0.000010	mg/L		<0.000010	0.000307	----	----	----
vanadium, dissolved	7440-62-2	E421	0.00050	mg/L		<0.00050	0.00392	----	----	----
zinc, dissolved	7440-66-6	E421	0.0010	mg/L		<0.0010	<0.0010	----	----	----
zirconium, dissolved	7440-67-7	E421	0.00020	mg/L		<0.00020	<0.00020	----	----	----
dissolved mercury filtration location	----	EP509	-	-		Field	Field	----	----	----
dissolved metals filtration location	----	EP421	-	-		Field	Field	----	----	----
Aggregate Organics										
biochemical oxygen demand [BOD]	----	E550	2.0	mg/L		<2.0	10.0	<2.0	<2.0	----
chemical oxygen demand [COD]	----	E559-L	10	mg/L		<10	51	13	15	----
Volatile Organic Compounds										
chlorobenzene	108-90-7	E611C	0.50	µg/L		<0.50	<0.50	<0.50	<0.50	----
chloromethane	74-87-3	E611C	5.0	µg/L		<5.0	<5.0	<5.0	<5.0	----
dichlorobenzene, 1,2-	95-50-1	E611C	0.50	µg/L		<0.50	<0.50	<0.50	<0.50	----
dichlorobenzene, 1,3-	541-73-1	E611C	0.50	µg/L		<0.50	<0.50	<0.50	<0.50	----
dichlorobenzene, 1,4-	106-46-7	E611C	0.50	µg/L		<0.50	<0.50	<0.50	<0.50	----
dichloropropane, 1,2-	78-87-5	E611C	0.50	µg/L		<0.50	<0.50	<0.50	<0.50	----
dichloropropylene, cis+trans-1,3-	542-75-6	E611C	0.75	µg/L		<0.75	<0.75	<0.75	<0.75	----
dichloropropylene, cis-1,3-	10061-01-5	E611C	0.50	µg/L		<0.50	<0.50	<0.50	<0.50	----
tetrachloroethane, 1,1,1,2-	630-20-6	E611C	0.50	µg/L		<0.50	<0.50	<0.50	<0.50	----
tetrachloroethane, 1,1,2,2-	79-34-5	E611C	0.20	µg/L		<0.20	<0.20	<0.20	<0.20	----
trichloroethane, 1,1,2-	79-00-5	E611C	0.50	µg/L		<0.50	<0.50	<0.50	<0.50	----
trichlorofluoromethane	75-69-4	E611C	0.50	µg/L		<0.50	<0.50	<0.50	<0.50	----
Volatile Organic Compounds [Drycleaning]										
carbon tetrachloride	56-23-5	E611C	0.50	µg/L		<0.50	<0.50	<0.50	<0.50	----

Analytical Results

Sub-Matrix: Water (Matrix: Water)					Client sample ID	Field Blank	DUP	Noohalk Creek Upstream	Noohalk Creek Downstream	----
					Client sampling date / time	02-Nov-2022 12:00	02-Nov-2022 12:00	31-Oct-2022 17:30	31-Oct-2022 17:00	----
Analyte	CAS Number	Method	LOR	Unit		VA22C6784-006	VA22C6784-007	VA22C6784-008	VA22C6784-009	--------
						Result	Result	Result	Result	----
Volatile Organic Compounds [Drycleaning]										
chloroethane	75-00-3	E611C	0.50	µg/L		<0.50	<0.50	<0.50	<0.50	----
dichloroethane, 1,1-	75-34-3	E611C	0.50	µg/L		<0.50	<0.50	<0.50	<0.50	----
dichloroethane, 1,2-	107-06-2	E611C	0.50	µg/L		<0.50	<0.50	<0.50	<0.50	----
dichloroethylene, 1,1-	75-35-4	E611C	0.50	µg/L		<0.50	<0.50	<0.50	<0.50	----
dichloroethylene, cis-1,2-	156-59-2	E611C	0.50	µg/L		<0.50	<0.50	<0.50	<0.50	----
dichloroethylene, trans-1,2-	156-60-5	E611C	0.50	µg/L		<0.50	<0.50	<0.50	<0.50	----
dichloromethane	75-09-2	E611C	1.0	µg/L		<1.0	<1.0	<1.0	<1.0	----
dichloropropylene, trans-1,3-	10061-02-6	E611C	0.50	µg/L		<0.50	<0.50	<0.50	<0.50	----
tetrachloroethylene	127-18-4	E611C	0.50	µg/L		<0.50	<0.50	<0.50	<0.50	----
trichloroethane, 1,1,1-	71-55-6	E611C	0.50	µg/L		<0.50	<0.50	<0.50	<0.50	----
trichloroethylene	79-01-6	E611C	0.50	µg/L		<0.50	<0.50	<0.50	<0.50	----
vinyl chloride	75-01-4	E611C	0.40	µg/L		<0.40	<0.40	<0.40	<0.40	----
Volatile Organic Compounds [Fuels]										
benzene	71-43-2	E611C	0.50	µg/L		<0.50	<0.50	<0.50	<0.50	----
ethylbenzene	100-41-4	E611C	0.50	µg/L		<0.50	<0.50	<0.50	<0.50	----
methyl-tert-butyl ether [MTBE]	1634-04-4	E611C	0.50	µg/L		<0.50	<0.50	<0.50	<0.50	----
styrene	100-42-5	E611C	0.50	µg/L		<0.50	<0.50	<0.50	<0.50	----
toluene	108-88-3	E611C	0.40	µg/L		<0.40	<0.40	<0.40	<0.40	----
xylene, m+p-	179601-23-1	E611C	0.40	µg/L		<0.40	<0.40	<0.40	<0.40	----
xylene, o-	95-47-6	E611C	0.30	µg/L		<0.30	<0.30	<0.30	<0.30	----
xylenes, total	1330-20-7	E611C	0.50	µg/L		<0.50	<0.50	<0.50	<0.50	----
Volatile Organic Compounds [THMs]										
bromodichloromethane	75-27-4	E611C	0.50	µg/L		<0.50	<0.50	<0.50	<0.50	----
bromoform	75-25-2	E611C	0.50	µg/L		<0.50	<0.50	<0.50	<0.50	----
chloroform	67-66-3	E611C	0.50	µg/L		1.27	<0.50	<0.50	<0.50	----
dibromochloromethane	124-48-1	E611C	0.50	µg/L		<0.50	<0.50	<0.50	<0.50	----
Hydrocarbons										
EPH (C10-C19)	----	E601A	250	µg/L		<250	<250	<250	<250	----
EPH (C19-C32)	----	E601A	250	µg/L		<250	<250	<250	<250	----
HEPHw	----	EC600A	250	µg/L		<250	<250	<250	<250	----

Analytical Results

Sub-Matrix: Water (Matrix: Water)					Client sample ID	Field Blank	DUP	Noohalk Creek Upstream	Noohalk Creek Downstream	----
					Client sampling date / time	02-Nov-2022 12:00	02-Nov-2022 12:00	31-Oct-2022 17:30	31-Oct-2022 17:00	----
Analyte	CAS Number	Method	LOR	Unit		VA22C6784-006	VA22C6784-007	VA22C6784-008	VA22C6784-009	--------
						Result	Result	Result	Result	----
Hydrocarbons										
LEPHw	----	EC600A	250	µg/L		<250	<250	<250	<250	----
Hydrocarbons Surrogates										
bromobenzotrifluoride, 2- (EPH surr)	392-83-6	E601A	1.0	%		91.9	93.7	78.3	95.6	----
Volatile Organic Compounds Surrogates										
bromofluorobenzene, 4-	460-00-4	E611C	1.0	%		84.2	85.5	84.4	78.4	----
difluorobenzene, 1,4-	540-36-3	E611C	1.0	%		104	104	105	102	----
Polycyclic Aromatic Hydrocarbons										
acenaphthene	83-32-9	E641A	0.010	µg/L		<0.010	<0.010	<0.010	<0.010	----
acenaphthylene	208-96-8	E641A	0.010	µg/L		<0.010	<0.010	<0.010	<0.010	----
acridine	260-94-6	E641A	0.010	µg/L		<0.010	<0.010	<0.010	<0.010	----
anthracene	120-12-7	E641A	0.010	µg/L		<0.010	<0.010	<0.010	<0.010	----
benz(a)anthracene	56-55-3	E641A	0.010	µg/L		<0.010	<0.010	<0.010	<0.010	----
benzo(a)pyrene	50-32-8	E641A	0.0050	µg/L		<0.0050	<0.0050	<0.0050	<0.0050	----
benzo(b+j)fluoranthene	n/a	E641A	0.010	µg/L		<0.010	<0.010	<0.010	<0.010	----
benzo(b+j+k)fluoranthene	n/a	E641A	0.015	µg/L		<0.015	<0.015	<0.015	<0.015	----
benzo(g,h,i)perylene	191-24-2	E641A	0.010	µg/L		<0.010	<0.010	<0.010	<0.010	----
benzo(k)fluoranthene	207-08-9	E641A	0.010	µg/L		<0.010	<0.010	<0.010	<0.010	----
chrysene	218-01-9	E641A	0.010	µg/L		<0.010	<0.010	<0.010	<0.010	----
dibenz(a,h)anthracene	53-70-3	E641A	0.0050	µg/L		<0.0050	<0.0050	<0.0050	<0.0050	----
fluoranthene	206-44-0	E641A	0.010	µg/L		<0.010	<0.010	<0.010	<0.010	----
fluorene	86-73-7	E641A	0.010	µg/L		<0.010	<0.010	<0.010	<0.010	----
indeno(1,2,3-c,d)pyrene	193-39-5	E641A	0.010	µg/L		<0.010	<0.010	<0.010	<0.010	----
methylnaphthalene, 1-	90-12-0	E641A	0.010	µg/L		<0.010	<0.010	<0.010	<0.010	----
methylnaphthalene, 2-	91-57-6	E641A	0.010	µg/L		<0.010	<0.010	<0.010	<0.010	----
naphthalene	91-20-3	E641A	0.050	µg/L		<0.050	<0.050	<0.050	<0.050	----
phenanthrene	85-01-8	E641A	0.020	µg/L		<0.020	<0.020	<0.020	<0.020	----
pyrene	129-00-0	E641A	0.010	µg/L		<0.010	<0.010	<0.010	<0.010	----
quinoline	91-22-5	E641A	0.050	µg/L		<0.050	<0.050	<0.050	<0.050	----
Polycyclic Aromatic Hydrocarbons Surrogates										
chrysene-d12	1719-03-5	E641A	0.1	%		101	72.6	83.6	101	----

Analytical Results

Sub-Matrix: Water (Matrix: Water)					Client sample ID	Field Blank	DUP	Noohalk Creek Upstream	Noohalk Creek Downstream	----
					Client sampling date / time	02-Nov-2022 12:00	02-Nov-2022 12:00	31-Oct-2022 17:30	31-Oct-2022 17:00	----
Analyte	CAS Number	Method	LOR	Unit		VA22C6784-006	VA22C6784-007	VA22C6784-008	VA22C6784-009	--------
						Result	Result	Result	Result	----
Polycyclic Aromatic Hydrocarbons Surrogates										
naphthalene-d8	1146-65-2	E641A	0.1	%		93.8	92.0	74.4	87.7	----
phenanthrene-d10	1517-22-2	E641A	0.1	%		101	99.1	82.3	99.6	----

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

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QUALITY CONTROL INTERPRETIVE REPORT

Work Order	: **VA22C6784**	Page	: 1 of 35
Amendment	: **1**		
Client	: **Morrison Hershfield Limited**	Laboratory	: Vancouver - Environmental
Contact	: Emily Rogal	Account Manager	: Ian Chen
Address	: 4321 Still Creek Dr Burnaby BC Canada V5C 6S7	Address	: 8081 Lougheed Highway Burnaby, British Columbia Canada V5A 1W9
Telephone	: ----	Telephone	: +1 604 253 4188
Project	: 210629400	Date Samples Received	: 03-Nov-2022 16:05
PO	: 20104530	Issue Date	: 18-Nov-2022 14:51
C-O-C number	: 20-1016075		
Sampler	: CJ, ER		
Site	: ----		
Quote number	: ----		
No. of samples received	: 9		
No. of samples analysed	: 9		

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
- Matrix Spike 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

- No Quality Control Sample Frequency Outliers occur.

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
Matrix Spike (MS) Recoveries								
Dissolved Metals	Anonymous	Anonymous	silver, dissolved	7440-22-4	E421	65.8 % MES	70.0-130%	Recovery less than lower data quality objective

Result Qualifiers

Qualifier	Description
MES	*Data Quality Objective was marginally exceeded (by < 10% absolute) for < 10% of analytes in a Multi-Element Scan / Multi-Parameter Scan (considered acceptable as per OMOE & CCME).*

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] DUP	E550	02-Nov-2022	----	----	----		04-Nov-2022	3 days	2 days	✓
Aggregate Organics : Biochemical Oxygen Demand - 5 day										
HDPE [BOD HT 3d] Field Blank	E550	02-Nov-2022	----	----	----		04-Nov-2022	3 days	2 days	✓
Aggregate Organics : Biochemical Oxygen Demand - 5 day										
HDPE [BOD HT 3d] MW22-01	E550	02-Nov-2022	----	----	----		04-Nov-2022	3 days	2 days	✓
Aggregate Organics : Biochemical Oxygen Demand - 5 day										
HDPE [BOD HT 3d] MW22-02	E550	02-Nov-2022	----	----	----		04-Nov-2022	3 days	2 days	✓
Aggregate Organics : Biochemical Oxygen Demand - 5 day										
HDPE [BOD HT 3d] MW22-03	E550	02-Nov-2022	----	----	----		04-Nov-2022	3 days	2 days	✓
Aggregate Organics : Biochemical Oxygen Demand - 5 day										
HDPE [BOD HT 3d] MW22-04	E550	02-Nov-2022	----	----	----		04-Nov-2022	3 days	2 days	✓
Aggregate Organics : Biochemical Oxygen Demand - 5 day										
HDPE [BOD HT 3d] MW22-05	E550	02-Nov-2022	----	----	----		04-Nov-2022	3 days	2 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
Aggregate Organics : Biochemical Oxygen Demand - 5 day										
HDPE [BOD HT 3d]										
Noohalk Creek Downstream	E550	31-Oct-2022	----	----	----		04-Nov-2022	3 days	4 days	×
Aggregate Organics : Biochemical Oxygen Demand - 5 day										
HDPE [BOD HT 3d]										
Noohalk Creek Upstream	E550	31-Oct-2022	----	----	----		04-Nov-2022	3 days	4 days	×
Aggregate Organics : Chemical Oxygen Demand by Colourimetry (Low Level)										
Amber glass total (sulfuric acid)										
DUP	E559-L	02-Nov-2022	----	----	----		12-Nov-2022	28 days	10 days	✓
Aggregate Organics : Chemical Oxygen Demand by Colourimetry (Low Level)										
Amber glass total (sulfuric acid)										
Field Blank	E559-L	02-Nov-2022	----	----	----		12-Nov-2022	28 days	10 days	✓
Aggregate Organics : Chemical Oxygen Demand by Colourimetry (Low Level)										
Amber glass total (sulfuric acid)										
MW22-01	E559-L	02-Nov-2022	----	----	----		12-Nov-2022	28 days	10 days	✓
Aggregate Organics : Chemical Oxygen Demand by Colourimetry (Low Level)										
Amber glass total (sulfuric acid)										
MW22-02	E559-L	02-Nov-2022	----	----	----		12-Nov-2022	28 days	10 days	✓
Aggregate Organics : Chemical Oxygen Demand by Colourimetry (Low Level)										
Amber glass total (sulfuric acid)										
MW22-03	E559-L	02-Nov-2022	----	----	----		12-Nov-2022	28 days	10 days	✓
Aggregate Organics : Chemical Oxygen Demand by Colourimetry (Low Level)										
Amber glass total (sulfuric acid)										
MW22-04	E559-L	02-Nov-2022	----	----	----		12-Nov-2022	28 days	10 days	✓
Aggregate Organics : Chemical Oxygen Demand by Colourimetry (Low Level)										
Amber glass total (sulfuric acid)										
MW22-05	E559-L	02-Nov-2022	----	----	----		12-Nov-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
Aggregate Organics : Chemical Oxygen Demand by Colourimetry (Low Level)										
Amber glass total (sulfuric acid)										
Noohalk Creek Downstream	E559-L	31-Oct-2022	----	----	----		12-Nov-2022	28 days	12 days	✓
Aggregate Organics : Chemical Oxygen Demand by Colourimetry (Low Level)										
Amber glass total (sulfuric acid)										
Noohalk Creek Upstream	E559-L	31-Oct-2022	----	----	----		12-Nov-2022	28 days	12 days	✓
Anions and Nutrients : Ammonia by Fluorescence										
Amber glass total (sulfuric acid)										
DUP	E298	02-Nov-2022	16-Nov-2022	----	----		17-Nov-2022	28 days	15 days	✓
Anions and Nutrients : Ammonia by Fluorescence										
Amber glass total (sulfuric acid)										
Field Blank	E298	02-Nov-2022	16-Nov-2022	----	----		17-Nov-2022	28 days	15 days	✓
Anions and Nutrients : Ammonia by Fluorescence										
Amber glass total (sulfuric acid)										
MW22-01	E298	02-Nov-2022	16-Nov-2022	----	----		17-Nov-2022	28 days	15 days	✓
Anions and Nutrients : Ammonia by Fluorescence										
Amber glass total (sulfuric acid)										
MW22-02	E298	02-Nov-2022	16-Nov-2022	----	----		17-Nov-2022	28 days	15 days	✓
Anions and Nutrients : Ammonia by Fluorescence										
Amber glass total (sulfuric acid)										
MW22-03	E298	02-Nov-2022	16-Nov-2022	----	----		17-Nov-2022	28 days	15 days	✓
Anions and Nutrients : Ammonia by Fluorescence										
Amber glass total (sulfuric acid)										
MW22-04	E298	02-Nov-2022	16-Nov-2022	----	----		17-Nov-2022	28 days	15 days	✓
Anions and Nutrients : Ammonia by Fluorescence										
Amber glass total (sulfuric acid)										
MW22-05	E298	02-Nov-2022	16-Nov-2022	----	----		17-Nov-2022	28 days	15 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)										
Noohalk Creek Downstream	E298	31-Oct-2022	16-Nov-2022	----	----		17-Nov-2022	28 days	17 days	✓
Anions and Nutrients : Ammonia by Fluorescence										
Amber glass total (sulfuric acid)										
Noohalk Creek Upstream	E298	31-Oct-2022	16-Nov-2022	----	----		17-Nov-2022	28 days	17 days	✓
Anions and Nutrients : Bromide in Water by IC (Low Level)										
HDPE [BOD HT 3d]										
MW22-01	E235.Br-L	02-Nov-2022	05-Nov-2022	28 days	2 days	✓	05-Nov-2022	26 days	0 days	✓
Anions and Nutrients : Bromide in Water by IC (Low Level)										
HDPE [BOD HT 3d]										
MW22-02	E235.Br-L	02-Nov-2022	05-Nov-2022	28 days	2 days	✓	05-Nov-2022	26 days	0 days	✓
Anions and Nutrients : Bromide in Water by IC (Low Level)										
HDPE [BOD HT 3d]										
MW22-03	E235.Br-L	02-Nov-2022	05-Nov-2022	28 days	2 days	✓	05-Nov-2022	26 days	0 days	✓
Anions and Nutrients : Bromide in Water by IC (Low Level)										
HDPE [BOD HT 3d]										
DUP	E235.Br-L	02-Nov-2022	05-Nov-2022	28 days	3 days	✓	05-Nov-2022	25 days	0 days	✓
Anions and Nutrients : Bromide in Water by IC (Low Level)										
HDPE [BOD HT 3d]										
Field Blank	E235.Br-L	02-Nov-2022	05-Nov-2022	28 days	3 days	✓	05-Nov-2022	25 days	0 days	✓
Anions and Nutrients : Bromide in Water by IC (Low Level)										
HDPE [BOD HT 3d]										
MW22-04	E235.Br-L	02-Nov-2022	05-Nov-2022	28 days	3 days	✓	05-Nov-2022	25 days	0 days	✓
Anions and Nutrients : Bromide in Water by IC (Low Level)										
HDPE [BOD HT 3d]										
MW22-05	E235.Br-L	02-Nov-2022	05-Nov-2022	28 days	3 days	✓	05-Nov-2022	25 days	0 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 [BOD HT 3d]										
Noohalk Creek Downstream	E235.Br-L	31-Oct-2022	05-Nov-2022	28 days	5 days	✓	05-Nov-2022	23 days	0 days	✓
Anions and Nutrients : Bromide in Water by IC (Low Level)										
HDPE [BOD HT 3d]										
Noohalk Creek Upstream	E235.Br-L	31-Oct-2022	05-Nov-2022	28 days	5 days	✓	05-Nov-2022	23 days	0 days	✓
Anions and Nutrients : Chloride in Water by IC										
HDPE [BOD HT 3d]										
MW22-01	E235.Cl	02-Nov-2022	05-Nov-2022	28 days	2 days	✓	05-Nov-2022	26 days	0 days	✓
Anions and Nutrients : Chloride in Water by IC										
HDPE [BOD HT 3d]										
MW22-02	E235.Cl	02-Nov-2022	05-Nov-2022	28 days	2 days	✓	05-Nov-2022	26 days	0 days	✓
Anions and Nutrients : Chloride in Water by IC										
HDPE [BOD HT 3d]										
MW22-03	E235.Cl	02-Nov-2022	05-Nov-2022	28 days	2 days	✓	05-Nov-2022	26 days	0 days	✓
Anions and Nutrients : Chloride in Water by IC										
HDPE [BOD HT 3d]										
DUP	E235.Cl	02-Nov-2022	05-Nov-2022	28 days	3 days	✓	05-Nov-2022	25 days	0 days	✓
Anions and Nutrients : Chloride in Water by IC										
HDPE [BOD HT 3d]										
Field Blank	E235.Cl	02-Nov-2022	05-Nov-2022	28 days	3 days	✓	05-Nov-2022	25 days	0 days	✓
Anions and Nutrients : Chloride in Water by IC										
HDPE [BOD HT 3d]										
MW22-04	E235.Cl	02-Nov-2022	05-Nov-2022	28 days	3 days	✓	05-Nov-2022	25 days	0 days	✓
Anions and Nutrients : Chloride in Water by IC										
HDPE [BOD HT 3d]										
MW22-05	E235.Cl	02-Nov-2022	05-Nov-2022	28 days	3 days	✓	05-Nov-2022	25 days	0 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 : Chloride in Water by IC										
HDPE [BOD HT 3d] Noohalk Creek Downstream	E235.Cl	31-Oct-2022	05-Nov-2022	28 days	5 days	✓	05-Nov-2022	23 days	0 days	✓
Anions and Nutrients : Chloride in Water by IC										
HDPE [BOD HT 3d] Noohalk Creek Upstream	E235.Cl	31-Oct-2022	05-Nov-2022	28 days	5 days	✓	05-Nov-2022	23 days	0 days	✓
Anions and Nutrients : Dissolved Orthophosphate by Colourimetry (Ultra Trace Level 0.001										
HDPE [BOD HT 3d] MW22-01	E378-U	02-Nov-2022	05-Nov-2022	3 days	2 days	✓	05-Nov-2022	1 days	0 days	✓
Anions and Nutrients : Dissolved Orthophosphate by Colourimetry (Ultra Trace Level 0.001										
HDPE [BOD HT 3d] MW22-02	E378-U	02-Nov-2022	05-Nov-2022	3 days	2 days	✓	05-Nov-2022	1 days	0 days	✓
Anions and Nutrients : Dissolved Orthophosphate by Colourimetry (Ultra Trace Level 0.001										
HDPE [BOD HT 3d] MW22-03	E378-U	02-Nov-2022	05-Nov-2022	3 days	2 days	✓	05-Nov-2022	1 days	0 days	✓
Anions and Nutrients : Dissolved Orthophosphate by Colourimetry (Ultra Trace Level 0.001										
HDPE [BOD HT 3d] DUP	E378-U	02-Nov-2022	05-Nov-2022	3 days	3 days	✓	05-Nov-2022	0 days	0 days	✓
Anions and Nutrients : Dissolved Orthophosphate by Colourimetry (Ultra Trace Level 0.001										
HDPE [BOD HT 3d] Field Blank	E378-U	02-Nov-2022	05-Nov-2022	3 days	3 days	✓	05-Nov-2022	0 days	0 days	✓
Anions and Nutrients : Dissolved Orthophosphate by Colourimetry (Ultra Trace Level 0.001										
HDPE [BOD HT 3d] MW22-04	E378-U	02-Nov-2022	05-Nov-2022	3 days	3 days	✓	05-Nov-2022	0 days	0 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 : Dissolved Orthophosphate by Colourimetry (Ultra Trace Level 0.001										
HDPE [BOD HT 3d] MW22-05	E378-U	02-Nov-2022	05-Nov-2022	3 days	3 days	✓	05-Nov-2022	0 days	0 days	✓
Anions and Nutrients : Dissolved Orthophosphate by Colourimetry (Ultra Trace Level 0.001										
HDPE [BOD HT 3d] Noohalk Creek Upstream	E378-U	31-Oct-2022	05-Nov-2022	3 days	4 days	× EHT	05-Nov-2022	-1 days	0 days	× EHT
Anions and Nutrients : Dissolved Orthophosphate by Colourimetry (Ultra Trace Level 0.001										
HDPE [BOD HT 3d] Noohalk Creek Downstream	E378-U	31-Oct-2022	05-Nov-2022	3 days	5 days	× EHT	05-Nov-2022	-2 days	0 days	× EHT
Anions and Nutrients : Fluoride in Water by IC										
HDPE [BOD HT 3d] MW22-01	E235.F	02-Nov-2022	05-Nov-2022	28 days	2 days	✓	05-Nov-2022	26 days	0 days	✓
Anions and Nutrients : Fluoride in Water by IC										
HDPE [BOD HT 3d] MW22-02	E235.F	02-Nov-2022	05-Nov-2022	28 days	2 days	✓	05-Nov-2022	26 days	0 days	✓
Anions and Nutrients : Fluoride in Water by IC										
HDPE [BOD HT 3d] MW22-03	E235.F	02-Nov-2022	05-Nov-2022	28 days	2 days	✓	05-Nov-2022	26 days	0 days	✓
Anions and Nutrients : Fluoride in Water by IC										
HDPE [BOD HT 3d] DUP	E235.F	02-Nov-2022	05-Nov-2022	28 days	3 days	✓	05-Nov-2022	25 days	0 days	✓
Anions and Nutrients : Fluoride in Water by IC										
HDPE [BOD HT 3d] Field Blank	E235.F	02-Nov-2022	05-Nov-2022	28 days	3 days	✓	05-Nov-2022	25 days	0 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 : Fluoride in Water by IC										
HDPE [BOD HT 3d]										
MW22-04	E235.F	02-Nov-2022	05-Nov-2022	28 days	3 days	✓	05-Nov-2022	25 days	0 days	✓
Anions and Nutrients : Fluoride in Water by IC										
HDPE [BOD HT 3d]										
MW22-05	E235.F	02-Nov-2022	05-Nov-2022	28 days	3 days	✓	05-Nov-2022	25 days	0 days	✓
Anions and Nutrients : Fluoride in Water by IC										
HDPE [BOD HT 3d]										
Noohalk Creek Downstream	E235.F	31-Oct-2022	05-Nov-2022	28 days	5 days	✓	05-Nov-2022	23 days	0 days	✓
Anions and Nutrients : Fluoride in Water by IC										
HDPE [BOD HT 3d]										
Noohalk Creek Upstream	E235.F	31-Oct-2022	05-Nov-2022	28 days	5 days	✓	05-Nov-2022	23 days	0 days	✓
Anions and Nutrients : Nitrate in Water by IC (Low Level)										
HDPE [BOD HT 3d]										
MW22-01	E235.NO3-L	02-Nov-2022	05-Nov-2022	3 days	2 days	✓	05-Nov-2022	3 days	0 days	✓
Anions and Nutrients : Nitrate in Water by IC (Low Level)										
HDPE [BOD HT 3d]										
MW22-02	E235.NO3-L	02-Nov-2022	05-Nov-2022	3 days	2 days	✓	05-Nov-2022	3 days	0 days	✓
Anions and Nutrients : Nitrate in Water by IC (Low Level)										
HDPE [BOD HT 3d]										
MW22-03	E235.NO3-L	02-Nov-2022	05-Nov-2022	3 days	2 days	✓	05-Nov-2022	3 days	0 days	✓
Anions and Nutrients : Nitrate in Water by IC (Low Level)										
HDPE [BOD HT 3d]										
DUP	E235.NO3-L	02-Nov-2022	05-Nov-2022	3 days	3 days	✓	05-Nov-2022	3 days	0 days	✓
Anions and Nutrients : Nitrate in Water by IC (Low Level)										
HDPE [BOD HT 3d]										
Field Blank	E235.NO3-L	02-Nov-2022	05-Nov-2022	3 days	3 days	✓	05-Nov-2022	3 days	0 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 : Nitrate in Water by IC (Low Level)										
HDPE [BOD HT 3d]										
MW22-04	E235.NO3-L	02-Nov-2022	05-Nov-2022	3 days	3 days	✓	05-Nov-2022	3 days	0 days	✓
Anions and Nutrients : Nitrate in Water by IC (Low Level)										
HDPE [BOD HT 3d]										
MW22-05	E235.NO3-L	02-Nov-2022	05-Nov-2022	3 days	3 days	✓	05-Nov-2022	3 days	0 days	✓
Anions and Nutrients : Nitrate in Water by IC (Low Level)										
HDPE [BOD HT 3d]										
Noohalk Creek Downstream	E235.NO3-L	31-Oct-2022	05-Nov-2022	3 days	5 days	× EHT	05-Nov-2022	3 days	0 days	✓
Anions and Nutrients : Nitrate in Water by IC (Low Level)										
HDPE [BOD HT 3d]										
Noohalk Creek Upstream	E235.NO3-L	31-Oct-2022	05-Nov-2022	3 days	5 days	× EHT	05-Nov-2022	3 days	0 days	✓
Anions and Nutrients : Nitrite in Water by IC (Low Level)										
HDPE [BOD HT 3d]										
MW22-01	E235.NO2-L	02-Nov-2022	05-Nov-2022	3 days	2 days	✓	05-Nov-2022	1 days	0 days	✓
Anions and Nutrients : Nitrite in Water by IC (Low Level)										
HDPE [BOD HT 3d]										
MW22-02	E235.NO2-L	02-Nov-2022	05-Nov-2022	3 days	2 days	✓	05-Nov-2022	1 days	0 days	✓
Anions and Nutrients : Nitrite in Water by IC (Low Level)										
HDPE [BOD HT 3d]										
MW22-03	E235.NO2-L	02-Nov-2022	05-Nov-2022	3 days	2 days	✓	05-Nov-2022	1 days	0 days	✓
Anions and Nutrients : Nitrite in Water by IC (Low Level)										
HDPE [BOD HT 3d]										
DUP	E235.NO2-L	02-Nov-2022	05-Nov-2022	3 days	3 days	✓	05-Nov-2022	0 days	0 days	✓
Anions and Nutrients : Nitrite in Water by IC (Low Level)										
HDPE [BOD HT 3d]										
Field Blank	E235.NO2-L	02-Nov-2022	05-Nov-2022	3 days	3 days	✓	05-Nov-2022	0 days	0 days	✓

Matrix: **Water**

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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 [BOD HT 3d]										
MW22-04	E235.NO2-L	02-Nov-2022	05-Nov-2022	3 days	3 days	✓	05-Nov-2022	0 days	0 days	✓
Anions and Nutrients : Nitrite in Water by IC (Low Level)										
HDPE [BOD HT 3d]										
MW22-05	E235.NO2-L	02-Nov-2022	05-Nov-2022	3 days	3 days	✓	05-Nov-2022	0 days	0 days	✓
Anions and Nutrients : Nitrite in Water by IC (Low Level)										
HDPE [BOD HT 3d]										
Noohalk Creek Downstream	E235.NO2-L	31-Oct-2022	05-Nov-2022	3 days	5 days	× EHT	05-Nov-2022	-2 days	0 days	× EHT
Anions and Nutrients : Nitrite in Water by IC (Low Level)										
HDPE [BOD HT 3d]										
Noohalk Creek Upstream	E235.NO2-L	31-Oct-2022	05-Nov-2022	3 days	5 days	× EHT	05-Nov-2022	-2 days	0 days	× EHT
Anions and Nutrients : Sulfate in Water by IC										
HDPE [BOD HT 3d]										
MW22-01	E235.SO4	02-Nov-2022	05-Nov-2022	28 days	2 days	✓	05-Nov-2022	26 days	0 days	✓
Anions and Nutrients : Sulfate in Water by IC										
HDPE [BOD HT 3d]										
MW22-02	E235.SO4	02-Nov-2022	05-Nov-2022	28 days	2 days	✓	05-Nov-2022	26 days	0 days	✓
Anions and Nutrients : Sulfate in Water by IC										
HDPE [BOD HT 3d]										
MW22-03	E235.SO4	02-Nov-2022	05-Nov-2022	28 days	2 days	✓	05-Nov-2022	26 days	0 days	✓
Anions and Nutrients : Sulfate in Water by IC										
HDPE [BOD HT 3d]										
DUP	E235.SO4	02-Nov-2022	05-Nov-2022	28 days	3 days	✓	05-Nov-2022	25 days	0 days	✓
Anions and Nutrients : Sulfate in Water by IC										
HDPE [BOD HT 3d]										
Field Blank	E235.SO4	02-Nov-2022	05-Nov-2022	28 days	3 days	✓	05-Nov-2022	25 days	0 days	✓

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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 : Sulfate in Water by IC										
HDPE [BOD HT 3d]										
MW22-04	E235.SO4	02-Nov-2022	05-Nov-2022	28 days	3 days	✓	05-Nov-2022	25 days	0 days	✓
Anions and Nutrients : Sulfate in Water by IC										
HDPE [BOD HT 3d]										
MW22-05	E235.SO4	02-Nov-2022	05-Nov-2022	28 days	3 days	✓	05-Nov-2022	25 days	0 days	✓
Anions and Nutrients : Sulfate in Water by IC										
HDPE [BOD HT 3d]										
Noohalk Creek Downstream	E235.SO4	31-Oct-2022	05-Nov-2022	28 days	5 days	✓	05-Nov-2022	23 days	0 days	✓
Anions and Nutrients : Sulfate in Water by IC										
HDPE [BOD HT 3d]										
Noohalk Creek Upstream	E235.SO4	31-Oct-2022	05-Nov-2022	28 days	5 days	✓	05-Nov-2022	23 days	0 days	✓
Dissolved Metals : Dissolved Mercury in Water by CVAAS										
Glass vial dissolved (hydrochloric acid)										
MW22-01	E509	02-Nov-2022	05-Nov-2022	----	----		05-Nov-2022	28 days	2 days	✓
Dissolved Metals : Dissolved Mercury in Water by CVAAS										
Glass vial dissolved (hydrochloric acid)										
DUP	E509	02-Nov-2022	05-Nov-2022	----	----		05-Nov-2022	28 days	3 days	✓
Dissolved Metals : Dissolved Mercury in Water by CVAAS										
Glass vial dissolved (hydrochloric acid)										
Field Blank	E509	02-Nov-2022	05-Nov-2022	----	----		05-Nov-2022	28 days	3 days	✓
Dissolved Metals : Dissolved Mercury in Water by CVAAS										
Glass vial dissolved (hydrochloric acid)										
MW22-02	E509	02-Nov-2022	05-Nov-2022	----	----		05-Nov-2022	28 days	3 days	✓
Dissolved Metals : Dissolved Mercury in Water by CVAAS										
Glass vial dissolved (hydrochloric acid)										
MW22-03	E509	02-Nov-2022	05-Nov-2022	----	----		05-Nov-2022	28 days	3 days	✓

Matrix: **Water**

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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) MW22-04	E509	02-Nov-2022	05-Nov-2022	----	----		05-Nov-2022	28 days	3 days	✓
Dissolved Metals : Dissolved Mercury in Water by CVAAS										
Glass vial dissolved (hydrochloric acid) MW22-05	E509	02-Nov-2022	05-Nov-2022	----	----		05-Nov-2022	28 days	3 days	✓
Dissolved Metals : Dissolved Metals in Water by CRC ICPMS										
HDPE dissolved (nitric acid) DUP	E421	02-Nov-2022	09-Nov-2022	----	----		12-Nov-2022	180 days	10 days	✓
Dissolved Metals : Dissolved Metals in Water by CRC ICPMS										
HDPE dissolved (nitric acid) Field Blank	E421	02-Nov-2022	09-Nov-2022	----	----		12-Nov-2022	180 days	10 days	✓
Dissolved Metals : Dissolved Metals in Water by CRC ICPMS										
HDPE dissolved (nitric acid) MW22-01	E421	02-Nov-2022	09-Nov-2022	----	----		12-Nov-2022	180 days	10 days	✓
Dissolved Metals : Dissolved Metals in Water by CRC ICPMS										
HDPE dissolved (nitric acid) MW22-02	E421	02-Nov-2022	09-Nov-2022	----	----		12-Nov-2022	180 days	10 days	✓
Dissolved Metals : Dissolved Metals in Water by CRC ICPMS										
HDPE dissolved (nitric acid) MW22-03	E421	02-Nov-2022	09-Nov-2022	----	----		12-Nov-2022	180 days	10 days	✓
Dissolved Metals : Dissolved Metals in Water by CRC ICPMS										
HDPE dissolved (nitric acid) MW22-04	E421	02-Nov-2022	09-Nov-2022	----	----		12-Nov-2022	180 days	10 days	✓
Dissolved Metals : Dissolved Metals in Water by CRC ICPMS										
HDPE dissolved (nitric acid) MW22-05	E421	02-Nov-2022	09-Nov-2022	----	----		12-Nov-2022	180 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
Hydrocarbons : BC PHCs - EPH by GC-FID										
Amber glass/Teflon lined cap (sodium bisulfate) DUP	E601A	02-Nov-2022	14-Nov-2022	14 days	12 days	✓	15-Nov-2022	40 days	1 days	✓
Hydrocarbons : BC PHCs - EPH by GC-FID										
Amber glass/Teflon lined cap (sodium bisulfate) Field Blank	E601A	02-Nov-2022	14-Nov-2022	14 days	12 days	✓	15-Nov-2022	40 days	1 days	✓
Hydrocarbons : BC PHCs - EPH by GC-FID										
Amber glass/Teflon lined cap (sodium bisulfate) MW22-01	E601A	02-Nov-2022	14-Nov-2022	14 days	12 days	✓	15-Nov-2022	40 days	1 days	✓
Hydrocarbons : BC PHCs - EPH by GC-FID										
Amber glass/Teflon lined cap (sodium bisulfate) MW22-02	E601A	02-Nov-2022	14-Nov-2022	14 days	12 days	✓	15-Nov-2022	40 days	1 days	✓
Hydrocarbons : BC PHCs - EPH by GC-FID										
Amber glass/Teflon lined cap (sodium bisulfate) MW22-03	E601A	02-Nov-2022	14-Nov-2022	14 days	12 days	✓	15-Nov-2022	40 days	1 days	✓
Hydrocarbons : BC PHCs - EPH by GC-FID										
Amber glass/Teflon lined cap (sodium bisulfate) MW22-04	E601A	02-Nov-2022	14-Nov-2022	14 days	12 days	✓	15-Nov-2022	40 days	1 days	✓
Hydrocarbons : BC PHCs - EPH by GC-FID										
Amber glass/Teflon lined cap (sodium bisulfate) MW22-05	E601A	02-Nov-2022	14-Nov-2022	14 days	12 days	✓	15-Nov-2022	40 days	1 days	✓
Hydrocarbons : BC PHCs - EPH by GC-FID										
Amber glass/Teflon lined cap (sodium bisulfate) Noohalk Creek Downstream	E601A	31-Oct-2022	13-Nov-2022	14 days	13 days	✓	13-Nov-2022	40 days	0 days	✓
Hydrocarbons : BC PHCs - EPH by GC-FID										
Amber glass/Teflon lined cap (sodium bisulfate) Noohalk Creek Upstream	E601A	31-Oct-2022	13-Nov-2022	14 days	13 days	✓	13-Nov-2022	40 days	0 days	✓

Matrix: **Water**

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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
Organic / Inorganic Carbon : Total Organic Carbon (Non-Purgeable) by Combustion (Low Level)										
Amber glass total (sulfuric acid) DUP	E355-L	02-Nov-2022	06-Nov-2022	----	----		06-Nov-2022	28 days	4 days	✓
Organic / Inorganic Carbon : Total Organic Carbon (Non-Purgeable) by Combustion (Low Level)										
Amber glass total (sulfuric acid) Field Blank	E355-L	02-Nov-2022	06-Nov-2022	----	----		06-Nov-2022	28 days	4 days	✓
Organic / Inorganic Carbon : Total Organic Carbon (Non-Purgeable) by Combustion (Low Level)										
Amber glass total (sulfuric acid) MW22-01	E355-L	02-Nov-2022	06-Nov-2022	----	----		06-Nov-2022	28 days	4 days	✓
Organic / Inorganic Carbon : Total Organic Carbon (Non-Purgeable) by Combustion (Low Level)										
Amber glass total (sulfuric acid) MW22-02	E355-L	02-Nov-2022	06-Nov-2022	----	----		06-Nov-2022	28 days	4 days	✓
Organic / Inorganic Carbon : Total Organic Carbon (Non-Purgeable) by Combustion (Low Level)										
Amber glass total (sulfuric acid) MW22-03	E355-L	02-Nov-2022	06-Nov-2022	----	----		06-Nov-2022	28 days	4 days	✓
Organic / Inorganic Carbon : Total Organic Carbon (Non-Purgeable) by Combustion (Low Level)										
Amber glass total (sulfuric acid) MW22-04	E355-L	02-Nov-2022	06-Nov-2022	----	----		06-Nov-2022	28 days	4 days	✓
Organic / Inorganic Carbon : Total Organic Carbon (Non-Purgeable) by Combustion (Low Level)										
Amber glass total (sulfuric acid) MW22-05	E355-L	02-Nov-2022	06-Nov-2022	----	----		06-Nov-2022	28 days	4 days	✓
Organic / Inorganic Carbon : Total Organic Carbon (Non-Purgeable) by Combustion (Low Level)										
Amber glass total (sulfuric acid) Noohalk Creek Downstream	E355-L	31-Oct-2022	06-Nov-2022	----	----		06-Nov-2022	28 days	6 days	✓
Organic / Inorganic Carbon : Total Organic Carbon (Non-Purgeable) by Combustion (Low Level)										
Amber glass total (sulfuric acid) Noohalk Creek Upstream	E355-L	31-Oct-2022	06-Nov-2022	----	----		06-Nov-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
Physical Tests : Alkalinity Species by Titration										
HDPE [BOD HT 3d] DUP	E290	02-Nov-2022	16-Nov-2022	14 days	14 days	✓	16-Nov-2022	0 days	0 days	✓
Physical Tests : Alkalinity Species by Titration										
HDPE [BOD HT 3d] Field Blank	E290	02-Nov-2022	16-Nov-2022	14 days	14 days	✓	16-Nov-2022	0 days	0 days	✓
Physical Tests : Alkalinity Species by Titration										
HDPE [BOD HT 3d] MW22-01	E290	02-Nov-2022	16-Nov-2022	14 days	14 days	✓	16-Nov-2022	0 days	0 days	✓
Physical Tests : Alkalinity Species by Titration										
HDPE [BOD HT 3d] MW22-02	E290	02-Nov-2022	16-Nov-2022	14 days	14 days	✓	16-Nov-2022	0 days	0 days	✓
Physical Tests : Alkalinity Species by Titration										
HDPE [BOD HT 3d] MW22-03	E290	02-Nov-2022	16-Nov-2022	14 days	14 days	✓	16-Nov-2022	0 days	0 days	✓
Physical Tests : Alkalinity Species by Titration										
HDPE [BOD HT 3d] MW22-04	E290	02-Nov-2022	16-Nov-2022	14 days	14 days	✓	16-Nov-2022	0 days	0 days	✓
Physical Tests : Alkalinity Species by Titration										
HDPE [BOD HT 3d] MW22-05	E290	02-Nov-2022	16-Nov-2022	14 days	14 days	✓	16-Nov-2022	0 days	0 days	✓
Physical Tests : Alkalinity Species by Titration										
HDPE [BOD HT 3d] Noohalk Creek Downstream	E290	31-Oct-2022	16-Nov-2022	14 days	16 days	× EHT	16-Nov-2022	-2 days	0 days	× EHT
Physical Tests : Alkalinity Species by Titration										
HDPE [BOD HT 3d] Noohalk Creek Upstream	E290	31-Oct-2022	16-Nov-2022	14 days	16 days	× EHT	16-Nov-2022	-2 days	0 days	× EHT

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 [BOD HT 3d] MW22-01	E100	02-Nov-2022	05-Nov-2022	28 days	2 days	✓	05-Nov-2022	26 days	0 days	✓
Physical Tests : Conductivity in Water										
HDPE [BOD HT 3d] MW22-02	E100	02-Nov-2022	05-Nov-2022	28 days	2 days	✓	05-Nov-2022	26 days	0 days	✓
Physical Tests : Conductivity in Water										
HDPE [BOD HT 3d] MW22-03	E100	02-Nov-2022	05-Nov-2022	28 days	2 days	✓	05-Nov-2022	26 days	0 days	✓
Physical Tests : Conductivity in Water										
HDPE [BOD HT 3d] DUP	E100	02-Nov-2022	05-Nov-2022	28 days	3 days	✓	05-Nov-2022	25 days	0 days	✓
Physical Tests : Conductivity in Water										
HDPE [BOD HT 3d] Field Blank	E100	02-Nov-2022	05-Nov-2022	28 days	3 days	✓	05-Nov-2022	25 days	0 days	✓
Physical Tests : Conductivity in Water										
HDPE [BOD HT 3d] MW22-04	E100	02-Nov-2022	05-Nov-2022	28 days	3 days	✓	05-Nov-2022	25 days	0 days	✓
Physical Tests : Conductivity in Water										
HDPE [BOD HT 3d] MW22-05	E100	02-Nov-2022	05-Nov-2022	28 days	3 days	✓	05-Nov-2022	25 days	0 days	✓
Physical Tests : Conductivity in Water										
HDPE [BOD HT 3d] Noohalk Creek Downstream	E100	31-Oct-2022	05-Nov-2022	28 days	5 days	✓	05-Nov-2022	23 days	0 days	✓
Physical Tests : Conductivity in Water										
HDPE [BOD HT 3d] Noohalk Creek Upstream	E100	31-Oct-2022	05-Nov-2022	28 days	5 days	✓	05-Nov-2022	23 days	0 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 [BOD HT 3d] DUP	E108	02-Nov-2022	05-Nov-2022	4 hrs	4 hrs	× EHTR-FM	05-Nov-2022	-59.75 hrs	4 hrs	× EHTR-FM
Physical Tests : pH by Meter										
HDPE [BOD HT 3d] Field Blank	E108	02-Nov-2022	05-Nov-2022	4 hrs	4 hrs	× EHTR-FM	05-Nov-2022	-59.75 hrs	4 hrs	× EHTR-FM
Physical Tests : pH by Meter										
HDPE [BOD HT 3d] MW22-04	E108	02-Nov-2022	05-Nov-2022	5 hrs	1.50 hrs	× EHTR-FM	05-Nov-2022	-58.55 hrs	5 hrs	× EHTR-FM
Physical Tests : pH by Meter										
HDPE [BOD HT 3d] MW22-05	E108	02-Nov-2022	05-Nov-2022	5 hrs	1.75 hrs	× EHTR-FM	05-Nov-2022	-58.55 hrs	5 hrs	× EHTR-FM
Physical Tests : pH by Meter										
HDPE [BOD HT 3d] MW22-01	E108	02-Nov-2022	05-Nov-2022	5 hrs	22 hrs	× EHTL	05-Nov-2022	-34.55 hrs	5 hrs	× EHTL
Physical Tests : pH by Meter										
HDPE [BOD HT 3d] MW22-02	E108	02-Nov-2022	05-Nov-2022	5 hrs	23 hrs	× EHTL	05-Nov-2022	-34.55 hrs	5 hrs	× EHTL
Physical Tests : pH by Meter										
HDPE [BOD HT 3d] MW22-03	E108	02-Nov-2022	05-Nov-2022	5 hrs	23 hrs	× EHTL	05-Nov-2022	-34.55 hrs	5 hrs	× EHTL
Physical Tests : pH by Meter										
HDPE [BOD HT 3d] Noohalk Creek Downstream	E108	31-Oct-2022	05-Nov-2022	9 hrs	23 hrs	× EHTR-FM	05-Nov-2022	-84.79 hrs	9 hrs	× EHTR-FM
Physical Tests : pH by Meter										
HDPE [BOD HT 3d] Noohalk Creek Upstream	E108	31-Oct-2022	05-Nov-2022	9 hrs	23 hrs	× EHTR-FM	05-Nov-2022	-84.79 hrs	9 hrs	× EHTR-FM

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 : TDS by Gravimetry										
HDPE [BOD HT 3d] DUP	E162	02-Nov-2022	----	----	----		05-Nov-2022	7 days	3 days	✓
Physical Tests : TDS by Gravimetry										
HDPE [BOD HT 3d] Field Blank	E162	02-Nov-2022	----	----	----		05-Nov-2022	7 days	3 days	✓
Physical Tests : TDS by Gravimetry										
HDPE [BOD HT 3d] MW22-01	E162	02-Nov-2022	----	----	----		05-Nov-2022	7 days	3 days	✓
Physical Tests : TDS by Gravimetry										
HDPE [BOD HT 3d] MW22-02	E162	02-Nov-2022	----	----	----		05-Nov-2022	7 days	3 days	✓
Physical Tests : TDS by Gravimetry										
HDPE [BOD HT 3d] MW22-03	E162	02-Nov-2022	----	----	----		05-Nov-2022	7 days	3 days	✓
Physical Tests : TDS by Gravimetry										
HDPE [BOD HT 3d] MW22-04	E162	02-Nov-2022	----	----	----		05-Nov-2022	7 days	3 days	✓
Physical Tests : TDS by Gravimetry										
HDPE [BOD HT 3d] MW22-05	E162	02-Nov-2022	----	----	----		05-Nov-2022	7 days	3 days	✓
Physical Tests : TDS by Gravimetry										
HDPE [BOD HT 3d] Noohalk Creek Downstream	E162	31-Oct-2022	----	----	----		05-Nov-2022	7 days	5 days	✓
Physical Tests : TDS by Gravimetry										
HDPE [BOD HT 3d] Noohalk Creek Upstream	E162	31-Oct-2022	----	----	----		05-Nov-2022	7 days	5 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 : TSS by Gravimetry										
HDPE [BOD HT 3d] DUP	E160	02-Nov-2022	----	----	----		05-Nov-2022	7 days	3 days	✓
Physical Tests : TSS by Gravimetry										
HDPE [BOD HT 3d] Field Blank	E160	02-Nov-2022	----	----	----		05-Nov-2022	7 days	3 days	✓
Physical Tests : TSS by Gravimetry										
HDPE [BOD HT 3d] MW22-01	E160	02-Nov-2022	----	----	----		05-Nov-2022	7 days	3 days	✓
Physical Tests : TSS by Gravimetry										
HDPE [BOD HT 3d] MW22-02	E160	02-Nov-2022	----	----	----		05-Nov-2022	7 days	3 days	✓
Physical Tests : TSS by Gravimetry										
HDPE [BOD HT 3d] MW22-03	E160	02-Nov-2022	----	----	----		05-Nov-2022	7 days	3 days	✓
Physical Tests : TSS by Gravimetry										
HDPE [BOD HT 3d] MW22-04	E160	02-Nov-2022	----	----	----		05-Nov-2022	7 days	3 days	✓
Physical Tests : TSS by Gravimetry										
HDPE [BOD HT 3d] MW22-05	E160	02-Nov-2022	----	----	----		05-Nov-2022	7 days	3 days	✓
Physical Tests : TSS by Gravimetry										
HDPE [BOD HT 3d] Noohalk Creek Downstream	E160	31-Oct-2022	----	----	----		05-Nov-2022	7 days	5 days	✓
Physical Tests : TSS by Gravimetry										
HDPE [BOD HT 3d] Noohalk Creek Upstream	E160	31-Oct-2022	----	----	----		05-Nov-2022	7 days	5 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
Polycyclic Aromatic Hydrocarbons : PAHs by Hexane LVI GC-MS										
Amber glass/Teflon lined cap (sodium bisulfate)										
DUP	E641A	02-Nov-2022	14-Nov-2022	14 days	12 days	✓	15-Nov-2022	40 days	1 days	✓
Polycyclic Aromatic Hydrocarbons : PAHs by Hexane LVI GC-MS										
Amber glass/Teflon lined cap (sodium bisulfate)										
Field Blank	E641A	02-Nov-2022	14-Nov-2022	14 days	12 days	✓	15-Nov-2022	40 days	1 days	✓
Polycyclic Aromatic Hydrocarbons : PAHs by Hexane LVI GC-MS										
Amber glass/Teflon lined cap (sodium bisulfate)										
MW22-01	E641A	02-Nov-2022	14-Nov-2022	14 days	12 days	✓	15-Nov-2022	40 days	1 days	✓
Polycyclic Aromatic Hydrocarbons : PAHs by Hexane LVI GC-MS										
Amber glass/Teflon lined cap (sodium bisulfate)										
MW22-02	E641A	02-Nov-2022	14-Nov-2022	14 days	12 days	✓	15-Nov-2022	40 days	1 days	✓
Polycyclic Aromatic Hydrocarbons : PAHs by Hexane LVI GC-MS										
Amber glass/Teflon lined cap (sodium bisulfate)										
MW22-03	E641A	02-Nov-2022	14-Nov-2022	14 days	12 days	✓	15-Nov-2022	40 days	1 days	✓
Polycyclic Aromatic Hydrocarbons : PAHs by Hexane LVI GC-MS										
Amber glass/Teflon lined cap (sodium bisulfate)										
MW22-04	E641A	02-Nov-2022	14-Nov-2022	14 days	12 days	✓	15-Nov-2022	40 days	1 days	✓
Polycyclic Aromatic Hydrocarbons : PAHs by Hexane LVI GC-MS										
Amber glass/Teflon lined cap (sodium bisulfate)										
MW22-05	E641A	02-Nov-2022	14-Nov-2022	14 days	12 days	✓	15-Nov-2022	40 days	1 days	✓
Polycyclic Aromatic Hydrocarbons : PAHs by Hexane LVI GC-MS										
Amber glass/Teflon lined cap (sodium bisulfate)										
Noohalk Creek Downstream	E641A	31-Oct-2022	13-Nov-2022	14 days	13 days	✓	13-Nov-2022	40 days	0 days	✓
Polycyclic Aromatic Hydrocarbons : PAHs by Hexane LVI GC-MS										
Amber glass/Teflon lined cap (sodium bisulfate)										
Noohalk Creek Upstream	E641A	31-Oct-2022	13-Nov-2022	14 days	13 days	✓	13-Nov-2022	40 days	0 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)										
Noohalk Creek Downstream	E508	31-Oct-2022	07-Nov-2022	----	----		07-Nov-2022	28 days	7 days	✓
Total Metals : Total Mercury in Water by CVAAS										
Glass vial total (hydrochloric acid)										
Noohalk Creek Upstream	E508	31-Oct-2022	07-Nov-2022	----	----		07-Nov-2022	28 days	7 days	✓
Total Metals : Total metals in Water by CRC ICPMS										
HDPE total (nitric acid)										
Noohalk Creek Downstream	E420	31-Oct-2022	10-Nov-2022	----	----		15-Nov-2022	180 days	15 days	✓
Total Metals : Total metals in Water by CRC ICPMS										
HDPE total (nitric acid)										
Noohalk Creek Upstream	E420	31-Oct-2022	10-Nov-2022	----	----		15-Nov-2022	180 days	15 days	✓
Volatile Organic Compounds : VOCs (BC List) by Headspace GC-MS										
Glass vial (sodium bisulfate)										
DUP	E611C	02-Nov-2022	08-Nov-2022	----	----		12-Nov-2022	----	----	
Volatile Organic Compounds : VOCs (BC List) by Headspace GC-MS										
Glass vial (sodium bisulfate)										
Field Blank	E611C	02-Nov-2022	08-Nov-2022	----	----		12-Nov-2022	----	----	
Volatile Organic Compounds : VOCs (BC List) by Headspace GC-MS										
Glass vial (sodium bisulfate)										
MW22-01	E611C	02-Nov-2022	08-Nov-2022	----	----		12-Nov-2022	----	----	
Volatile Organic Compounds : VOCs (BC List) by Headspace GC-MS										
Glass vial (sodium bisulfate)										
MW22-02	E611C	02-Nov-2022	08-Nov-2022	----	----		12-Nov-2022	----	----	
Volatile Organic Compounds : VOCs (BC List) by Headspace GC-MS										
Glass vial (sodium bisulfate)										
MW22-03	E611C	02-Nov-2022	08-Nov-2022	----	----		12-Nov-2022	----	----	

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
Volatile Organic Compounds : VOCs (BC List) by Headspace GC-MS										
Glass vial (sodium bisulfate) MW22-04	E611C	02-Nov-2022	08-Nov-2022	----	----		12-Nov-2022	----	----	
Volatile Organic Compounds : VOCs (BC List) by Headspace GC-MS										
Glass vial (sodium bisulfate) MW22-05	E611C	02-Nov-2022	08-Nov-2022	----	----		12-Nov-2022	----	----	
Volatile Organic Compounds : VOCs (BC List) by Headspace GC-MS										
Glass vial (sodium bisulfate) Noohalk Creek Downstream	E611C	31-Oct-2022	08-Nov-2022	----	----		12-Nov-2022	----	----	
Volatile Organic Compounds : VOCs (BC List) by Headspace GC-MS										
Glass vial (sodium bisulfate) Noohalk Creek Upstream	E611C	31-Oct-2022	08-Nov-2022	----	----		12-Nov-2022	----	----	
Volatile Organic Compounds [Drycleaning] : VOCs (BC List) by Headspace GC-MS										
Glass vial (sodium bisulfate) DUP	E611C	02-Nov-2022	08-Nov-2022	----	----		12-Nov-2022	----	----	
Volatile Organic Compounds [Drycleaning] : VOCs (BC List) by Headspace GC-MS										
Glass vial (sodium bisulfate) Field Blank	E611C	02-Nov-2022	08-Nov-2022	----	----		12-Nov-2022	----	----	
Volatile Organic Compounds [Drycleaning] : VOCs (BC List) by Headspace GC-MS										
Glass vial (sodium bisulfate) MW22-01	E611C	02-Nov-2022	08-Nov-2022	----	----		12-Nov-2022	----	----	
Volatile Organic Compounds [Drycleaning] : VOCs (BC List) by Headspace GC-MS										
Glass vial (sodium bisulfate) MW22-02	E611C	02-Nov-2022	08-Nov-2022	----	----		12-Nov-2022	----	----	
Volatile Organic Compounds [Drycleaning] : VOCs (BC List) by Headspace GC-MS										
Glass vial (sodium bisulfate) MW22-03	E611C	02-Nov-2022	08-Nov-2022	----	----		12-Nov-2022	----	----	

Matrix: **Water**

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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
Volatile Organic Compounds [Drycleaning] : VOCs (BC List) by Headspace GC-MS										
Glass vial (sodium bisulfate) MW22-04	E611C	02-Nov-2022	08-Nov-2022	----	----		12-Nov-2022	----	----	
Volatile Organic Compounds [Drycleaning] : VOCs (BC List) by Headspace GC-MS										
Glass vial (sodium bisulfate) MW22-05	E611C	02-Nov-2022	08-Nov-2022	----	----		12-Nov-2022	----	----	
Volatile Organic Compounds [Drycleaning] : VOCs (BC List) by Headspace GC-MS										
Glass vial (sodium bisulfate) Noohalk Creek Downstream	E611C	31-Oct-2022	08-Nov-2022	----	----		12-Nov-2022	----	----	
Volatile Organic Compounds [Drycleaning] : VOCs (BC List) by Headspace GC-MS										
Glass vial (sodium bisulfate) Noohalk Creek Upstream	E611C	31-Oct-2022	08-Nov-2022	----	----		12-Nov-2022	----	----	
Volatile Organic Compounds [Fuels] : VOCs (BC List) by Headspace GC-MS										
Glass vial (sodium bisulfate) DUP	E611C	02-Nov-2022	08-Nov-2022	----	----		12-Nov-2022	14 days	10 days	✓
Volatile Organic Compounds [Fuels] : VOCs (BC List) by Headspace GC-MS										
Glass vial (sodium bisulfate) Field Blank	E611C	02-Nov-2022	08-Nov-2022	----	----		12-Nov-2022	14 days	10 days	✓
Volatile Organic Compounds [Fuels] : VOCs (BC List) by Headspace GC-MS										
Glass vial (sodium bisulfate) MW22-01	E611C	02-Nov-2022	08-Nov-2022	----	----		12-Nov-2022	14 days	10 days	✓
Volatile Organic Compounds [Fuels] : VOCs (BC List) by Headspace GC-MS										
Glass vial (sodium bisulfate) MW22-02	E611C	02-Nov-2022	08-Nov-2022	----	----		12-Nov-2022	14 days	10 days	✓
Volatile Organic Compounds [Fuels] : VOCs (BC List) by Headspace GC-MS										
Glass vial (sodium bisulfate) MW22-03	E611C	02-Nov-2022	08-Nov-2022	----	----		12-Nov-2022	14 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
Volatile Organic Compounds [Fuels] : VOCs (BC List) by Headspace GC-MS										
Glass vial (sodium bisulfate) MW22-04	E611C	02-Nov-2022	08-Nov-2022	----	----		12-Nov-2022	14 days	10 days	✓
Volatile Organic Compounds [Fuels] : VOCs (BC List) by Headspace GC-MS										
Glass vial (sodium bisulfate) MW22-05	E611C	02-Nov-2022	08-Nov-2022	----	----		12-Nov-2022	14 days	10 days	✓
Volatile Organic Compounds [Fuels] : VOCs (BC List) by Headspace GC-MS										
Glass vial (sodium bisulfate) Noohalk Creek Downstream	E611C	31-Oct-2022	08-Nov-2022	----	----		12-Nov-2022	14 days	12 days	✓
Volatile Organic Compounds [Fuels] : VOCs (BC List) by Headspace GC-MS										
Glass vial (sodium bisulfate) Noohalk Creek Upstream	E611C	31-Oct-2022	08-Nov-2022	----	----		12-Nov-2022	14 days	12 days	✓
Volatile Organic Compounds [THMs] : VOCs (BC List) by Headspace GC-MS										
Glass vial (sodium bisulfate) DUP	E611C	02-Nov-2022	08-Nov-2022	----	----		12-Nov-2022	----	----	
Volatile Organic Compounds [THMs] : VOCs (BC List) by Headspace GC-MS										
Glass vial (sodium bisulfate) Field Blank	E611C	02-Nov-2022	08-Nov-2022	----	----		12-Nov-2022	----	----	
Volatile Organic Compounds [THMs] : VOCs (BC List) by Headspace GC-MS										
Glass vial (sodium bisulfate) MW22-01	E611C	02-Nov-2022	08-Nov-2022	----	----		12-Nov-2022	----	----	
Volatile Organic Compounds [THMs] : VOCs (BC List) by Headspace GC-MS										
Glass vial (sodium bisulfate) MW22-02	E611C	02-Nov-2022	08-Nov-2022	----	----		12-Nov-2022	----	----	
Volatile Organic Compounds [THMs] : VOCs (BC List) by Headspace GC-MS										
Glass vial (sodium bisulfate) MW22-03	E611C	02-Nov-2022	08-Nov-2022	----	----		12-Nov-2022	----	----	

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
Volatile Organic Compounds [THMs] : VOCs (BC List) by Headspace GC-MS										
Glass vial (sodium bisulfate) MW22-04	E611C	02-Nov-2022	08-Nov-2022	----	----		12-Nov-2022	----	----	
Volatile Organic Compounds [THMs] : VOCs (BC List) by Headspace GC-MS										
Glass vial (sodium bisulfate) MW22-05	E611C	02-Nov-2022	08-Nov-2022	----	----		12-Nov-2022	----	----	
Volatile Organic Compounds [THMs] : VOCs (BC List) by Headspace GC-MS										
Glass vial (sodium bisulfate) Noohalk Creek Downstream	E611C	31-Oct-2022	08-Nov-2022	----	----		12-Nov-2022	----	----	
Volatile Organic Compounds [THMs] : VOCs (BC List) by Headspace GC-MS										
Glass vial (sodium bisulfate) Noohalk Creek Upstream	E611C	31-Oct-2022	08-Nov-2022	----	----		12-Nov-2022	----	----	

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.

EHT: Exceeded ALS recommended hold time prior to analysis.

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	745789	1	9	11.1	5.0	✓
Ammonia by Fluorescence	E298	745895	1	9	11.1	5.0	✓
Biochemical Oxygen Demand - 5 day	E550	731090	1	15	6.6	5.0	✓
Bromide in Water by IC (Low Level)	E235.Br-L	731535	3	30	10.0	5.0	✓
Chemical Oxygen Demand by Colourimetry (Low Level)	E559-L	740658	1	19	5.2	5.0	✓
Chloride in Water by IC	E235.Cl	731534	3	50	6.0	5.0	✓
Conductivity in Water	E100	731532	3	40	7.5	5.0	✓
Dissolved Mercury in Water by CVAAS	E509	731623	1	20	5.0	5.0	✓
Dissolved Metals in Water by CRC ICPMS	E421	736358	1	20	5.0	5.0	✓
Dissolved Orthophosphate by Colourimetry (Ultra Trace Level 0.001 mg/L)	E378-U	731539	3	26	11.5	5.0	✓
Fluoride in Water by IC	E235.F	731533	3	43	6.9	5.0	✓
Nitrate in Water by IC (Low Level)	E235.NO3-L	731536	3	46	6.5	5.0	✓
Nitrite in Water by IC (Low Level)	E235.NO2-L	731537	3	54	5.5	5.0	✓
pH by Meter	E108	731530	3	49	6.1	5.0	✓
Sulfate in Water by IC	E235.SO4	731538	3	53	5.6	5.0	✓
TDS by Gravimetry	E162	731864	1	20	5.0	5.0	✓
Total Mercury in Water by CVAAS	E508	733391	1	20	5.0	5.0	✓
Total metals in Water by CRC ICPMS	E420	735839	1	20	5.0	5.0	✓
Total Organic Carbon (Non-Purgeable) by Combustion (Low Level)	E355-L	732901	1	20	5.0	5.0	✓
TSS by Gravimetry	E160	731860	1	20	5.0	5.0	✓
VOCs (BC List) by Headspace GC-MS	E611C	734790	1	9	11.1	5.0	✓
Laboratory Control Samples (LCS)							
Alkalinity Species by Titration	E290	745789	1	9	11.1	5.0	✓
Ammonia by Fluorescence	E298	745895	1	9	11.1	5.0	✓
BC PHCs - EPH by GC-FID	E601A	741177	2	12	16.6	5.0	✓
Biochemical Oxygen Demand - 5 day	E550	731090	1	15	6.6	5.0	✓
Bromide in Water by IC (Low Level)	E235.Br-L	731535	3	30	10.0	5.0	✓
Chemical Oxygen Demand by Colourimetry (Low Level)	E559-L	740658	1	19	5.2	5.0	✓
Chloride in Water by IC	E235.Cl	731534	3	50	6.0	5.0	✓
Conductivity in Water	E100	731532	3	40	7.5	5.0	✓
Dissolved Mercury in Water by CVAAS	E509	731623	1	20	5.0	5.0	✓
Dissolved Metals in Water by CRC ICPMS	E421	736358	1	20	5.0	5.0	✓
Dissolved Orthophosphate by Colourimetry (Ultra Trace Level 0.001 mg/L)	E378-U	731539	3	26	11.5	5.0	✓
Fluoride in Water by IC	E235.F	731533	3	43	6.9	5.0	✓
Nitrate in Water by IC (Low Level)	E235.NO3-L	731536	3	46	6.5	5.0	✓
Nitrite in Water by IC (Low Level)	E235.NO2-L	731537	3	54	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*
Laboratory Control Samples (LCS) - Continued							
PAHs by Hexane LVI GC-MS	E641A	741176	2	16	12.5	5.0	✓
pH by Meter	E108	731530	3	49	6.1	5.0	✓
Sulfate in Water by IC	E235.SO4	731538	3	53	5.6	5.0	✓
TDS by Gravimetry	E162	731864	1	20	5.0	5.0	✓
Total Mercury in Water by CVAAS	E508	733391	1	20	5.0	5.0	✓
Total metals in Water by CRC ICPMS	E420	735839	1	20	5.0	5.0	✓
Total Organic Carbon (Non-Purgeable) by Combustion (Low Level)	E355-L	732901	1	20	5.0	5.0	✓
TSS by Gravimetry	E160	731860	1	20	5.0	5.0	✓
VOCs (BC List) by Headspace GC-MS	E611C	734790	1	9	11.1	5.0	✓
Method Blanks (MB)							
Alkalinity Species by Titration	E290	745789	1	9	11.1	5.0	✓
Ammonia by Fluorescence	E298	745895	1	9	11.1	5.0	✓
BC PHCs - EPH by GC-FID	E601A	741177	2	12	16.6	5.0	✓
Biochemical Oxygen Demand - 5 day	E550	731090	1	15	6.6	5.0	✓
Bromide in Water by IC (Low Level)	E235.Br-L	731535	3	30	10.0	5.0	✓
Chemical Oxygen Demand by Colourimetry (Low Level)	E559-L	740658	1	19	5.2	5.0	✓
Chloride in Water by IC	E235.Cl	731534	3	50	6.0	5.0	✓
Conductivity in Water	E100	731532	3	40	7.5	5.0	✓
Dissolved Mercury in Water by CVAAS	E509	731623	1	20	5.0	5.0	✓
Dissolved Metals in Water by CRC ICPMS	E421	736358	1	20	5.0	5.0	✓
Dissolved Orthophosphate by Colourimetry (Ultra Trace Level 0.001 mg/L)	E378-U	731539	3	26	11.5	5.0	✓
Fluoride in Water by IC	E235.F	731533	3	43	6.9	5.0	✓
Nitrate in Water by IC (Low Level)	E235.NO3-L	731536	3	46	6.5	5.0	✓
Nitrite in Water by IC (Low Level)	E235.NO2-L	731537	3	54	5.5	5.0	✓
PAHs by Hexane LVI GC-MS	E641A	741176	2	16	12.5	5.0	✓
Sulfate in Water by IC	E235.SO4	731538	3	53	5.6	5.0	✓
TDS by Gravimetry	E162	731864	1	20	5.0	5.0	✓
Total Mercury in Water by CVAAS	E508	733391	1	20	5.0	5.0	✓
Total metals in Water by CRC ICPMS	E420	735839	1	20	5.0	5.0	✓
Total Organic Carbon (Non-Purgeable) by Combustion (Low Level)	E355-L	732901	1	20	5.0	5.0	✓
TSS by Gravimetry	E160	731860	1	20	5.0	5.0	✓
VOCs (BC List) by Headspace GC-MS	E611C	734790	1	9	11.1	5.0	✓
Matrix Spikes (MS)							
Ammonia by Fluorescence	E298	745895	1	9	11.1	5.0	✓
Bromide in Water by IC (Low Level)	E235.Br-L	731535	3	30	10.0	5.0	✓
Chemical Oxygen Demand by Colourimetry (Low Level)	E559-L	740658	1	19	5.2	5.0	✓
Chloride in Water by IC	E235.Cl	731534	3	50	6.0	5.0	✓
Dissolved Mercury in Water by CVAAS	E509	731623	1	20	5.0	5.0	✓
Dissolved Metals in Water by CRC ICPMS	E421	736358	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 Orthophosphate by Colourimetry (Ultra Trace Level 0.001 mg/L)	E378-U	731539	3	26	11.5	5.0	✓
Fluoride in Water by IC	E235.F	731533	3	43	6.9	5.0	✓
Nitrate in Water by IC (Low Level)	E235.NO3-L	731536	3	46	6.5	5.0	✓
Nitrite in Water by IC (Low Level)	E235.NO2-L	731537	3	54	5.5	5.0	✓
Sulfate in Water by IC	E235.SO4	731538	3	53	5.6	5.0	✓
Total Mercury in Water by CVAAS	E508	733391	1	20	5.0	5.0	✓
Total metals in Water by CRC ICPMS	E420	735839	1	20	5.0	5.0	✓
Total Organic Carbon (Non-Purgeable) by Combustion (Low Level)	E355-L	732901	1	20	5.0	5.0	✓
VOCs (BC List) by Headspace GC-MS	E611C	734790	1	9	11.1	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 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 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.
TSS by Gravimetry	E160 Vancouver - Environmental	Water	APHA 2540 D (mod)	Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, following by drying of the filter at 104 ± 1°C, with gravimetric measurement of the filtered solids. Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.
TDS by Gravimetry	E162 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 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 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 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 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 Vancouver - Environmental	Water	EPA 300.1 (mod)	Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

Analytical Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
Sulfate in Water by IC	E235.SO4 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 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.
Ammonia by Fluorescence	E298 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 Organic Carbon (Non-Purgeable) by Combustion (Low Level)	E355-L Vancouver - Environmental	Water	APHA 5310 B (mod)	Total Organic Carbon (Non-Purgeable), also known as NPOC (total), is a direct measurement of TOC after an acidified sample has been purged to remove inorganic carbon (IC). Analysis is by high temperature combustion with infrared detection of CO_2. NPOC does not include volatile organic species that are purged off with IC. For samples where the majority of total carbon (TC) is comprised of IC (which is common), this method is more accurate and more reliable than the TOC by subtraction method (i.e. TC minus TIC).
Dissolved Orthophosphate by Colourimetry (Ultra Trace Level 0.001 mg/L)	E378-U Vancouver - Environmental	Water	APHA 4500-P F (mod)	Dissolved Orthophosphate is determined colourimetrically on a sample that has been lab or field filtered through a 0.45 micron membrane filter. Field filtration is recommended to ensure test results represent conditions at time of sampling.
Total metals in Water by CRC ICPMS	E420 Vancouver - Environmental	Water	EPA 200.2/6020B (mod)	Water samples are digested with nitric and hydrochloric acids, and analyzed by Collision/Reaction Cell ICPMS. Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.
Dissolved Metals in Water by CRC ICPMS	E421 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. Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.
Total Mercury in Water by CVAAS	E508 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
Dissolved Mercury in Water by CVAAS	E509 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.

Analytical Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
Biochemical Oxygen Demand - 5 day	E550 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. 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 Vancouver - Environmental	Water	APHA 5220 D (mod)	Samples are analyzed using the closed reflux colourimetric method.
BC PHCs - EPH by GC-FID	E601A Calgary - Environmental	Water	BC MOE Lab Manual	Sample extracts are analyzed by GC-FID for BC hydrocarbon fractions.
VOCs (BC List) by Headspace GC-MS	E611C Calgary - Environmental	Water	EPA 8260D (mod)	Volatile Organic Compounds (VOCs) are analyzed by static headspace GC-MS. Samples are prepared in headspace vials and are heated and agitated on the headspace autosampler, causing VOCs to partition between the aqueous phase and the headspace in accordance with Henry's law.
PAHs by Hexane LVI GC-MS	E641A Calgary - Environmental	Water	EPA 8270E (mod)	Polycyclic Aromatic Hydrocarbons (PAHs) are analyzed by large volume injection (LVI) GC-MS.
Dissolved Hardness (Calculated)	EC100 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 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.
Nitrate and Nitrite (as N) (Calculation)	EC235.N+N Vancouver - Environmental	Water	EPA 300.0	Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).
LEPH and HEPH: EPH-PAH	EC600A Calgary - Environmental	Water	BC MOE Lab Manual (LEPH and HEPH) (mod)	Light Extractable Petroleum Hydrocarbons (LEPH) and Heavy Extractable Petroleum Hydrocarbons (HEPH) are calculated as follows: LEPH = Extractable Petroleum Hydrocarbons (EPH10-19) minus Acenaphthene, Acridine, Anthracene, Fluorene, Naphthalene and Phenanthrene; HEPH = Extractable Petroleum Hydrocarbons (EPH19-32) minus Benz(a)anthracene, Benzo(a)pyrene, Fluoranthene, and Pyrene.

Preparation Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
Preparation for Ammonia	EP298 Vancouver - Environmental	Water		Sample preparation for Preserved Nutrients Water Quality Analysis.

Preparation Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
Preparation for Total Organic Carbon by Combustion	EP355 Vancouver - Environmental	Water		Preparation for Total Organic Carbon by Combustion
Dissolved Metals Water Filtration	EP421 Vancouver - Environmental	Water	APHA 3030B	Water samples are filtered (0.45 um), and preserved with HNO3.
Dissolved Mercury Water Filtration	EP509 Vancouver - Environmental	Water	APHA 3030B	Water samples are filtered (0.45 um), and preserved with HCl.
VOCs Preparation for Headspace Analysis	EP581 Calgary - Environmental	Water	EPA 5021A (mod)	Samples are prepared in headspace vials and are heated and agitated on the headspace autosampler. An aliquot of the headspace is then injected into the GC/MS-FID system.
PHCs and PAHs Hexane Extraction	EP601 Calgary - Environmental	Water	EPA 3511 (mod)	Petroleum Hydrocarbons (PHCs) and Polycyclic Aromatic Hydrocarbons (PAHs) are extracted using a hexane liquid-liquid extraction.

ALS Canada Ltd.

QUALITY CONTROL REPORT

Work Order	: **VA22C6784**	Page	: 1 of 28
Amendment	: **1**		
Client	: Morrison Hershfield Limited	Laboratory	: Vancouver - Environmental
Contact	: Emily Rogal	Account Manager	: Ian Chen
Address	: 4321 Still Creek Dr Burnaby BC Canada V5C 6S7	Address	: 8081 Lougheed Highway Burnaby, British Columbia Canada V5A 1W9
Telephone	:	Telephone	: +1 604 253 4188
Project	: 210629400	Date Samples Received	: 03-Nov-2022 16:05
PO	: 20104530	Date Analysis Commenced	: 04-Nov-2022
C-O-C number	: 20-1016075	Issue Date	: 18-Nov-2022 14:51
Sampler	: CJ, ER ----		
Site	: ----		
Quote number	: ----		
No. of samples received	: 9		
No. of samples analysed	: 9		

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*
Alex Thornton	Analyst	Vancouver Metals, Burnaby, British Columbia
Angelo Salandanan	Lab Assistant	Vancouver Metals, Burnaby, British Columbia
Caitlin Macey	Team Leader - Inorganics	Vancouver Inorganics, Burnaby, British Columbia
Cindy Tang	Team Leader - Inorganics	Vancouver Inorganics, Burnaby, British Columbia
Cynthia Bauer	Organic Supervisor	Calgary Organics, Calgary, Alberta
Hamideh Moradi	Analyst	Vancouver Metals, Burnaby, British Columbia
Jeanie Mark	Laboratory Analyst	Calgary Organics, Calgary, Alberta
Kim Jensen	Department Manager - Metals	Vancouver Metals, Burnaby, British Columbia
Lindsay Gung	Supervisor - Water Chemistry	Vancouver Inorganics, Burnaby, British Columbia
Maqsood UlHassan	Laboratory Analyst	Calgary Organics, Calgary, Alberta
Miles Gropen	Department Manager - Inorganics	Vancouver Inorganics, Burnaby, British Columbia
Owen Cheng		Vancouver Metals, Burnaby, British Columbia
Sorina Motea	Laboratory Analyst	Calgary Organics, Calgary, Alberta

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: 731530)											
KS2204232-001	Anonymous	pH	----	E108	0.10	pH units	7.92	7.90	0.253%	4%	----
Physical Tests (QC Lot: 731532)											
KS2204232-001	Anonymous	conductivity	----	E100	2.0	µS/cm	1050	1050	0.286%	10%	----
Physical Tests (QC Lot: 731553)											
KS2204234-002	Anonymous	pH	----	E108	0.10	pH units	8.09	8.09	0.00%	4%	----
Physical Tests (QC Lot: 731554)											
KS2204234-002	Anonymous	conductivity	----	E100	2.0	µS/cm	456	452	0.881%	10%	----
Physical Tests (QC Lot: 731617)											
VA22C6784-008	Noohalk Creek Upstream	conductivity	----	E100	2.0	µS/cm	27.1	26.6	0.5	Diff <2x LOR	----
Physical Tests (QC Lot: 731618)											
VA22C6784-008	Noohalk Creek Upstream	pH	----	E108	0.10	pH units	6.86	6.86	0.00%	4%	----
Physical Tests (QC Lot: 731860)											
KS2204227-001	Anonymous	solids, total suspended [TSS]	----	E160	3.0	mg/L	15.3	17.1	1.8	Diff <2x LOR	----
Physical Tests (QC Lot: 731864)											
KS2204227-001	Anonymous	solids, total dissolved [TDS]	----	E162	20	mg/L	909	873	3.98%	20%	----
Physical Tests (QC Lot: 745789)											
VA22C6784-003	MW22-03	alkalinity, total (as CaCO3)	----	E290	2.0	mg/L	60.4	60.4	0.00%	20%	----
Anions and Nutrients (QC Lot: 731533)											
KS2204232-001	Anonymous	fluoride	16984-48-8	E235.F	0.100	mg/L	<0.100	<0.100	0	Diff <2x LOR	----
Anions and Nutrients (QC Lot: 731534)											
KS2204232-001	Anonymous	chloride	16887-00-6	E235.Cl	2.50	mg/L	5.87	5.84	0.03	Diff <2x LOR	----
Anions and Nutrients (QC Lot: 731535)											
KS2204232-001	Anonymous	bromide	24959-67-9	E235.Br-L	0.250	mg/L	<0.250	<0.250	0	Diff <2x LOR	----
Anions and Nutrients (QC Lot: 731536)											
KS2204232-001	Anonymous	nitrate (as N)	14797-55-8	E235.NO3-L	0.0250	mg/L	<0.0250	<0.0250	0	Diff <2x LOR	----
Anions and Nutrients (QC Lot: 731537)											
KS2204232-001	Anonymous	nitrite (as N)	14797-65-0	E235.NO2-L	0.0050	mg/L	<0.0050	<0.0050	0	Diff <2x LOR	----
Anions and Nutrients (QC Lot: 731538)											
KS2204232-001	Anonymous	sulfate (as SO4)	14808-79-8	E235.SO4	1.50	mg/L	468	466	0.546%	20%	----
Anions and Nutrients (QC Lot: 731539)											

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*
Anions and Nutrients (QC Lot: 731539) - continued											
KS2204232-001	Anonymous	phosphate, ortho-, dissolved (as P)	14265-44-2	E378-U	0.0100	mg/L	0.0563	0.0562	0.0001	Diff <2x LOR	----
Anions and Nutrients (QC Lot: 731552)											
KS2204232-002	Anonymous	phosphate, ortho-, dissolved (as P)	14265-44-2	E378-U	0.0010	mg/L	0.0302	0.0302	0.241%	20%	----
Anions and Nutrients (QC Lot: 731556)											
FJ2203127-001	Anonymous	chloride	16887-00-6	E235.Cl	0.50	mg/L	<0.50	<0.50	0	Diff <2x LOR	----
Anions and Nutrients (QC Lot: 731557)											
FJ2203127-001	Anonymous	nitrite (as N)	14797-65-0	E235.NO2-L	0.0010	mg/L	<0.0010	<0.0010	0	Diff <2x LOR	----
Anions and Nutrients (QC Lot: 731559)											
FJ2203127-001	Anonymous	sulfate (as SO4)	14808-79-8	E235.SO4	0.30	mg/L	14.0	14.1	0.412%	20%	----
Anions and Nutrients (QC Lot: 731560)											
KS2204232-002	Anonymous	fluoride	16984-48-8	E235.F	0.400	mg/L	<0.400	<0.400	0	Diff <2x LOR	----
Anions and Nutrients (QC Lot: 731561)											
KS2204232-002	Anonymous	bromide	24959-67-9	E235.Br-L	1.00	mg/L	1.20	1.30	0.095	Diff <2x LOR	----
Anions and Nutrients (QC Lot: 731562)											
KS2204232-002	Anonymous	nitrate (as N)	14797-55-8	E235.NO3-L	0.100	mg/L	44.3	43.8	1.10%	20%	----
Anions and Nutrients (QC Lot: 731609)											
VA22C6784-008	Noohalk Creek Upstream	sulfate (as SO4)	14808-79-8	E235.SO4	0.30	mg/L	2.29	2.25	0.04	Diff <2x LOR	----
Anions and Nutrients (QC Lot: 731610)											
VA22C6784-008	Noohalk Creek Upstream	nitrate (as N)	14797-55-8	E235.NO3-L	0.0050	mg/L	0.740	0.742	0.254%	20%	----
Anions and Nutrients (QC Lot: 731611)											
VA22C6784-008	Noohalk Creek Upstream	nitrite (as N)	14797-65-0	E235.NO2-L	0.0010	mg/L	<0.0010	<0.0010	0	Diff <2x LOR	----
Anions and Nutrients (QC Lot: 731612)											
VA22C6784-008	Noohalk Creek Upstream	fluoride	16984-48-8	E235.F	0.020	mg/L	<0.020	<0.020	0	Diff <2x LOR	----
Anions and Nutrients (QC Lot: 731613)											
VA22C6784-008	Noohalk Creek Upstream	chloride	16887-00-6	E235.Cl	0.50	mg/L	<0.50	<0.50	0	Diff <2x LOR	----
Anions and Nutrients (QC Lot: 731614)											
VA22C6784-008	Noohalk Creek Upstream	bromide	24959-67-9	E235.Br-L	0.050	mg/L	<0.050	<0.050	0	Diff <2x LOR	----
Anions and Nutrients (QC Lot: 731620)											
VA22C6784-008	Noohalk Creek Upstream	phosphate, ortho-, dissolved (as P)	14265-44-2	E378-U	0.0010	mg/L	<0.0010	<0.0010	0	Diff <2x LOR	----
Anions and Nutrients (QC Lot: 745895)											
VA22C6784-001	MW22-01	ammonia, total (as N)	7664-41-7	E298	0.0050	mg/L	<0.0050	<0.0050	0	Diff <2x LOR	----
Organic / Inorganic Carbon (QC Lot: 732901)											
VA22C6784-001	MW22-01	carbon, total organic [TOC]	----	E355-L	0.50	mg/L	<0.50	<0.50	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*
Total Metals (QC Lot: 733391)											
KS2204233-001	Anonymous	mercury, total	7439-97-6	E508	0.0000050	mg/L	<0.0000050	<0.0000050	0	Diff <2x LOR	----
Total Metals (QC Lot: 735839)											
VA22C6711-001	Anonymous	aluminum, total	7429-90-5	E420	0.0060	mg/L	1.17	1.20	3.01%	20%	----
		antimony, total	7440-36-0	E420	0.00020	mg/L	<0.00020	<0.00020	0	Diff <2x LOR	----
		arsenic, total	7440-38-2	E420	0.00020	mg/L	<0.00020	0.00020	0.000004	Diff <2x LOR	----
		barium, total	7440-39-3	E420	0.00020	mg/L	0.00668	0.00671	0.398%	20%	----
		beryllium, total	7440-41-7	E420	0.000040	mg/L	0.000075	0.000067	0.000008	Diff <2x LOR	----
		bismuth, total	7440-69-9	E420	0.000100	mg/L	<0.000100	<0.000100	0	Diff <2x LOR	----
		boron, total	7440-42-8	E420	0.020	mg/L	0.170	0.162	0.008	Diff <2x LOR	----
		cadmium, total	7440-43-9	E420	0.0000100	mg/L	0.00372	0.00378	1.72%	20%	----
		calcium, total	7440-70-2	E420	0.100	mg/L	508	488	4.14%	20%	----
		cesium, total	7440-46-2	E420	0.000020	mg/L	0.000201	0.000200	0.236%	20%	----
		chromium, total	7440-47-3	E420	0.00050	mg/L	<0.00050	0.00080	0.00030	Diff <2x LOR	----
		cobalt, total	7440-48-4	E420	0.00020	mg/L	0.00296	0.00297	0.152%	20%	----
		copper, total	7440-50-8	E420	0.00100	mg/L	0.895	0.903	0.912%	20%	----
		iron, total	7439-89-6	E420	0.020	mg/L	0.068	0.071	0.003	Diff <2x LOR	----
		lead, total	7439-92-1	E420	0.000100	mg/L	0.00417	0.00423	1.26%	20%	----
		lithium, total	7439-93-2	E420	0.0020	mg/L	0.0554	0.0515	7.36%	20%	----
		magnesium, total	7439-95-4	E420	0.0100	mg/L	40.9	40.5	1.04%	20%	----
		manganese, total	7439-96-5	E420	0.00020	mg/L	0.342	0.349	1.90%	20%	----
		molybdenum, total	7439-98-7	E420	0.000100	mg/L	0.000158	0.000142	0.000015	Diff <2x LOR	----
		nickel, total	7440-02-0	E420	0.00100	mg/L	0.00238	0.00234	0.00005	Diff <2x LOR	----
		phosphorus, total	7723-14-0	E420	0.100	mg/L	<0.100	<0.100	0	Diff <2x LOR	----
		potassium, total	7440-09-7	E420	0.100	mg/L	0.973	0.989	0.016	Diff <2x LOR	----
		rubidium, total	7440-17-7	E420	0.00040	mg/L	0.00106	0.00096	0.00010	Diff <2x LOR	----
		selenium, total	7782-49-2	E420	0.000100	mg/L	0.000219	0.000185	0.000034	Diff <2x LOR	----
		silicon, total	7440-21-3	E420	0.20	mg/L	2.20	2.22	0.878%	20%	----
		silver, total	7440-22-4	E420	0.000020	mg/L	<0.000020	<0.000020	0	Diff <2x LOR	----
		sodium, total	7440-23-5	E420	0.100	mg/L	10.6	10.8	2.08%	20%	----
		strontium, total	7440-24-6	E420	0.00040	mg/L	2.20	2.31	4.65%	20%	----
		sulfur, total	7704-34-9	E420	1.00	mg/L	534	529	1.03%	20%	----
		tellurium, total	13494-80-9	E420	0.00040	mg/L	<0.00040	<0.00040	0	Diff <2x LOR	----
		thallium, total	7440-28-0	E420	0.000020	mg/L	0.000050	0.000052	0.000002	Diff <2x LOR	----
		thorium, total	7440-29-1	E420	0.00020	mg/L	<0.00020	<0.00020	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*
Total Metals (QC Lot: 735839) - continued											
VA22C6711-001	Anonymous	tin, total	7440-31-5	E420	0.00020	mg/L	<0.00020	<0.00020	0	Diff <2x LOR	----
		titanium, total	7440-32-6	E420	0.00060	mg/L	<0.00060	<0.00060	0	Diff <2x LOR	----
		tungsten, total	7440-33-7	E420	0.00020	mg/L	<0.00020	<0.00020	0	Diff <2x LOR	----
		uranium, total	7440-61-1	E420	0.000020	mg/L	0.000098	0.000093	0.000005	Diff <2x LOR	----
		vanadium, total	7440-62-2	E420	0.00100	mg/L	<0.00100	<0.00100	0	Diff <2x LOR	----
		zinc, total	7440-66-6	E420	0.0060	mg/L	0.886	0.892	0.624%	20%	----
		zirconium, total	7440-67-7	E420	0.00040	mg/L	<0.00040	<0.00040	0	Diff <2x LOR	----
Dissolved Metals (QC Lot: 731623)											
VA22C6110-014	Anonymous	mercury, dissolved	7439-97-6	E509	0.00250	mg/L	0.0144	0.0160	0.00154	Diff <2x LOR	----
Dissolved Metals (QC Lot: 736358)											
TY2203715-001	Anonymous	aluminum, dissolved	7429-90-5	E421	0.0020	mg/L	0.322	0.324	0.703%	20%	----
		antimony, dissolved	7440-36-0	E421	0.00020	mg/L	<0.00020	<0.00020	0	Diff <2x LOR	----
		arsenic, dissolved	7440-38-2	E421	0.00020	mg/L	0.00147	0.00144	0.00004	Diff <2x LOR	----
		barium, dissolved	7440-39-3	E421	0.00020	mg/L	0.291	0.300	2.96%	20%	----
		beryllium, dissolved	7440-41-7	E421	0.000040	mg/L	<0.000040	<0.000040	0	Diff <2x LOR	----
		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	0.024	0.024	0.0003	Diff <2x LOR	----
		cadmium, dissolved	7440-43-9	E421	0.0000100	mg/L	<0.0000100	<0.0000100	0	Diff <2x LOR	----
		calcium, dissolved	7440-70-2	E421	0.100	mg/L	273	266	2.54%	20%	----
		cesium, dissolved	7440-46-2	E421	0.000020	mg/L	0.00204	0.00201	1.57%	20%	----
		chromium, dissolved	7440-47-3	E421	0.00100	mg/L	<0.00100	<0.00100	0	Diff <2x LOR	----
		cobalt, dissolved	7440-48-4	E421	0.00020	mg/L	<0.00020	<0.00020	0	Diff <2x LOR	----
		copper, dissolved	7440-50-8	E421	0.00040	mg/L	<0.00040	<0.00040	0	Diff <2x LOR	----
		iron, dissolved	7439-89-6	E421	0.020	mg/L	0.158	0.154	0.004	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	0.136	0.134	0.828%	20%	----
		magnesium, dissolved	7439-95-4	E421	0.0100	mg/L	0.0250	0.0235	0.0015	Diff <2x LOR	----
		manganese, dissolved	7439-96-5	E421	0.00020	mg/L	0.00194	0.00181	0.00013	Diff <2x LOR	----
		molybdenum, dissolved	7439-98-7	E421	0.000100	mg/L	0.0276	0.0275	0.354%	20%	----
		nickel, dissolved	7440-02-0	E421	0.00100	mg/L	0.00144	0.00147	0.00003	Diff <2x LOR	----
		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	65.4	63.9	2.27%	20%	----
		rubidium, dissolved	7440-17-7	E421	0.00040	mg/L	0.169	0.168	0.612%	20%	----
		selenium, dissolved	7782-49-2	E421	0.000100	mg/L	0.00109	0.00119	8.82%	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*
Dissolved Metals (QC Lot: 736358) - continued											
TY2203715-001	Anonymous	silicon, dissolved	7440-21-3	E421	0.100	mg/L	1.51	1.49	1.38%	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	120	121	1.03%	20%	----
		strontium, dissolved	7440-24-6	E421	0.00040	mg/L	1.44	1.42	1.16%	20%	----
		sulfur, dissolved	7704-34-9	E421	1.00	mg/L	26.1	26.6	1.93%	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	<0.000020	<0.000020	0	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	0.00251	0.00254	1.14%	20%	----
		uranium, dissolved	7440-61-1	E421	0.000020	mg/L	<0.000020	<0.000020	0	Diff <2x LOR	----
		vanadium, dissolved	7440-62-2	E421	0.00100	mg/L	0.00924	0.00931	0.00007	Diff <2x LOR	----
		zinc, dissolved	7440-66-6	E421	0.0020	mg/L	<0.0020	<0.0020	0	Diff <2x LOR	----
		zirconium, dissolved	7440-67-7	E421	0.00060	mg/L	<0.00060	<0.00060	0	Diff <2x LOR	----
Aggregate Organics (QC Lot: 731090)											
KS2204223-001	Anonymous	biochemical oxygen demand [BOD]	----	E550	2.0	mg/L	<2.0	<2.0	0.0%	30%	----
Aggregate Organics (QC Lot: 740658)											
VA22C6704-001	Anonymous	chemical oxygen demand [COD]	----	E559-L	10	mg/L	18	18	0.3	Diff <2x LOR	----
Volatile Organic Compounds (QC Lot: 734790)											
VA22C6784-001	MW22-01	benzene	71-43-2	E611C	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		bromodichloromethane	75-27-4	E611C	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		bromoform	75-25-2	E611C	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		carbon tetrachloride	56-23-5	E611C	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		chlorobenzene	108-90-7	E611C	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		chloroethane	75-00-3	E611C	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		chloroform	67-66-3	E611C	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		chloromethane	74-87-3	E611C	5.0	µg/L	<5.0	<5.0	0	Diff <2x LOR	----
		dibromochloromethane	124-48-1	E611C	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		dichlorobenzene, 1,2-	95-50-1	E611C	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		dichlorobenzene, 1,3-	541-73-1	E611C	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		dichlorobenzene, 1,4-	106-46-7	E611C	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		dichloroethane, 1,1-	75-34-3	E611C	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		dichloroethane, 1,2-	107-06-2	E611C	0.50	µg/L	<0.50	<0.50	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*
Volatile Organic Compounds (QC Lot: 734790) - continued											
VA22C6784-001	MW22-01	dichloroethylene, 1,1-	75-35-4	E611C	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		dichloroethylene, cis-1,2-	156-59-2	E611C	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		dichloroethylene, trans-1,2-	156-60-5	E611C	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		dichloromethane	75-09-2	E611C	1.0	µg/L	<1.0	<1.0	0	Diff <2x LOR	----
		dichloropropane, 1,2-	78-87-5	E611C	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		dichloropropylene, cis-1,3-	10061-01-5	E611C	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		dichloropropylene, trans-1,3-	10061-02-6	E611C	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		ethylbenzene	100-41-4	E611C	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		methyl-tert-butyl ether [MTBE]	1634-04-4	E611C	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		styrene	100-42-5	E611C	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		tetrachloroethane, 1,1,1,2-	630-20-6	E611C	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		tetrachloroethane, 1,1,2,2-	79-34-5	E611C	0.20	µg/L	<0.20	<0.20	0	Diff <2x LOR	----
		tetrachloroethylene	127-18-4	E611C	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		toluene	108-88-3	E611C	0.40	µg/L	<0.40	<0.40	0	Diff <2x LOR	----
		trichloroethane, 1,1,1-	71-55-6	E611C	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		trichloroethane, 1,1,2-	79-00-5	E611C	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		trichloroethylene	79-01-6	E611C	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		trichlorofluoromethane	75-69-4	E611C	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		vinyl chloride	75-01-4	E611C	0.40	µg/L	<0.40	<0.40	0	Diff <2x LOR	----
		xylene, m+p-	179601-23-1	E611C	0.40	µg/L	<0.40	<0.40	0	Diff <2x LOR	----
		xylene, o-	95-47-6	E611C	0.30	µg/L	<0.30	<0.30	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: 731532)						
conductivity	----	E100	1	µS/cm	1.1	----
Physical Tests (QCLot: 731554)						
conductivity	----	E100	1	µS/cm	1.1	----
Physical Tests (QCLot: 731617)						
conductivity	----	E100	1	µS/cm	1.2	----
Physical Tests (QCLot: 731860)						
solids, total suspended [TSS]	----	E160	3	mg/L	<3.0	----
Physical Tests (QCLot: 731864)						
solids, total dissolved [TDS]	----	E162	10	mg/L	<10	----
Physical Tests (QCLot: 745789)						
alkalinity, total (as CaCO3)	----	E290	1	mg/L	<1.0	----
Anions and Nutrients (QCLot: 731533)						
fluoride	16984-48-8	E235.F	0.02	mg/L	<0.020	----
Anions and Nutrients (QCLot: 731534)						
chloride	16887-00-6	E235.Cl	0.5	mg/L	<0.50	----
Anions and Nutrients (QCLot: 731535)						
bromide	24959-67-9	E235.Br-L	0.05	mg/L	<0.050	----
Anions and Nutrients (QCLot: 731536)						
nitrate (as N)	14797-55-8	E235.NO3-L	0.005	mg/L	<0.0050	----
Anions and Nutrients (QCLot: 731537)						
nitrite (as N)	14797-65-0	E235.NO2-L	0.001	mg/L	<0.0010	----
Anions and Nutrients (QCLot: 731538)						
sulfate (as SO4)	14808-79-8	E235.SO4	0.3	mg/L	<0.30	----
Anions and Nutrients (QCLot: 731539)						
phosphate, ortho-, dissolved (as P)	14265-44-2	E378-U	0.001	mg/L	<0.0010	----
Anions and Nutrients (QCLot: 731552)						
phosphate, ortho-, dissolved (as P)	14265-44-2	E378-U	0.001	mg/L	<0.0010	----
Anions and Nutrients (QCLot: 731556)						
chloride	16887-00-6	E235.Cl	0.5	mg/L	<0.50	----
Anions and Nutrients (QCLot: 731557)						
nitrite (as N)	14797-65-0	E235.NO2-L	0.001	mg/L	<0.0010	----
Anions and Nutrients (QCLot: 731559)						

Sub-Matrix: **Water**

Analyte	CAS Number	Method	LOR	Unit	Result	Qualifier
Anions and Nutrients (QCLot: 731559) - continued						
sulfate (as SO4)	14808-79-8	E235.SO4	0.3	mg/L	<0.30	----
Anions and Nutrients (QCLot: 731560)						
fluoride	16984-48-8	E235.F	0.02	mg/L	<0.020	----
Anions and Nutrients (QCLot: 731561)						
bromide	24959-67-9	E235.Br-L	0.05	mg/L	<0.050	----
Anions and Nutrients (QCLot: 731562)						
nitrate (as N)	14797-55-8	E235.NO3-L	0.005	mg/L	<0.0050	----
Anions and Nutrients (QCLot: 731609)						
sulfate (as SO4)	14808-79-8	E235.SO4	0.3	mg/L	<0.30	----
Anions and Nutrients (QCLot: 731610)						
nitrate (as N)	14797-55-8	E235.NO3-L	0.005	mg/L	<0.0050	----
Anions and Nutrients (QCLot: 731611)						
nitrite (as N)	14797-65-0	E235.NO2-L	0.001	mg/L	<0.0010	----
Anions and Nutrients (QCLot: 731612)						
fluoride	16984-48-8	E235.F	0.02	mg/L	<0.020	----
Anions and Nutrients (QCLot: 731613)						
chloride	16887-00-6	E235.Cl	0.5	mg/L	<0.50	----
Anions and Nutrients (QCLot: 731614)						
bromide	24959-67-9	E235.Br-L	0.05	mg/L	<0.050	----
Anions and Nutrients (QCLot: 731620)						
phosphate, ortho-, dissolved (as P)	14265-44-2	E378-U	0.001	mg/L	<0.0010	----
Anions and Nutrients (QCLot: 745895)						
ammonia, total (as N)	7664-41-7	E298	0.005	mg/L	<0.0050	----
Organic / Inorganic Carbon (QCLot: 732901)						
carbon, total organic [TOC]	----	E355-L	0.5	mg/L	<0.50	----
Total Metals (QCLot: 733391)						
mercury, total	7439-97-6	E508	0.000005	mg/L	<0.0000050	----
Total Metals (QCLot: 735839)						
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	----

Sub-Matrix: **Water**

Analyte	CAS Number	Method	LOR	Unit	Result	Qualifier
Total Metals (QCLot: 735839) - continued						
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	----
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: 731623)						
mercury, dissolved	7439-97-6	E509	0.000005	mg/L	<0.0000050	----
Dissolved Metals (QCLot: 736358)						

Sub-Matrix: **Water**

Analyte	CAS Number	Method	LOR	Unit	Result	Qualifier
Dissolved Metals (QCLot: 736358) - continued						
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	----
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	----

Sub-Matrix: **Water**

Analyte	CAS Number	Method	LOR	Unit	Result	Qualifier
Dissolved Metals (QCLot: 736358) - continued						
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: 731090)						
biochemical oxygen demand [BOD]	----	E550	2	mg/L	<2.0	----
Aggregate Organics (QCLot: 740658)						
chemical oxygen demand [COD]	----	E559-L	10	mg/L	<10	----
Volatile Organic Compounds (QCLot: 734790)						
benzene	71-43-2	E611C	0.5	µg/L	<0.50	----
bromodichloromethane	75-27-4	E611C	0.5	µg/L	<0.50	----
bromoform	75-25-2	E611C	0.5	µg/L	<0.50	----
carbon tetrachloride	56-23-5	E611C	0.5	µg/L	<0.50	----
chlorobenzene	108-90-7	E611C	0.5	µg/L	<0.50	----
chloroethane	75-00-3	E611C	0.5	µg/L	<0.50	----
chloroform	67-66-3	E611C	0.5	µg/L	<0.50	----
chloromethane	74-87-3	E611C	5	µg/L	<5.0	----
dibromochloromethane	124-48-1	E611C	0.5	µg/L	<0.50	----
dichlorobenzene, 1,2-	95-50-1	E611C	0.5	µg/L	<0.50	----
dichlorobenzene, 1,3-	541-73-1	E611C	0.5	µg/L	<0.50	----
dichlorobenzene, 1,4-	106-46-7	E611C	0.5	µg/L	<0.50	----
dichloroethane, 1,1-	75-34-3	E611C	0.5	µg/L	<0.50	----
dichloroethane, 1,2-	107-06-2	E611C	0.5	µg/L	<0.50	----
dichloroethylene, 1,1-	75-35-4	E611C	0.5	µg/L	<0.50	----
dichloroethylene, cis-1,2-	156-59-2	E611C	0.5	µg/L	<0.50	----
dichloroethylene, trans-1,2-	156-60-5	E611C	0.5	µg/L	<0.50	----
dichloromethane	75-09-2	E611C	1	µg/L	<1.0	----
dichloropropane, 1,2-	78-87-5	E611C	0.5	µg/L	<0.50	----
dichloropropylene, cis-1,3-	10061-01-5	E611C	0.5	µg/L	<0.50	----
dichloropropylene, trans-1,3-	10061-02-6	E611C	0.5	µg/L	<0.50	----
ethylbenzene	100-41-4	E611C	0.5	µg/L	<0.50	----
methyl-tert-butyl ether [MTBE]	1634-04-4	E611C	0.5	µg/L	<0.50	----
styrene	100-42-5	E611C	0.5	µg/L	<0.50	----
tetrachloroethane, 1,1,1,2-	630-20-6	E611C	0.5	µg/L	<0.50	----
tetrachloroethane, 1,1,2,2-	79-34-5	E611C	0.2	µg/L	<0.20	----

Sub-Matrix: **Water**

Analyte	CAS Number	Method	LOR	Unit	Result	Qualifier
Volatile Organic Compounds (QCLot: 734790) - continued						
tetrachloroethylene	127-18-4	E611C	0.5	µg/L	<0.50	----
toluene	108-88-3	E611C	0.4	µg/L	<0.40	----
trichloroethane, 1,1,1-	71-55-6	E611C	0.5	µg/L	<0.50	----
trichloroethane, 1,1,2-	79-00-5	E611C	0.5	µg/L	<0.50	----
trichloroethylene	79-01-6	E611C	0.5	µg/L	<0.50	----
trichlorofluoromethane	75-69-4	E611C	0.5	µg/L	<0.50	----
vinyl chloride	75-01-4	E611C	0.4	µg/L	<0.40	----
xylene, m+p-	179601-23-1	E611C	0.4	µg/L	<0.40	----
xylene, o-	95-47-6	E611C	0.3	µg/L	<0.30	----
Hydrocarbons (QCLot: 741177)						
EPH (C10-C19)	----	E601A	250	µg/L	<250	----
EPH (C19-C32)	----	E601A	250	µg/L	<250	----
Hydrocarbons (QCLot: 741652)						
EPH (C10-C19)	----	E601A	250	µg/L	<250	----
EPH (C19-C32)	----	E601A	250	µg/L	<250	----
Polycyclic Aromatic Hydrocarbons (QCLot: 741176)						
acenaphthene	83-32-9	E641A	0.01	µg/L	<0.010	----
acenaphthylene	208-96-8	E641A	0.01	µg/L	<0.010	----
acridine	260-94-6	E641A	0.01	µg/L	<0.010	----
anthracene	120-12-7	E641A	0.01	µg/L	<0.010	----
benz(a)anthracene	56-55-3	E641A	0.01	µg/L	<0.010	----
benzo(a)pyrene	50-32-8	E641A	0.005	µg/L	<0.0050	----
benzo(b+j)fluoranthene	n/a	E641A	0.01	µg/L	<0.010	----
benzo(g,h,i)perylene	191-24-2	E641A	0.01	µg/L	<0.010	----
benzo(k)fluoranthene	207-08-9	E641A	0.01	µg/L	<0.010	----
chrysene	218-01-9	E641A	0.01	µg/L	<0.010	----
dibenz(a,h)anthracene	53-70-3	E641A	0.005	µg/L	<0.0050	----
fluoranthene	206-44-0	E641A	0.01	µg/L	<0.010	----
fluorene	86-73-7	E641A	0.01	µg/L	<0.010	----
indeno(1,2,3-c,d)pyrene	193-39-5	E641A	0.01	µg/L	<0.010	----
methylnaphthalene, 1-	90-12-0	E641A	0.01	µg/L	<0.010	----
methylnaphthalene, 2-	91-57-6	E641A	0.01	µg/L	<0.010	----
naphthalene	91-20-3	E641A	0.05	µg/L	<0.050	----
phenanthrene	85-01-8	E641A	0.02	µg/L	<0.020	----
pyrene	129-00-0	E641A	0.01	µg/L	<0.010	----

Sub-Matrix: **Water**

Analyte	CAS Number	Method	LOR	Unit	Result	Qualifier
Polycyclic Aromatic Hydrocarbons (QCLot: 741176) - continued						
quinoline	91-22-5	E641A	0.05	µg/L	<0.050	----
Polycyclic Aromatic Hydrocarbons (QCLot: 741650)						
acenaphthene	83-32-9	E641A	0.01	µg/L	<0.010	----
acenaphthylene	208-96-8	E641A	0.01	µg/L	<0.010	----
acridine	260-94-6	E641A	0.01	µg/L	<0.010	----
anthracene	120-12-7	E641A	0.01	µg/L	<0.010	----
benz(a)anthracene	56-55-3	E641A	0.01	µg/L	<0.010	----
benzo(a)pyrene	50-32-8	E641A	0.005	µg/L	<0.0050	----
benzo(b+j)fluoranthene	n/a	E641A	0.01	µg/L	<0.010	----
benzo(g,h,i)perylene	191-24-2	E641A	0.01	µg/L	<0.010	----
benzo(k)fluoranthene	207-08-9	E641A	0.01	µg/L	<0.010	----
chrysene	218-01-9	E641A	0.01	µg/L	<0.010	----
dibenz(a,h)anthracene	53-70-3	E641A	0.005	µg/L	<0.0050	----
fluoranthene	206-44-0	E641A	0.01	µg/L	<0.010	----
fluorene	86-73-7	E641A	0.01	µg/L	<0.010	----
indeno(1,2,3-c,d)pyrene	193-39-5	E641A	0.01	µg/L	<0.010	----
methylnaphthalene, 1-	90-12-0	E641A	0.01	µg/L	<0.010	----
methylnaphthalene, 2-	91-57-6	E641A	0.01	µg/L	<0.010	----
naphthalene	91-20-3	E641A	0.05	µg/L	<0.050	----
phenanthrene	85-01-8	E641A	0.02	µg/L	<0.020	----
pyrene	129-00-0	E641A	0.01	µg/L	<0.010	----
quinoline	91-22-5	E641A	0.05	µg/L	<0.050	----

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: 731530)									
pH	----	E108	----	pH units	7 pH units	99.8	98.0	102	----
Physical Tests (QCLot: 731532)									
conductivity	----	E100	1	µS/cm	146.9 µS/cm	98.3	90.0	110	----
Physical Tests (QCLot: 731553)									
pH	----	E108	----	pH units	7 pH units	99.8	98.0	102	----
Physical Tests (QCLot: 731554)									
conductivity	----	E100	1	µS/cm	146.9 µS/cm	98.9	90.0	110	----
Physical Tests (QCLot: 731617)									
conductivity	----	E100	1	µS/cm	146.9 µS/cm	97.3	90.0	110	----
Physical Tests (QCLot: 731618)									
pH	----	E108	----	pH units	7 pH units	100	98.0	102	----
Physical Tests (QCLot: 731860)									
solids, total suspended [TSS]	----	E160	3	mg/L	150 mg/L	87.5	85.0	115	----
Physical Tests (QCLot: 731864)									
solids, total dissolved [TDS]	----	E162	10	mg/L	1000 mg/L	101	85.0	115	----
Physical Tests (QCLot: 745789)									
alkalinity, total (as CaCO3)	----	E290	1	mg/L	500 mg/L	103	85.0	115	----
Anions and Nutrients (QCLot: 731533)									
fluoride	16984-48-8	E235.F	0.02	mg/L	1 mg/L	99.7	90.0	110	----
Anions and Nutrients (QCLot: 731534)									
chloride	16887-00-6	E235.Cl	0.5	mg/L	100 mg/L	101	90.0	110	----
Anions and Nutrients (QCLot: 731535)									
bromide	24959-67-9	E235.Br-L	0.05	mg/L	0.5 mg/L	100	85.0	115	----
Anions and Nutrients (QCLot: 731536)									
nitrate (as N)	14797-55-8	E235.NO3-L	0.005	mg/L	2.5 mg/L	102	90.0	110	----
Anions and Nutrients (QCLot: 731537)									
nitrite (as N)	14797-65-0	E235.NO2-L	0.001	mg/L	0.5 mg/L	102	90.0	110	----
Anions and Nutrients (QCLot: 731538)									
sulfate (as SO4)	14808-79-8	E235.SO4	0.3	mg/L	100 mg/L	103	90.0	110	----
Anions and Nutrients (QCLot: 731539)									
phosphate, ortho-, dissolved (as P)	14265-44-2	E378-U	0.001	mg/L	0.03 mg/L	93.6	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
Anions and Nutrients (QCLot: 731552)									
phosphate, ortho-, dissolved (as P)	14265-44-2	E378-U	0.001	mg/L	0.03 mg/L	94.7	80.0	120	----
Anions and Nutrients (QCLot: 731556)									
chloride	16887-00-6	E235.Cl	0.5	mg/L	100 mg/L	100	90.0	110	----
Anions and Nutrients (QCLot: 731557)									
nitrite (as N)	14797-65-0	E235.NO2-L	0.001	mg/L	0.5 mg/L	100	90.0	110	----
Anions and Nutrients (QCLot: 731559)									
sulfate (as SO4)	14808-79-8	E235.SO4	0.3	mg/L	100 mg/L	102	90.0	110	----
Anions and Nutrients (QCLot: 731560)									
fluoride	16984-48-8	E235.F	0.02	mg/L	1 mg/L	100	90.0	110	----
Anions and Nutrients (QCLot: 731561)									
bromide	24959-67-9	E235.Br-L	0.05	mg/L	0.5 mg/L	99.1	85.0	115	----
Anions and Nutrients (QCLot: 731562)									
nitrate (as N)	14797-55-8	E235.NO3-L	0.005	mg/L	2.5 mg/L	102	90.0	110	----
Anions and Nutrients (QCLot: 731609)									
sulfate (as SO4)	14808-79-8	E235.SO4	0.3	mg/L	100 mg/L	103	90.0	110	----
Anions and Nutrients (QCLot: 731610)									
nitrate (as N)	14797-55-8	E235.NO3-L	0.005	mg/L	2.5 mg/L	102	90.0	110	----
Anions and Nutrients (QCLot: 731611)									
nitrite (as N)	14797-65-0	E235.NO2-L	0.001	mg/L	0.5 mg/L	101	90.0	110	----
Anions and Nutrients (QCLot: 731612)									
fluoride	16984-48-8	E235.F	0.02	mg/L	1 mg/L	97.9	90.0	110	----
Anions and Nutrients (QCLot: 731613)									
chloride	16887-00-6	E235.Cl	0.5	mg/L	100 mg/L	100	90.0	110	----
Anions and Nutrients (QCLot: 731614)									
bromide	24959-67-9	E235.Br-L	0.05	mg/L	0.5 mg/L	99.3	85.0	115	----
Anions and Nutrients (QCLot: 731620)									
phosphate, ortho-, dissolved (as P)	14265-44-2	E378-U	0.001	mg/L	0.03 mg/L	94.3	80.0	120	----
Anions and Nutrients (QCLot: 745895)									
ammonia, total (as N)	7664-41-7	E298	0.005	mg/L	0.2 mg/L	102	85.0	115	----
Organic / Inorganic Carbon (QCLot: 732901)									
carbon, total organic [TOC]	----	E355-L	0.5	mg/L	8.57 mg/L	98.6	80.0	120	----
Total Metals (QCLot: 733391)									
mercury, total	7439-97-6	E508	0.000005	mg/L	0.0001 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: 735839)									
aluminum, total	7429-90-5	E420	0.003	mg/L	2 mg/L	97.7	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	109	80.0	120	----
barium, total	7440-39-3	E420	0.0001	mg/L	0.25 mg/L	107	80.0	120	----
beryllium, total	7440-41-7	E420	0.00002	mg/L	0.1 mg/L	103	80.0	120	----
bismuth, total	7440-69-9	E420	0.00005	mg/L	1 mg/L	108	80.0	120	----
boron, total	7440-42-8	E420	0.01	mg/L	1 mg/L	96.5	80.0	120	----
cadmium, total	7440-43-9	E420	0.000005	mg/L	0.1 mg/L	105	80.0	120	----
calcium, total	7440-70-2	E420	0.05	mg/L	50 mg/L	104	80.0	120	----
cesium, total	7440-46-2	E420	0.00001	mg/L	0.05 mg/L	98.4	80.0	120	----
chromium, total	7440-47-3	E420	0.0005	mg/L	0.25 mg/L	99.8	80.0	120	----
cobalt, total	7440-48-4	E420	0.0001	mg/L	0.25 mg/L	103	80.0	120	----
copper, total	7440-50-8	E420	0.0005	mg/L	0.25 mg/L	101	80.0	120	----
iron, total	7439-89-6	E420	0.01	mg/L	1 mg/L	113	80.0	120	----
lead, total	7439-92-1	E420	0.00005	mg/L	0.5 mg/L	111	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	109	80.0	120	----
manganese, total	7439-96-5	E420	0.0001	mg/L	0.25 mg/L	104	80.0	120	----
molybdenum, total	7439-98-7	E420	0.00005	mg/L	0.25 mg/L	104	80.0	120	----
nickel, total	7440-02-0	E420	0.0005	mg/L	0.5 mg/L	103	80.0	120	----
phosphorus, total	7723-14-0	E420	0.05	mg/L	10 mg/L	106	80.0	120	----
potassium, total	7440-09-7	E420	0.05	mg/L	50 mg/L	107	80.0	120	----
rubidium, total	7440-17-7	E420	0.0002	mg/L	0.1 mg/L	105	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	106	80.0	120	----
silver, total	7440-22-4	E420	0.00001	mg/L	0.1 mg/L	95.1	80.0	120	----
sodium, total	7440-23-5	E420	0.05	mg/L	50 mg/L	99.7	80.0	120	----
strontium, total	7440-24-6	E420	0.0002	mg/L	0.25 mg/L	104	80.0	120	----
sulfur, total	7704-34-9	E420	0.5	mg/L	50 mg/L	90.6	80.0	120	----
tellurium, total	13494-80-9	E420	0.0002	mg/L	0.1 mg/L	100	80.0	120	----
thallium, total	7440-28-0	E420	0.00001	mg/L	1 mg/L	114	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	104	80.0	120	----
titanium, total	7440-32-6	E420	0.0003	mg/L	0.25 mg/L	99.1	80.0	120	----
tungsten, total	7440-33-7	E420	0.0001	mg/L	0.1 mg/L	110	80.0	120	----
uranium, total	7440-61-1	E420	0.00001	mg/L	0.005 mg/L	109	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: 735839) - continued									
vanadium, total	7440-62-2	E420	0.0005	mg/L	0.5 mg/L	104	80.0	120	----
zinc, total	7440-66-6	E420	0.003	mg/L	0.5 mg/L	109	80.0	120	----
zirconium, total	7440-67-7	E420	0.0002	mg/L	0.1 mg/L	102	80.0	120	----
mercury, dissolved	7439-97-6	E509	0.000005	mg/L	0.0001 mg/L	95.4	80.0	120	----
Dissolved Metals (QCLot: 736358)									
aluminum, dissolved	7429-90-5	E421	0.001	mg/L	2 mg/L	107	80.0	120	----
antimony, dissolved	7440-36-0	E421	0.0001	mg/L	1 mg/L	105	80.0	120	----
arsenic, dissolved	7440-38-2	E421	0.0001	mg/L	1 mg/L	110	80.0	120	----
barium, dissolved	7440-39-3	E421	0.0001	mg/L	0.25 mg/L	105	80.0	120	----
beryllium, dissolved	7440-41-7	E421	0.00002	mg/L	0.1 mg/L	103	80.0	120	----
bismuth, dissolved	7440-69-9	E421	0.00005	mg/L	1 mg/L	104	80.0	120	----
boron, dissolved	7440-42-8	E421	0.01	mg/L	1 mg/L	95.0	80.0	120	----
cadmium, dissolved	7440-43-9	E421	0.000005	mg/L	0.1 mg/L	106	80.0	120	----
calcium, dissolved	7440-70-2	E421	0.05	mg/L	50 mg/L	105	80.0	120	----
cesium, dissolved	7440-46-2	E421	0.00001	mg/L	0.05 mg/L	104	80.0	120	----
chromium, dissolved	7440-47-3	E421	0.0005	mg/L	0.25 mg/L	107	80.0	120	----
cobalt, dissolved	7440-48-4	E421	0.0001	mg/L	0.25 mg/L	105	80.0	120	----
copper, dissolved	7440-50-8	E421	0.0002	mg/L	0.25 mg/L	104	80.0	120	----
iron, dissolved	7439-89-6	E421	0.01	mg/L	1 mg/L	102	80.0	120	----
lead, dissolved	7439-92-1	E421	0.00005	mg/L	0.5 mg/L	104	80.0	120	----
lithium, dissolved	7439-93-2	E421	0.001	mg/L	0.25 mg/L	107	80.0	120	----
magnesium, dissolved	7439-95-4	E421	0.005	mg/L	50 mg/L	110	80.0	120	----
manganese, dissolved	7439-96-5	E421	0.0001	mg/L	0.25 mg/L	107	80.0	120	----
molybdenum, dissolved	7439-98-7	E421	0.00005	mg/L	0.25 mg/L	107	80.0	120	----
nickel, dissolved	7440-02-0	E421	0.0005	mg/L	0.5 mg/L	108	80.0	120	----
phosphorus, dissolved	7723-14-0	E421	0.05	mg/L	10 mg/L	113	80.0	120	----
potassium, dissolved	7440-09-7	E421	0.05	mg/L	50 mg/L	108	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	103	80.0	120	----
silicon, dissolved	7440-21-3	E421	0.05	mg/L	10 mg/L	110	80.0	120	----
silver, dissolved	7440-22-4	E421	0.00001	mg/L	0.1 mg/L	89.2	80.0	120	----
sodium, dissolved	7440-23-5	E421	0.05	mg/L	50 mg/L	108	80.0	120	----
strontium, dissolved	7440-24-6	E421	0.0002	mg/L	0.25 mg/L	107	80.0	120	----
sulfur, dissolved	7704-34-9	E421	0.5	mg/L	50 mg/L	104	80.0	120	----
tellurium, dissolved	13494-80-9	E421	0.0002	mg/L	0.1 mg/L	101	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: 736358) - continued									
thallium, dissolved	7440-28-0	E421	0.00001	mg/L	1 mg/L	106	80.0	120	----
thorium, dissolved	7440-29-1	E421	0.0001	mg/L	0.1 mg/L	99.5	80.0	120	----
tin, dissolved	7440-31-5	E421	0.0001	mg/L	0.5 mg/L	104	80.0	120	----
titanium, dissolved	7440-32-6	E421	0.0003	mg/L	0.25 mg/L	102	80.0	120	----
tungsten, dissolved	7440-33-7	E421	0.0001	mg/L	0.1 mg/L	103	80.0	120	----
uranium, dissolved	7440-61-1	E421	0.00001	mg/L	0.005 mg/L	109	80.0	120	----
vanadium, dissolved	7440-62-2	E421	0.0005	mg/L	0.5 mg/L	109	80.0	120	----
zinc, dissolved	7440-66-6	E421	0.001	mg/L	0.5 mg/L	104	80.0	120	----
zirconium, dissolved	7440-67-7	E421	0.0002	mg/L	0.1 mg/L	106	80.0	120	----
Aggregate Organics (QCLot: 731090)									
biochemical oxygen demand [BOD]	----	E550	2	mg/L	198 mg/L	104	85.0	115	----
Aggregate Organics (QCLot: 740658)									
chemical oxygen demand [COD]	----	E559-L	10	mg/L	100 mg/L	105	85.0	115	----
Volatile Organic Compounds (QCLot: 734790)									
benzene	71-43-2	E611C	0.5	µg/L	100 µg/L	97.7	70.0	130	----
bromodichloromethane	75-27-4	E611C	0.5	µg/L	100 µg/L	104	70.0	130	----
bromoform	75-25-2	E611C	0.5	µg/L	100 µg/L	89.2	70.0	130	----
carbon tetrachloride	56-23-5	E611C	0.5	µg/L	100 µg/L	110	70.0	130	----
chlorobenzene	108-90-7	E611C	0.5	µg/L	100 µg/L	103	70.0	130	----
chloroethane	75-00-3	E611C	0.5	µg/L	100 µg/L	108	70.0	130	----
chloroform	67-66-3	E611C	0.5	µg/L	100 µg/L	109	70.0	130	----
chloromethane	74-87-3	E611C	5	µg/L	100 µg/L	95.5	70.0	130	----
dibromochloromethane	124-48-1	E611C	0.5	µg/L	100 µg/L	102	70.0	130	----
dichlorobenzene, 1,2-	95-50-1	E611C	0.5	µg/L	100 µg/L	101	70.0	130	----
dichlorobenzene, 1,3-	541-73-1	E611C	0.5	µg/L	100 µg/L	95.8	70.0	130	----
dichlorobenzene, 1,4-	106-46-7	E611C	0.5	µg/L	100 µg/L	99.9	70.0	130	----
dichloroethane, 1,1-	75-34-3	E611C	0.5	µg/L	100 µg/L	106	70.0	130	----
dichloroethane, 1,2-	107-06-2	E611C	0.5	µg/L	100 µg/L	96.4	70.0	130	----
dichloroethylene, 1,1-	75-35-4	E611C	0.5	µg/L	100 µg/L	101	70.0	130	----
dichloroethylene, cis-1,2-	156-59-2	E611C	0.5	µg/L	100 µg/L	103	70.0	130	----
dichloroethylene, trans-1,2-	156-60-5	E611C	0.5	µg/L	100 µg/L	93.5	70.0	130	----
dichloromethane	75-09-2	E611C	1	µg/L	100 µg/L	94.6	70.0	130	----
dichloropropane, 1,2-	78-87-5	E611C	0.5	µg/L	100 µg/L	99.4	70.0	130	----
dichloropropylene, cis-1,3-	10061-01-5	E611C	0.5	µg/L	100 µg/L	86.6	70.0	130	----

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
Volatile Organic Compounds (QCLot: 734790) - continued									
dichloropropylene, trans-1,3-	10061-02-6	E611C	0.5	µg/L	100 µg/L	86.2	70.0	130	----
ethylbenzene	100-41-4	E611C	0.5	µg/L	100 µg/L	101	70.0	130	----
methyl-tert-butyl ether [MTBE]	1634-04-4	E611C	0.5	µg/L	100 µg/L	99.4	70.0	130	----
styrene	100-42-5	E611C	0.5	µg/L	100 µg/L	96.0	70.0	130	----
tetrachloroethane, 1,1,1,2-	630-20-6	E611C	0.5	µg/L	100 µg/L	110	70.0	130	----
tetrachloroethane, 1,1,2,2-	79-34-5	E611C	0.2	µg/L	100 µg/L	85.5	70.0	130	----
tetrachloroethylene	127-18-4	E611C	0.5	µg/L	100 µg/L	104	70.0	130	----
toluene	108-88-3	E611C	0.4	µg/L	100 µg/L	87.0	70.0	130	----
trichloroethane, 1,1,1-	71-55-6	E611C	0.5	µg/L	100 µg/L	116	70.0	130	----
trichloroethane, 1,1,2-	79-00-5	E611C	0.5	µg/L	100 µg/L	99.7	70.0	130	----
trichloroethylene	79-01-6	E611C	0.5	µg/L	100 µg/L	108	70.0	130	----
trichlorofluoromethane	75-69-4	E611C	0.5	µg/L	100 µg/L	116	60.0	140	----
vinyl chloride	75-01-4	E611C	0.4	µg/L	100 µg/L	93.8	60.0	140	----
xylene, m+p-	179601-23-1	E611C	0.4	µg/L	200 µg/L	105	70.0	130	----
xylene, o-	95-47-6	E611C	0.3	µg/L	100 µg/L	103	70.0	130	----
Hydrocarbons (QCLot: 741177)									
EPH (C10-C19)	----	E601A	250	µg/L	6638.596 µg/L	97.8	70.0	130	----
EPH (C19-C32)	----	E601A	250	µg/L	3614.035 µg/L	98.2	70.0	130	----
Hydrocarbons (QCLot: 741652)									
EPH (C10-C19)	----	E601A	250	µg/L	6638.596 µg/L	101	70.0	130	----
EPH (C19-C32)	----	E601A	250	µg/L	3614.035 µg/L	102	70.0	130	----
Polycyclic Aromatic Hydrocarbons (QCLot: 741176)									
acenaphthene	83-32-9	E641A	0.01	µg/L	0.5 µg/L	89.0	60.0	130	----
acenaphthylene	208-96-8	E641A	0.01	µg/L	0.5 µg/L	83.5	60.0	130	----
acridine	260-94-6	E641A	0.01	µg/L	0.5 µg/L	82.6	60.0	130	----
anthracene	120-12-7	E641A	0.01	µg/L	0.5 µg/L	94.8	60.0	130	----
benz(a)anthracene	56-55-3	E641A	0.01	µg/L	0.5 µg/L	103	60.0	130	----
benzo(a)pyrene	50-32-8	E641A	0.005	µg/L	0.5 µg/L	118	60.0	130	----
benzo(b+j)fluoranthene	n/a	E641A	0.01	µg/L	0.5 µg/L	103	60.0	130	----
benzo(g,h,i)perylene	191-24-2	E641A	0.01	µg/L	0.5 µg/L	87.9	60.0	130	----
benzo(k)fluoranthene	207-08-9	E641A	0.01	µg/L	0.5 µg/L	106	60.0	130	----
chrysene	218-01-9	E641A	0.01	µg/L	0.5 µg/L	91.1	60.0	130	----
dibenz(a,h)anthracene	53-70-3	E641A	0.005	µg/L	0.5 µg/L	92.5	60.0	130	----
fluoranthene	206-44-0	E641A	0.01	µg/L	0.5 µg/L	90.1	60.0	130	----

Sub-Matrix: **Water**

					Laboratory Control Sample (LCS) Report				
					Spike	Recovery (%)	Recovery Limits (%)		
Analyte	CAS Number	Method	LOR	Unit	Concentration	LCS	Low	High	Qualifier
Polycyclic Aromatic Hydrocarbons (QCLot: 741176) - continued									
fluorene	86-73-7	E641A	0.01	µg/L	0.5 µg/L	87.8	60.0	130	----
indeno(1,2,3-c,d)pyrene	193-39-5	E641A	0.01	µg/L	0.5 µg/L	106	60.0	130	----
methylnaphthalene, 1-	90-12-0	E641A	0.01	µg/L	0.5 µg/L	82.1	60.0	130	----
methylnaphthalene, 2-	91-57-6	E641A	0.01	µg/L	0.5 µg/L	87.6	60.0	130	----
naphthalene	91-20-3	E641A	0.05	µg/L	0.5 µg/L	83.0	50.0	130	----
phenanthrene	85-01-8	E641A	0.02	µg/L	0.5 µg/L	88.1	60.0	130	----
pyrene	129-00-0	E641A	0.01	µg/L	0.5 µg/L	91.2	60.0	130	----
quinoline	91-22-5	E641A	0.05	µg/L	0.5 µg/L	115	60.0	130	----
Polycyclic Aromatic Hydrocarbons (QCLot: 741650)									
acenaphthene	83-32-9	E641A	0.01	µg/L	0.5 µg/L	79.6	60.0	130	----
acenaphthylene	208-96-8	E641A	0.01	µg/L	0.5 µg/L	82.2	60.0	130	----
acridine	260-94-6	E641A	0.01	µg/L	0.5 µg/L	79.7	60.0	130	----
anthracene	120-12-7	E641A	0.01	µg/L	0.5 µg/L	90.2	60.0	130	----
benz(a)anthracene	56-55-3	E641A	0.01	µg/L	0.5 µg/L	85.7	60.0	130	----
benzo(a)pyrene	50-32-8	E641A	0.005	µg/L	0.5 µg/L	92.6	60.0	130	----
benzo(b+j)fluoranthene	n/a	E641A	0.01	µg/L	0.5 µg/L	84.5	60.0	130	----
benzo(g,h,i)perylene	191-24-2	E641A	0.01	µg/L	0.5 µg/L	102	60.0	130	----
benzo(k)fluoranthene	207-08-9	E641A	0.01	µg/L	0.5 µg/L	99.8	60.0	130	----
chrysene	218-01-9	E641A	0.01	µg/L	0.5 µg/L	94.2	60.0	130	----
dibenz(a,h)anthracene	53-70-3	E641A	0.005	µg/L	0.5 µg/L	95.1	60.0	130	----
fluoranthene	206-44-0	E641A	0.01	µg/L	0.5 µg/L	97.2	60.0	130	----
fluorene	86-73-7	E641A	0.01	µg/L	0.5 µg/L	85.9	60.0	130	----
indeno(1,2,3-c,d)pyrene	193-39-5	E641A	0.01	µg/L	0.5 µg/L	91.5	60.0	130	----
methylnaphthalene, 1-	90-12-0	E641A	0.01	µg/L	0.5 µg/L	82.7	60.0	130	----
methylnaphthalene, 2-	91-57-6	E641A	0.01	µg/L	0.5 µg/L	90.1	60.0	130	----
naphthalene	91-20-3	E641A	0.05	µg/L	0.5 µg/L	89.6	50.0	130	----
phenanthrene	85-01-8	E641A	0.02	µg/L	0.5 µg/L	88.3	60.0	130	----
pyrene	129-00-0	E641A	0.01	µg/L	0.5 µg/L	96.3	60.0	130	----
quinoline	91-22-5	E641A	0.05	µg/L	0.5 µg/L	88.9	60.0	130	----

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: 731533)										
VA22C6784-001	MW22-01	fluoride	16984-48-8	E235.F	1.03 mg/L	1 mg/L	103	75.0	125	----
Anions and Nutrients (QCLot: 731534)										
VA22C6784-001	MW22-01	chloride	16887-00-6	E235.Cl	106 mg/L	100 mg/L	106	75.0	125	----
Anions and Nutrients (QCLot: 731535)										
VA22C6784-001	MW22-01	bromide	24959-67-9	E235.Br-L	0.522 mg/L	0.5 mg/L	104	75.0	125	----
Anions and Nutrients (QCLot: 731536)										
VA22C6784-001	MW22-01	nitrate (as N)	14797-55-8	E235.NO3-L	2.64 mg/L	2.5 mg/L	106	75.0	125	----
Anions and Nutrients (QCLot: 731537)										
VA22C6784-001	MW22-01	nitrite (as N)	14797-65-0	E235.NO2-L	0.530 mg/L	0.5 mg/L	106	75.0	125	----
Anions and Nutrients (QCLot: 731538)										
VA22C6784-001	MW22-01	sulfate (as SO4)	14808-79-8	E235.SO4	107 mg/L	100 mg/L	107	75.0	125	----
Anions and Nutrients (QCLot: 731539)										
VA22C6784-001	MW22-01	phosphate, ortho-, dissolved (as P)	14265-44-2	E378-U	0.0284 mg/L	0.03 mg/L	94.5	70.0	130	----
Anions and Nutrients (QCLot: 731552)										
KS2204243-001	Anonymous	phosphate, ortho-, dissolved (as P)	14265-44-2	E378-U	0.0349 mg/L	0.03 mg/L	116	70.0	130	----
Anions and Nutrients (QCLot: 731556)										
KS2204243-001	Anonymous	chloride	16887-00-6	E235.Cl	2050 mg/L	2000 mg/L	102	75.0	125	----
Anions and Nutrients (QCLot: 731557)										
KS2204243-001	Anonymous	nitrite (as N)	14797-65-0	E235.NO2-L	9.94 mg/L	10 mg/L	99.4	75.0	125	----
Anions and Nutrients (QCLot: 731559)										
KS2204243-001	Anonymous	sulfate (as SO4)	14808-79-8	E235.SO4	ND mg/L	2000 mg/L	ND	75.0	125	----
Anions and Nutrients (QCLot: 731560)										
KS2204243-001	Anonymous	fluoride	16984-48-8	E235.F	19.8 mg/L	20 mg/L	99.1	75.0	125	----
Anions and Nutrients (QCLot: 731561)										
KS2204243-001	Anonymous	bromide	24959-67-9	E235.Br-L	10.6 mg/L	10 mg/L	106	75.0	125	----
Anions and Nutrients (QCLot: 731562)										
KS2204243-001	Anonymous	nitrate (as N)	14797-55-8	E235.NO3-L	ND mg/L	50 mg/L	ND	75.0	125	----

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: 731609)										
VA22C6784-009	Noohalk Creek Downstream	sulfate (as SO4)	14808-79-8	E235.SO4	107 mg/L	100 mg/L	107	75.0	125	----
Anions and Nutrients (QCLot: 731610)										
VA22C6784-009	Noohalk Creek Downstream	nitrate (as N)	14797-55-8	E235.NO3-L	2.67 mg/L	2.5 mg/L	107	75.0	125	----
Anions and Nutrients (QCLot: 731611)										
VA22C6784-009	Noohalk Creek Downstream	nitrite (as N)	14797-65-0	E235.NO2-L	0.531 mg/L	0.5 mg/L	106	75.0	125	----
Anions and Nutrients (QCLot: 731612)										
VA22C6784-009	Noohalk Creek Downstream	fluoride	16984-48-8	E235.F	1.04 mg/L	1 mg/L	104	75.0	125	----
Anions and Nutrients (QCLot: 731613)										
VA22C6784-009	Noohalk Creek Downstream	chloride	16887-00-6	E235.Cl	106 mg/L	100 mg/L	106	75.0	125	----
Anions and Nutrients (QCLot: 731614)										
VA22C6784-009	Noohalk Creek Downstream	bromide	24959-67-9	E235.Br-L	0.523 mg/L	0.5 mg/L	105	75.0	125	----
Anions and Nutrients (QCLot: 731620)										
VA22C6784-009	Noohalk Creek Downstream	phosphate, ortho-, dissolved (as P)	14265-44-2	E378-U	0.0268 mg/L	0.03 mg/L	89.2	70.0	130	----
Anions and Nutrients (QCLot: 745895)										
VA22C6784-002	MW22-02	ammonia, total (as N)	7664-41-7	E298	ND mg/L	0.1 mg/L	ND	75.0	125	MS-B
Organic / Inorganic Carbon (QCLot: 732901)										
VA22C6784-002	MW22-02	carbon, total organic [TOC]	----	E355-L	ND mg/L	5 mg/L	ND	70.0	130	----
Total Metals (QCLot: 733391)										
KS2204251-001	Anonymous	mercury, total	7439-97-6	E508	0.0000966 mg/L	0.0001 mg/L	96.6	70.0	130	----
Total Metals (QCLot: 735839)										
VA22C6711-002	Anonymous	aluminum, total	7429-90-5	E420	ND mg/L	0.2 mg/L	ND	70.0	130	----
		antimony, total	7440-36-0	E420	0.0400 mg/L	0.04 mg/L	99.9	70.0	130	----
		arsenic, total	7440-38-2	E420	0.0421 mg/L	0.04 mg/L	105	70.0	130	----
		barium, total	7440-39-3	E420	0.0383 mg/L	0.04 mg/L	95.8	70.0	130	----
		beryllium, total	7440-41-7	E420	0.0790 mg/L	0.08 mg/L	98.8	70.0	130	----
		bismuth, total	7440-69-9	E420	0.0194 mg/L	0.02 mg/L	97.0	70.0	130	----
		boron, total	7440-42-8	E420	ND mg/L	0.1 mg/L	ND	70.0	130	----
		cadmium, total	7440-43-9	E420	0.00812 mg/L	0.008 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	0.0198 mg/L	0.02 mg/L	99.0	70.0	130	----
		chromium, total	7440-47-3	E420	0.0783 mg/L	0.08 mg/L	97.8	70.0	130	----
		cobalt, total	7440-48-4	E420	0.0403 mg/L	0.04 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
Total Metals (QCLot: 735839) - continued										
VA22C6711-002	Anonymous	copper, total	7440-50-8	E420	ND mg/L	0.02 mg/L	ND	70.0	130	----
		iron, total	7439-89-6	E420	4.15 mg/L	4 mg/L	104	70.0	130	----
		lead, total	7439-92-1	E420	0.0395 mg/L	0.04 mg/L	98.8	70.0	130	----
		lithium, total	7439-93-2	E420	0.203 mg/L	0.2 mg/L	101	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	0.0407 mg/L	0.04 mg/L	102	70.0	130	----
		nickel, total	7440-02-0	E420	0.0783 mg/L	0.08 mg/L	97.9	70.0	130	----
		phosphorus, total	7723-14-0	E420	19.4 mg/L	20 mg/L	97.1	70.0	130	----
		potassium, total	7440-09-7	E420	8.23 mg/L	8 mg/L	103	70.0	130	----
		rubidium, total	7440-17-7	E420	0.0404 mg/L	0.04 mg/L	101	70.0	130	----
		selenium, total	7782-49-2	E420	0.0920 mg/L	0.08 mg/L	115	70.0	130	----
		silicon, total	7440-21-3	E420	19.2 mg/L	20 mg/L	96.1	70.0	130	----
		silver, total	7440-22-4	E420	0.00754 mg/L	0.008 mg/L	94.2	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	0.0842 mg/L	0.08 mg/L	105	70.0	130	----
		thallium, total	7440-28-0	E420	0.00809 mg/L	0.008 mg/L	101	70.0	130	----
		thorium, total	7440-29-1	E420	0.0429 mg/L	0.04 mg/L	107	70.0	130	----
		tin, total	7440-31-5	E420	0.0408 mg/L	0.04 mg/L	102	70.0	130	----
		titanium, total	7440-32-6	E420	0.0773 mg/L	0.08 mg/L	96.6	70.0	130	----
		tungsten, total	7440-33-7	E420	0.0432 mg/L	0.04 mg/L	108	70.0	130	----
		uranium, total	7440-61-1	E420	0.00844 mg/L	0.008 mg/L	105	70.0	130	----
		vanadium, total	7440-62-2	E420	0.205 mg/L	0.2 mg/L	103	70.0	130	----
		zinc, total	7440-66-6	E420	0.807 mg/L	0.8 mg/L	101	70.0	130	----
		zirconium, total	7440-67-7	E420	0.0826 mg/L	0.08 mg/L	103	70.0	130	----
Dissolved Metals (QCLot: 731623)										
VA22C6700-001	Anonymous	mercury, dissolved	7439-97-6	E509	0.0000912 mg/L	0.0001 mg/L	91.2	70.0	130	----
Dissolved Metals (QCLot: 736358)										
TY2203715-002	Anonymous	aluminum, dissolved	7429-90-5	E421	0.202 mg/L	0.2 mg/L	101	70.0	130	----
		antimony, dissolved	7440-36-0	E421	0.0212 mg/L	0.02 mg/L	106	70.0	130	----
		arsenic, dissolved	7440-38-2	E421	0.0212 mg/L	0.02 mg/L	106	70.0	130	----
		barium, dissolved	7440-39-3	E421	ND mg/L	0.02 mg/L	ND	70.0	130	----
		beryllium, dissolved	7440-41-7	E421	0.0412 mg/L	0.04 mg/L	103	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: 736358) - continued										
TY2203715-002	Anonymous	bismuth, dissolved	7440-69-9	E421	0.00924 mg/L	0.01 mg/L	92.4	70.0	130	----
		boron, dissolved	7440-42-8	E421	ND mg/L	0.1 mg/L	ND	70.0	130	----
		cadmium, dissolved	7440-43-9	E421	0.00416 mg/L	0.004 mg/L	104	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	0.0104 mg/L	0.01 mg/L	104	70.0	130	----
		chromium, dissolved	7440-47-3	E421	0.0403 mg/L	0.04 mg/L	101	70.0	130	----
		cobalt, dissolved	7440-48-4	E421	0.0198 mg/L	0.02 mg/L	99.1	70.0	130	----
		copper, dissolved	7440-50-8	E421	0.0193 mg/L	0.02 mg/L	96.4	70.0	130	----
		iron, dissolved	7439-89-6	E421	1.93 mg/L	2 mg/L	96.6	70.0	130	----
		lead, dissolved	7439-92-1	E421	0.0194 mg/L	0.02 mg/L	97.1	70.0	130	----
		lithium, dissolved	7439-93-2	E421	0.100 mg/L	0.1 mg/L	100	70.0	130	----
		magnesium, dissolved	7439-95-4	E421	ND mg/L	1 mg/L	ND	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	0.0215 mg/L	0.02 mg/L	108	70.0	130	----
		nickel, dissolved	7440-02-0	E421	0.0408 mg/L	0.04 mg/L	102	70.0	130	----
		phosphorus, dissolved	7723-14-0	E421	11.0 mg/L	10 mg/L	110	70.0	130	----
		potassium, dissolved	7440-09-7	E421	ND mg/L	4 mg/L	ND	70.0	130	----
		rubidium, dissolved	7440-17-7	E421	0.0205 mg/L	0.02 mg/L	102	70.0	130	----
		selenium, dissolved	7782-49-2	E421	0.0320 mg/L	0.04 mg/L	79.9	70.0	130	----
		silicon, dissolved	7440-21-3	E421	ND mg/L	10 mg/L	ND	70.0	130	----
		silver, dissolved	7440-22-4	E421	0.00263 mg/L	0.004 mg/L	65.8	70.0	130	MES
		sodium, dissolved	7440-23-5	E421	ND mg/L	2 mg/L	ND	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	21.8 mg/L	20 mg/L	109	70.0	130	----
		tellurium, dissolved	13494-80-9	E421	0.0340 mg/L	0.04 mg/L	85.1	70.0	130	----
		thallium, dissolved	7440-28-0	E421	0.00393 mg/L	0.004 mg/L	98.2	70.0	130	----
		thorium, dissolved	7440-29-1	E421	0.0205 mg/L	0.02 mg/L	102	70.0	130	----
		tin, dissolved	7440-31-5	E421	0.0204 mg/L	0.02 mg/L	102	70.0	130	----
		titanium, dissolved	7440-32-6	E421	0.0404 mg/L	0.04 mg/L	101	70.0	130	----
		tungsten, dissolved	7440-33-7	E421	0.0210 mg/L	0.02 mg/L	105	70.0	130	----
		uranium, dissolved	7440-61-1	E421	0.00416 mg/L	0.004 mg/L	104	70.0	130	----
		vanadium, dissolved	7440-62-2	E421	0.105 mg/L	0.1 mg/L	105	70.0	130	----
		zinc, dissolved	7440-66-6	E421	0.406 mg/L	0.4 mg/L	102	70.0	130	----
		zirconium, dissolved	7440-67-7	E421	0.0430 mg/L	0.04 mg/L	107	70.0	130	----
Aggregate Organics (QCLot: 740658)										

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
Aggregate Organics (QCLot: 740658) - continued										
VA22C6704-002	Anonymous	chemical oxygen demand [COD]	----	E559-L	106 mg/L	100 mg/L	106	75.0	125	----
Volatile Organic Compounds (QCLot: 734790)										
VA22C6784-001	MW22-01	benzene	71-43-2	E611C	98.0 µg/L	100 µg/L	98.0	70.0	130	----
		bromodichloromethane	75-27-4	E611C	102 µg/L	100 µg/L	102	70.0	130	----
		bromoform	75-25-2	E611C	80.4 µg/L	100 µg/L	80.4	70.0	130	----
		carbon tetrachloride	56-23-5	E611C	108 µg/L	100 µg/L	108	70.0	130	----
		chlorobenzene	108-90-7	E611C	103 µg/L	100 µg/L	103	70.0	130	----
		chloroethane	75-00-3	E611C	107 µg/L	100 µg/L	107	70.0	130	----
		chloroform	67-66-3	E611C	107 µg/L	100 µg/L	107	70.0	130	----
		chloromethane	74-87-3	E611C	93.9 µg/L	100 µg/L	93.9	70.0	130	----
		dibromochloromethane	124-48-1	E611C	99.4 µg/L	100 µg/L	99.4	70.0	130	----
		dichlorobenzene, 1,2-	95-50-1	E611C	104 µg/L	100 µg/L	104	70.0	130	----
		dichlorobenzene, 1,3-	541-73-1	E611C	99.1 µg/L	100 µg/L	99.1	70.0	130	----
		dichlorobenzene, 1,4-	106-46-7	E611C	101 µg/L	100 µg/L	101	70.0	130	----
		dichloroethane, 1,1-	75-34-3	E611C	104 µg/L	100 µg/L	104	70.0	130	----
		dichloroethane, 1,2-	107-06-2	E611C	92.6 µg/L	100 µg/L	92.6	70.0	130	----
		dichloroethylene, 1,1-	75-35-4	E611C	99.4 µg/L	100 µg/L	99.4	70.0	130	----
		dichloroethylene, cis-1,2-	156-59-2	E611C	102 µg/L	100 µg/L	102	70.0	130	----
		dichloroethylene, trans-1,2-	156-60-5	E611C	94.4 µg/L	100 µg/L	94.4	70.0	130	----
		dichloromethane	75-09-2	E611C	89.8 µg/L	100 µg/L	89.8	70.0	130	----
		dichloropropane, 1,2-	78-87-5	E611C	99.1 µg/L	100 µg/L	99.1	70.0	130	----
		dichloropropylene, cis-1,3-	10061-01-5	E611C	89.5 µg/L	100 µg/L	89.5	70.0	130	----
		dichloropropylene, trans-1,3-	10061-02-6	E611C	89.6 µg/L	100 µg/L	89.6	70.0	130	----
		ethylbenzene	100-41-4	E611C	107 µg/L	100 µg/L	107	70.0	130	----
		methyl-tert-butyl ether [MTBE]	1634-04-4	E611C	100 µg/L	100 µg/L	100	70.0	130	----
		styrene	100-42-5	E611C	96.5 µg/L	100 µg/L	96.5	70.0	130	----
		tetrachloroethane, 1,1,1,2-	630-20-6	E611C	106 µg/L	100 µg/L	106	70.0	130	----
		tetrachloroethane, 1,1,2,2-	79-34-5	E611C	84.0 µg/L	100 µg/L	84.0	70.0	130	----
		tetrachloroethylene	127-18-4	E611C	104 µg/L	100 µg/L	104	70.0	130	----
		toluene	108-88-3	E611C	91.9 µg/L	100 µg/L	91.9	70.0	130	----
		trichloroethane, 1,1,1-	71-55-6	E611C	113 µg/L	100 µg/L	113	70.0	130	----
		trichloroethane, 1,1,2-	79-00-5	E611C	97.4 µg/L	100 µg/L	97.4	70.0	130	----
		trichloroethylene	79-01-6	E611C	109 µg/L	100 µg/L	109	70.0	130	----
		trichlorofluoromethane	75-69-4	E611C	110 µg/L	100 µg/L	110	70.0	130	----
		vinyl chloride	75-01-4	E611C	94.5 µg/L	100 µg/L	94.5	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
Volatile Organic Compounds (QCLot: 734790) - continued										
VA22C6784-001	MW22-01	xylene, m+p-	179601-23-1	E611C	210 µg/L	200 µg/L	105	70.0	130	----
		xylene, o-	95-47-6	E611C	106 µg/L	100 µg/L	106	70.0	130	----

Qualifiers

Qualifier	Description
MES	*Data Quality Objective was marginally exceeded (by < 10% absolute) for < 10% of analytes in a Multi-Element Scan / Multi-Parameter Scan (considered acceptable as per OMOE & CCME).*
MS-B	*Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.*

Chain of Custody (COC) / Analytical Request Form

COC Number: 20 - 1016075

Canada Toll Free: 1 800 668 9878

Page 1 of 1

www.alsglobal.com

Report To	Contact and company name below will appear on the final report
Company:	Morrison Hershfield
Contact:	Emily Regal
Phone:	(306) 280-0190
	Company address below will appear on the final report
Street:	310-4321 Still Creek Drive
City/Province:	Burnaby BC
Postal Code:	V5C 6S7
Invoice To	Same as Report To ☒ YES ☐ NO
	Copy of Invoice with Report ☒ YES ☐ NO
Company:	Morrison Hershfield
Contact:	eregal@morrisonhershfield.com

Project Information

ALS Account # / Quote #:	MHG100
Job #:	2106 29400
PO / AFE:	
LSD:	
ALS Lab Work Order # (ALS use only):	

Reports / Recipients

Select Report Format: ☐ PDF ☒ EXCEL ☐ EDD (DIGITAL)

Merge QC/QCI Reports with COA ☒ YES ☐ NO ☐ N/A

☐ Compare Results to Criteria on Report - provide details below if box checked

Select Distribution: ☐ EMAIL ☐ MAIL ☐ FAX

Email 1 or Fax: eregal@morrisonhershfield.com

Email 2: cjung@morrisonhershfield.com

Email 3:

Invoice Recipients

Select Invoice Distribution: ☒ EMAIL ☐ MAIL ☐ FAX

Email 1 or Fax: suppliers@morrisonhershfield.com

Email 2:

Oil and Gas Required Fields (client use)

AFE/Cost Center:	PO#
Major/Minor Code:	Routing Code:
Requisitioner:	
Location:	

ALS Contact: Ian Chen Sampler: ER/CJ

Turnaround Time (TAT) Requested

☒ Routine [R] if received by 3pm M-F - no surcharges apply

☐ 4 day [P4] if received by 3pm M-F - 20% rush surcharge minimum

☐ 3 day [P3] if received by 3pm M-F - 25% rush surcharge minimum

☐ 2 day [P2] if received by 3pm M-F - 50% rush surcharge minimum

☐ 1 day [E] if received by 3pm M-F - 100% rush surcharge minimum

☐ Same day [E2] if received by 10am M-S - 200% rush surcharge. Additional fees may apply to rush requests on weekends, statutory holidays and non-routine tests

AFFIX ALS BARCODE LABEL HERE (ALS use only)

Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm am/pm

For all tests with rush TATs requested, please contact your AM to confirm availability.

Analysis Request

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

ALS Sample # (ALS use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	NUMBER OF CONTAINERS	F/P Dissolved metals	F/P Dissolved mercury	P Total metals	P Total mercury	VOCs	LEPH/HEPH/EPH/PAH	Routine (General Parameters)	Nutrients, Anions	COD, BOD, TOC	Specific Conductance	SAMPLES ON HOLD	EXTENDED STORAGE REQUIRED	SUSPECTED HAZARD (see notes)
	MW22-01	02-Nov-22	18:00	Water	8	X	X			X	X	X	X	X	X			
	MW22-02	02-Nov-22	17:00	Water	8	X	X			X	X	X	X	X	X			
	MW22-03	02-Nov-22	17:30	Water	8	X	X			X	X	X	X	X	X			
	MW22-04	02-Nov-22	15:30	Water	8	X	X			X	X	X	X	X	X			
	MW22-05	02-Nov-22	15:15	Water	8	X	X			X	X	X	X	X	X			
	Field Blank	02-Nov-22	12:00	Water	8	X	X			X	X	X	X	X	X			
	DUP	02-Nov-22	12:00	Water	8	X	X			X	X	X	X	X	X			
	Noohalk Creek Upstream	31-Oct-22	17:30	Water	8			X	X	X	X	X	X	X	X			
	Noohalk Creek Downstream	31-Oct-22	17:00	Water	8			X	X	X	X	X	X	X	X			

Environmental Division Vancouver
Work Order Reference
VA22C6784

Telephone : +1 604 253 4188

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

Notes / Specify ... below

SAMPLE RECEIPT DETAILS (ALS use only)

Cooling Method: ☐ NONE ☐ ICE ☐ ICE PACKS ☐ FROZEN ☐ COOLING INITIATED

Submission Comments identified on Sample Receipt Notification: ☐ YES ☐ NO

Cooler Custody Seals Intact: ☐ YES ☐ N/A Sample Custody Seals Intact: ☐ YES ☐ N/A

INITIAL COOLER TEMPERATURES °C				FINAL COOLER TEMPERATURES °C			
				5.0	5.7		

SHIPMENT RELEASE (client use)

Released by:	Date:	Time:
	Nov 3/2022	

...ALS use only)

Time:	Received by:	Date:	Time:
		11/03/22	4:05

FINAL SHIPMENT RECEPTION (ALS use only)

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

...RY COPY YELLOW - CLIENT COPY

AUG 2020 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this f... ...itions 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 Author...

APPENDIX B: Fire Safety & Emergency Response Plan

MORRISON HERSHFIELD now Stantec

Fire Safety & Emergency Response Plan (STAFF)

Thorsen Creek Waste and Recycling Centre Landfill

Date: November 15, 2024

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FIGURES

APPENDICES

1. INTRODUCTION

This document is prepared for the Thorsen Creek Waste & Recycling Centre Landfill (Thorsen Creek Landfill) staff for use in a case of a fire or emergency. This response plan sets out procedures to address foreseeable emergencies. This plan should be reviewed with staff and all relevant parties on a recurring basis. Updates to this plan should be considered should operations at the landfill change. The key points to note of this plan are:

- What is the nature and severity of the emergency?
- What needs to be done?
- Who does it?

This handbook is meant for **STAFF** use to be kept at an easily accessible and known place on site. Ideally, copies of this handbook are to be kept in a transfer station building and in all staff vehicles.

This document will cover the following:

- Important notes and terms related to an emergency response
- Procedure form to follow
- Relevant contacts
- Emergency Response form to fill (Appendix A)
- An emergency preparedness checklist (Appendix B)

This plan should be reviewed with the local fire department and make any further changes necessary to fit the site's needs.

2. DEFINITIONS AND TERMS

An emergency is when a serious, unexpected, and often dangerous situation occurs that requires immediate action. An emergency response is when the encountered staff responds to an emergency to defuse or lessen the negative impact of the incident. The goal of an emergency response plan is NOT to endanger self or others in the process of defusing or lessening the negative impact of the incident, it is to behave and act rationally in a safe manner without emotion to solve the emergency response.

Emergency responses include the following:

- Fires
- Accidents and medical emergencies (i.e., vehicular crashes, fall from heights)
- Environmental and operation contingencies (i.e., exposed electrical lines)

The following two levels of reporting is required by any individual who locates a fire or emergency:

- **Report to a Supervisor:** Refers to a direct supervisor in charge of the individual who encountered or witnessed an emergency incident.

and

- **Report to the Owner (the Central Coast Regional District):** The owner shall immediately be given details of the emergency incident. It is the owner's responsibility to ensure protection of human health and safety, provide directions to defuse or lessen the negative impact of the emergency, and report the incident to affected agencies prior to investigating the incident themselves.

3. FIRE MANAGEMENT

3.1 Fire Response Procedures

All fires should be treated seriously and reported as an emergency. Should an emergency occur, employees shall report to the primary muster point. Should the primary muster point be inaccessible, employees shall report to the secondary muster point.

The muster points for the Thorsen Creek Landfill are shown on Figure 1

In the event of a fire, the following general procedures should be followed:

- **Do not panic.** The greatest danger lies not in fighting the fire, but in the panic that arises from a fire.
- Do not fight fire alone.
- Do not place yourself or others in danger while fighting the fire.
- Contact other nearby employees and bystanders, direct them to first muster point when safe.
- Summon the appropriate landfill equipment.
- Notify the Fire Department. Tell them the location and type of fire and whether it looks like it will spread out of the immediate area.
- Notify the Solid Waste Services Manager immediately. Follow their instructions.
- Notify surrounding property owners, particularly if it appears that the fire could spread beyond the landfill.
- When the Fire Department arrives, follow their instructions.

All fires will be reported as an emergency situation. Should an emergency occur, employees shall report and direct all bystanders to the primary muster point. Should the primary muster point be inaccessible, employees shall report to the secondary muster point.

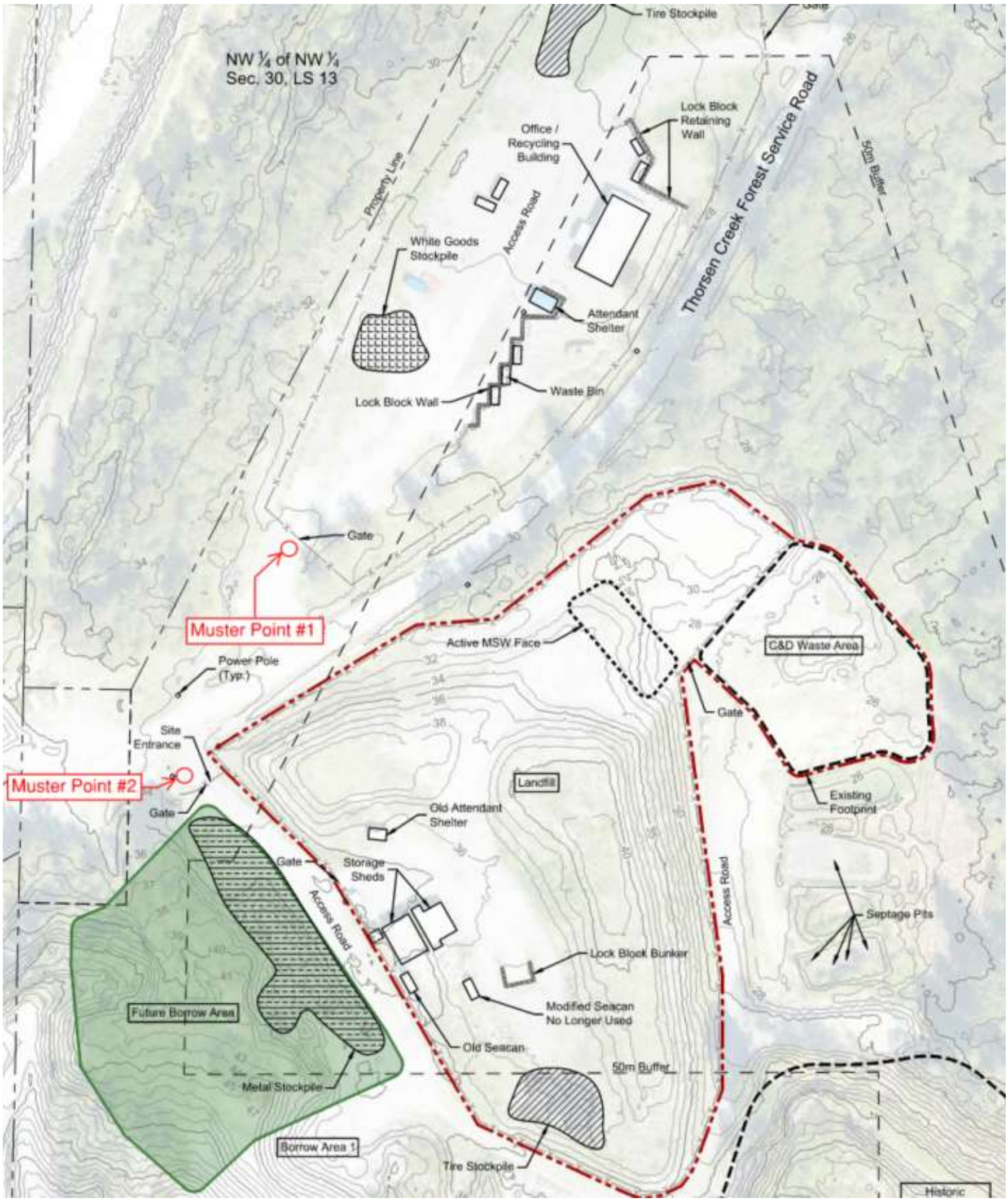

Figure 1: Muster Points #1 and #2

3.2 General Fire Fighting Guidelines

- For a landfill fire, the fire is better controlled with the use of a dozer and dirt. If it is safe to do so, dig out and isolate the burning waste. Then either let it burn out or cover with dirt. Lots of water will not necessarily extinguish the fire and can cause more problems than it solves.
- Do not overuse water. Remember that most landfill fires can be controlled with a relatively small amount of water. In most cases, soil is more effective than water.
- If two or more water trucks are being used, try to use shifts so that at least one water truck is at the fire at all times.
- Do not waste time trying to fight a large fire with a fire extinguisher.
- Do not approach any fire with a tractor unless a water truck is close by for backup.
- Never risk personal injury or death attempting to save a machine or building.
- Remember, **SAFETY FIRST**.

3.3 Fire Prevention on Landfill

Preventative fires are the best way to not require a fire response and lessens the risk of staff and bystanders from exposing to any dangers. The Thorsen Creek landfill will be operated in a manner that will minimize the potential for landfill fires.

The risk of a landfill fire occurring due to spontaneous combustion or surface ignition can be minimized by maintaining the active excavation size as small as practical.

Fire prevention techniques will include:

- Thoroughly compacting waste.
- Applying daily cover to completely cover each cell's daily waste with inert mineral soil.
- Maintaining adequate soil resources near the excavation face to fight a fire.
- Maintaining sufficient water resources available to fight a fire.
- A smoking ban, especially in refueling areas and landfill excavation areas.
- Good site security to prevent arson.
- Maintaining a comprehensive load checking program to prevent the dumping of hot/burning materials.
- Maintaining a program of separating the dumping of ash barrels from general waste tipping face.
- Maintenance around pits to keep weeds and grass down to maintain a fire break reaching in or out of the landfill.
- Ongoing employee training on early fire hazard recognition.

3.4 Wind-Blown Litter & Debris

Managing wind-blown litter and debris control is required at landfills, which is as important as fire prevention. Wind-blown litter and debris can be found from all sorts of waste, such as lightweight papers, cardboard, plastic bags, to even plastic Tupperware. Controlling and collecting wind-blown litter and debris will be a routine for landfill staff to take part in.

The following are preventative methods to control wind-blown litter and debris:

- Encourage covers on inbound loads.
- Maintain small working face as practical.
- Maintain portable litter catchment fences around active areas.
- Maintain perimeter fencing.
- Regular inspection of loads to make sure all objects and wastes are secured.
- Litter retrieval program for staff.
- Employee training and awareness.

It is recommended the staff performs the following routines, but not limited to:

- Review working face and litter catchment fence placement before starting work and before end of day.
- Off-site litter pick-up daily.
- On-site litter pick-up weekly.

4. FIRE PROCEDURE CHECKLIST

THE FIRST PERSON ON THE SCENE MUST:

1. **PROTECT** human health and safety. Eliminate possible dangerous sources. Warn/remove bystanders.

2. **EVACUATE** the building when safe to do so.

3. **DIRECT** self and bystanders to a muster point when it is safe to do so.

4. **CALL** and wait for emergency response personnel to arrive.

   Bella Coola Fire Department: **(250) 799-5321**

   Direct personnel to Civic Address:

   751 Thorsen Creek, Bella Coola

5. **CONTACT** the Supervisor and Owner to update the situation.

6. **REPORT** in writing on the emergency response as needed when help arrives.

5. EMERGENCY RESPONSE

Unexpected accidents can happen in any situation and staff at the landfill are no exception. The staff at the landfill will require training and understanding of the state of emergency and be considered as part of their daily job routine to be aware of the situation around them.

Staff at the Landfill will require to have the following:

- Employee Safety Training and Awareness
- First Aid Training
- Access to Safety Plan and Procedures

There are a number of different emergencies and accidents that the staff may encounter. Below are a couple of examples of emergencies that staff may encounter and should know how to handle when such situations occur.

5.1 Medical Emergencies:

All injuries should be considered important and will be reported as a safety incident to the Landfill Manager.

First Aid should be applied that is appropriate to the nature of the injury, and in the even the injury requires medical assistance, the individual should either be taken to a medical emergency center, or an ambulance service contacted.

A medical doctor should be consulted for all injuries that may result in infections as a result of working with waste materials. This includes injuries such as cuts and scrapes, skin punctures with sharp items, and fire or chemical burns.

If the person injured is a site customer or visitor, Landfill employees are to provide any assistance necessary and will apply appropriate First Aid.

For any serious medical injuries that involve life or death, contact BC Ambulance (800-461-9911) immediately.

5.2 Vehicular or Equipment Accidents:

All vehicle accidents should be reported and an investigation as to the cause should be carried out. Following the investigation, appropriate mitigative measure should be determined an implemented to avoid future accidents.

6. EMERGENCY PROCEDURE CHECKLIST

THE FIRST PERSON ON THE SCENE MUST:

1. **PROTECT** human health and safety. Eliminate possible dangerous sources. Warn/remove bystanders.

2. **ATTEND** to the injured person and apply First Aid.

3. **CALL** and wait for emergency response personnel to arrive.

   BC Ambulance: **(800) 461-9911**

   Direct personnel to Civic Address:

   751 Thorsen Creek, Bella Coola

4. **STAY** with injured person until medical assistance arrives.

5. **CONTACT** the Supervisor and Owner to update the situation.

6. **REPORT** in writing on the emergency response as needed when help arrives.

7. EMERGENCY RELATED RESOURCES AND CONTACT NUMBERS

Supervisor Nicola Koroluk	**(250) 982-0081** or (604) 309-4672
Fire Hall (Bella Coola) Fire Hall (Hagensborg)	**(250) 799-5321** (250) 982-2366
Chief Administrative Officer Curtis Slingerland	**(250) 799-5291**
BC Ambulance	**(800) 461-9911**
RCMP	**(250) 799-5361**
Environment Canada	**(800) 663-3456**
Nuxalk First Nation	**(250) 799-5613**

APPENDIX A: Emergency Checklist Sheet

EMERGENCY RECORD SHEET

Date of Emergency: _____ **Time:** _____am / pm

Location: _____

(Facility and exact location at facility)

Type of Emergency:

- ☐ Fire
- ☐ Medical (minor or major)
- ☐ Vehicle or equipment accidents
- ☐ Others: _____

What caused the emergency?

_____

_____

_____

Actions Taken: _____

_____

_____

_____

Who was the Emergency Reported to: _____

Emergency Impacts (Injuries, accidents, damage to property)

_____

_____

_____

Report Completed by: _____ **Date:** _____

Signature: _____

Central Coast Regional District
That we may be good people together

Morrison Hershfield now Stantec

Thorsen Creek Waste & Recycling Centre Landfill – Incident Report

Reported by: _____ **Reported to:** _____

Department: _____ **Date of Report:** _____

INCIDENT INFORMATION

Date of Incident: _____ **Time of Incident:** _____ (am/pm)

Location (please be specific): _____

Nature of Incident:

☐ Injury/Illness ☐ Fire ☐ Vehicle Collision

☐ Property Damage ☐ Spill ☐ Other: _____

Incident Description (use additional form if necessary): _____

_____

_____

_____

Nature of Injury (if applicable):

☐ First Aid ☐ Medical Aid ☐ Modified Work ☐ Lost Time ☐ Fatal

Property Damage and Estimated Loss/Damage (if applicable): _____

_____

_____

Name	Contact Information	Staff	Contractor	Witness
		☐	☐	☐
		☐	☐	☐
		☐	☐	☐
		☐	☐	☐

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Was a Police Report Filed? ☐ **YES** ☐ **NO** **File No.:** _____

Reporting Officer: _____ **Phone:** _____

Contributing Factors (if any): _____

_____

_____

_____

Corrective Actions: _____

_____

_____

_____

Disciplinary Actions: ☐ **Verbal Warning** ☐ **Written Warning** ☐**N/A**

Follow-Up Actions (use additional form if necessary): _____

_____

_____

_____

Reporting Employee Name/Position: _____

Employee Signature: _____ **Date:** _____

Supervisor Name: _____

Supervisor Signature: _____ **Date:** _____

Manager Name: _____

Manager Signature: _____ **Date:** _____

Comments/Recommendations: _____

_____

_____

WITNESS STATEMENT #1

Please give as many details about the incident as possible (who, what where, when how & why)

Witness Name: _____

Witness Signature: _____ **Date:** _____

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WITNESS STATEMENT #2

Please give as many details about the incident as possible (who, what where, when how & why)

Witness Name: _____

Witness Signature: _____ **Date:** _____

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APPENDIX B: Emergency Preparedness Checklist

Emergency Preparedness Checklist			
Checked by:		Date:	
Item List			Check Box
Soil/Cover Pile nearby active face (2-3 loads)			
Fire Extinguisher:			
• Inside excavator			
• Inside transfer station building			
• Inside staff vehicle			
Muster Points			
Are they clear?			
• Muster Point A			
• Muster Point B			
Are signages visible?			
• Muster Point A			
• Muster Point B			
First Aid Kit:			
• Inside transfer station building Expiry Date: _____			
• Inside staff vehicle Expiry Date: _____			

APPENDIX C: Operational Certificate MR-4223, Issued April 12, 2006

BRITISH COLUMBIA

VANCOUVER 2010

File: MR-4223

April 12, 2006

REGISTERED MAIL – RT 779 645 741 CA

Central Coast Regional District
P.O. Box 186
Bella Coola BC V0T 1C0

Dear Operational Certificate Holder,

Enclosed is an Operational Certificate 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 authorise entry upon, crossing over, or use for any purpose of private or Crown lands or works, unless and except as authorised by the owner of such lands or works. The responsibility for obtaining such authority shall rest with the Operational Certificate holder. Failure to comply with the requirements of this Operational Certificate is an offence pursuant to Section 120 of the *Environmental Management Act*. It is also the responsibility of the Operational Certificate holder to ensure that all activities conducted under this authorisation 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 in accordance with the practices, procedures and forms prescribed by regulation under the *Environmental Management Act*. For further information please contact the Environmental Appeal Board at (250) 387-3464.

...2/

Ministry of Environment Cariboo Region

Mailing/Location Address:
400 - 640 Borland Street
Williams Lake BC V2G 4T1

Telephone: 250-398-4530
Facsimile: 250-398-4214

Administration of this Operational Certificate will be carried out by staff from our Regional office located at 400-640 Borland Street, Williams Lake, British Columbia, V2G 4T1 (telephone 398-4530). Plans, data and reports pertinent to the Operational Certificate are to be submitted to the Environmental Protection Manager, at this address.

Yours truly,

Douglas J. Hill, P. Eng.
For Director, *Environmental Management Act*
Cariboo Region

Enclosure

BRITISH COLUMBIA

MINISTRY OF ENVIRONMENT

Environmental Protection

Operational Certificate
MR-4223

Under the Provisions of the Environmental Management Act and in Accordance with the Approved Central Coast Regional District Solid Waste Management Plan

Central Coast Regional District

P.O. Box 186

Bella Coola BC V0T 1C0

is authorised to discharge refuse to land and air contaminants to air from municipal solid waste sources located near Bella Coola, British Columbia, 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.

The issuance of this Operational Certificate supersedes all previous versions of Permit PR-4223 issued the *Environmental Management Act*.

1. AUTHORISED DISCHARGES

1.1. This subsection applies to the discharge of municipal solid waste from the Bella Coola Valley and surrounding area to land. The site reference number for this discharge is E210037.

1.1.1. Rate of Discharge

The maximum authorised rate of discharge is 1,300 tonnes/yr.

1.1.2. Characteristics of the Discharge

The refuse shall be typical municipal solid waste. Hazardous Waste shall be excluded from the landfill except waste asbestos, hydrocarbon contaminated soils, and household hazardous waste.

The disposal of waste asbestos in compliance with the Hazardous Waste Regulation is authorised at the landfill.

Date Issued: APR 1 2 2006

Douglas J. Hill, P.Eng.
For Director, Environmental Management Act

The management of hydrocarbon contaminated soils, in compliance with the Contaminated Sites Regulation is authorised in an area of the landfill approved by the Director. Hydrocarbon contaminated soils meeting the "Industrial" standard of the Contaminated Sites Regulation may be used as intermediate cover.

1.1.3. Authorised Works

The authorised works are a landfill, surface drainage diversion works and related appurtenances approximately located as shown on the attached Site Plan.

1.1.4. Location of the Point of Discharge

The location of the point of discharge is unsurveyed portion of the NW ¼ of Section 30, Township 1, Range 3, Coast District, approximately as shown on the Site Plan

1.2. This subsection applies to the discharge of air contaminants from regulated open burning of cardboard and wood residue from municipal sources.

1.2.1. Rate of Discharge

The maximum cumulative number of days during which air contaminants may be released shall not exceed 150 days per year. The maximum authorised quantity of waste that may be burned is 400 tonnes/year.

1.2.2. Characteristics of the Discharge

The characteristics of the discharge shall be typical of open burning of cardboard and wood residue conducted under well controlled conditions.

1.2.3. Location of the Point of Discharge

The location of the point of discharge is the same as described in Section 1.1.4.

2. GENERAL REQUIREMENTS

2.1. Maintenance of Works and Emergency Procedures

The Operational Certificate Holder shall inspect the authorized works regularly and maintain them in good working order. In the event of an emergency or condition beyond the control of the Operational Certificate Holder which prevents effective operation of the approved method of pollution

Douglas J. Hill, P.Eng.
For Director, Environmental Management Act

Date Issued: APR 1 2 2006

control, the Operational Certificate Holder shall immediately take appropriate remedial action and shall notify the Director or an Officer designated by the Director:

2.1.1. by telephone if the condition occurs between the hours of 08:00 and 16:30, Monday to Friday on normal working days; and

2.1.2. by facsimile transmission if the condition occurs at any other time.

All such reports must be received within 24 hours of the detection of the occurrence.

In addition, emergencies involving major effluent discharges that could affect public health and spills subject to the requirements of the Spill Reporting Regulation, shall be immediately reported to the Provincial Emergency Program at 1-800-663-3456.

2.2. Process Modifications

The Operational Certificate Holder shall have written approval from the Director prior to implementing changes to the authorised works that may result in discharges exceeding the characteristics authorised under this Operational Certificate.

2.3. Site Access

The Operational Certificate Holder shall control access to the site. An attendant shall be on duty on all days that the facility is open. The gate to the site shall stay locked on non-operational days. The Operational Certificate Holder may allow access to the site on non-operational days to selected individuals to deposit refuse which is not attractive to bears. Food waste or waste contaminated by food shall not be deposited on non-operational days. The applicants for extra access privileges shall be required to return any keys upon request, and shall be instructed not to make duplicate keys. After hours discharge of putrescible waste is prohibited.

Date Issued: APR 1 2 2006

Douglas J. Hill, P.Eng.
For Director, Environmental Management Act

2.4. Landfill Operation

2.4.1. The Operational Certificate Holder shall develop the landfill in a strip shaped cell pattern. The width of each strip cell shall not exceed 6 metres and the height shall not exceed 2 metres.

2.4.2. Refuse placed in the active putrescible waste cell shall be compacted at the end of each operating day. The top surface and the working face of the active putrescible waste cell shall be covered with a minimum of 15 cm of clean fill no less than once per week. Suitable alternatives to cover material on the surface of the working face may be used if approved by the Director

2.4.3. Final cover of the landfill surface shall be with a layer of compacted soil no less than 1 metre deep plus a minimum of 0.15 metres of topsoil with appropriate vegetation established. The final surface of the landfill shall be crowned to promote runoff of surface waters and to prevent ponding

2.4.4. Provision of surface water diversion works and site restoration as required, shall be carried out to the satisfaction of the Director.

2.4.5. Vegetation shall be removed from the surface of the entire site annually.

2.5. Litter Control

The Operational Certificate Holder shall control refuse scattered in the neighboring forested area, along the roads and trails accessing the site, in the drainage ditches, and within the site area. A thorough pick up of scattered litter shall be conducted at least twice per year around the site.

2.6. Segregation of Recyclable Materials

The Operational Certificate Holder shall segregate large recyclable wastes, such as large metallic waste and rubber tires of rim size less than or equal to 16 inches, in a separate area of the site for recycling. Lead acid batteries shall not be accepted for disposal or storage at the site unless authorized by the Director.

2.7. Electric Fencing

2.7.1. Bear Proof Containment of Putrescibles

All putrescible wastes that arrive at the landfill facility must be immediately contained within a bear proof bin or within a compound enclosed by an electric fence. Metals and tires stockpiled for recycling,

Douglas Hill

Douglas J. Hill, P.Eng.
For Director, Environmental Management Act

Date Issued: APR 12 2006

wood residue and clean cardboard stockpiled for incineration are not considered putrescible for the purposes of this Operational Certificate.

2.7.2. Electric Fence Design, Construction and Maintenance

Electric fencing at the landfill site shall be designed, constructed, and maintained such that bears are prevented from penetrating the fencing at all times throughout the Period of Operation.

2.7.3. Period of Operation

Electric fencing shall be fully operational during the period of March 1st to December 15th inclusive each year. If snow is present during this period, any electrified strands above the snow line shall be isolated from the remainder of the system and energized. The Operational Certificate Holder shall not vary the operating period without prior written authorization from the Director.

2.7.4. Minimum Voltage

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

2.7.5. Gate Operation

Any access through the 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 monitored for bear activity during hours of operation

2.7.6. 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 compatible with the brand of the fence charging unit. Any results less than the minimum 6,000 volts or any problems which affect operation of the fence shall be immediately investigated and corrected. In addition, the Director shall be notified as per section 2.1 in the event that the voltage is not maintained above 6,000 volts.

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

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fully restored or until there are no new signs of penetration attempts, respectively.

2.7.7. Record Keeping and Reporting

A log book containing a record of inspections is to be maintained by the Operational Certificate Holder and shall include notation on the voltage range of the fence, problems, corrective measures and evidence of bear activity in the vicinity of the fencing. Any penetration of the fence by bears is to be immediately reported to the Conservation Officer Service (1-800-663-9453).

2.8. Operational Requirements for Regulated Open Burning of Wood Residue

2.8.1. Timing

Burning shall take place only when the venting index is greater than 55 (good) on the day the wood debris is ignited. The Operational Certificate Holder shall discontinue charging debris to the burn pile if the venting index drops below 55. The venting index forecast may be obtained from the Atmospheric Environment Service by calling 1-900-565-5000 or by calling the regional forecast line at 250-398-4533. Burning shall take place only when approved by the Ministry of Forests who will determine whether it is safe to burn and may specify conditions under which burning may take place.

2.8.2. Nature of Wastes

Only cardboard and clean woody debris from demolition, land clearing or construction operations may be incinerated. Tires, treated lumber, asphalt products or hazardous waste shall not be burned. No material other than dry wood, paper, cardboard, propane, diesel fuel oil, or commercially prepared fire starter may be used to start, assist, or enhance the burning.

2.8.3. Smoke Control

An attendant shall be on duty when burning takes place. Each burn shall consist of one continuous burn necessary to reduce the stockpiled waste to ashes. Materials shall be charged to the trench in a manner to promote efficient combustion, restrict the uplift of lighter constituents, and minimize opacity. The residue of combustion must be cooled to ambient temperature before it is incorporated into the landfill. Additional works or other operational procedures may be required by the Director if conditions so warrant or problems regarding smoke emissions arise.

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3. MONITORING AND REPORTING REQUIREMENTS

3.1. Water Sampling and Analysis

The Operational Certificate Holder shall collect grab samples from the locations and at the frequencies listed in Table 1 of this Operational Certificate and have the samples analyzed for the parameters listed in Table 2 of this Operational Certificate. The minimum detection limit for analysis shall be as shown in Table 2 of this Operational Certificate.

3.2. Sampling Procedure

At sites where sampling is required, the Operational Certificate Holder shall install a suitable sampling facility and obtain samples in accordance with procedures described in "British Columbia Field Sampling Manual for Continuous Monitoring Plus the Collection of Air, Air-Emission, Water, Wastewater, Soil, Sediment, and Biological Samples," November, 1996, or by suitable alternative procedures as authorized by the Director. Proper care should be taken in sampling, storing and transporting the samples to adequately control temperature and avoid contamination, breakage, etc.

Copies of the above mentioned manual are available from the Queen's Printer Publication Centre, P.O. Box 9452, Stn. Prov. Govt, Victoria, British Columbia, V8W 9V7 (1-800-663-6105 or (250) 387-6409), and also available for inspection at all Environmental Protection Program Offices.

3.3. Analytical Procedures

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

A copy of the above manual may be purchased from Queen's Printer Publications Centre, P.O. Box 9452, Stn. Prov. Govt, Victoria, British Columbia, V8W 9V7 (1-800-663-6105 or (250) 387-6409). A copy of the manual is also available for inspection at all Environmental Protection Program Offices.

3.4. Quality Assurance

Analysis of samples for parameters designated under the Environmental Data Quality Assurance Regulation shall be at a laboratory registered for the designated

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parameter under the Regulation. In addition, the Operational Certificate Holder shall participate in quality assurance audits as required by the Regulation.

3.5. Reporting

The Operational Certificate Holder shall report the results of the previous years' sampling and quality assurance program to the Director by no later than January 31 of each year.

TABLE 1 - Monitoring Sites and Frequencies

Site Code	Site Name	Water Quality Sample Frequency
E239642	Noohalk Creek upstream of highway 20	field parameters only: once in late winter all parameters: once in early summer
E245136	Noohalk Creek upstream of landfill	field parameters only: once in late winter all parameters: once in early summer

TABLE 2 - Water Quality Parameters

Parameter	Sites	MDL
field pH	all	0.1 pH units
field temperature	all	0.1 °C
field conductivity	all	1 µS/cm
alkalinity	all	1 mg/L
chloride	all	1 mg/L
sulphate	all	1 mg/L
nitrate plus nitrite - N	all	0.005 mg/L
ortho-phosphorus	all	0.005 mg/L
hardness	all	1 mg/L
dissolved calcium	all	0.1 mg/L
dissolved iron	all	0.05 mg/L
dissolved magnesium	all	0.1mg/L
dissolved manganese	all	0.001 mg/L
dissolved sodium	all	0.01 mg/L

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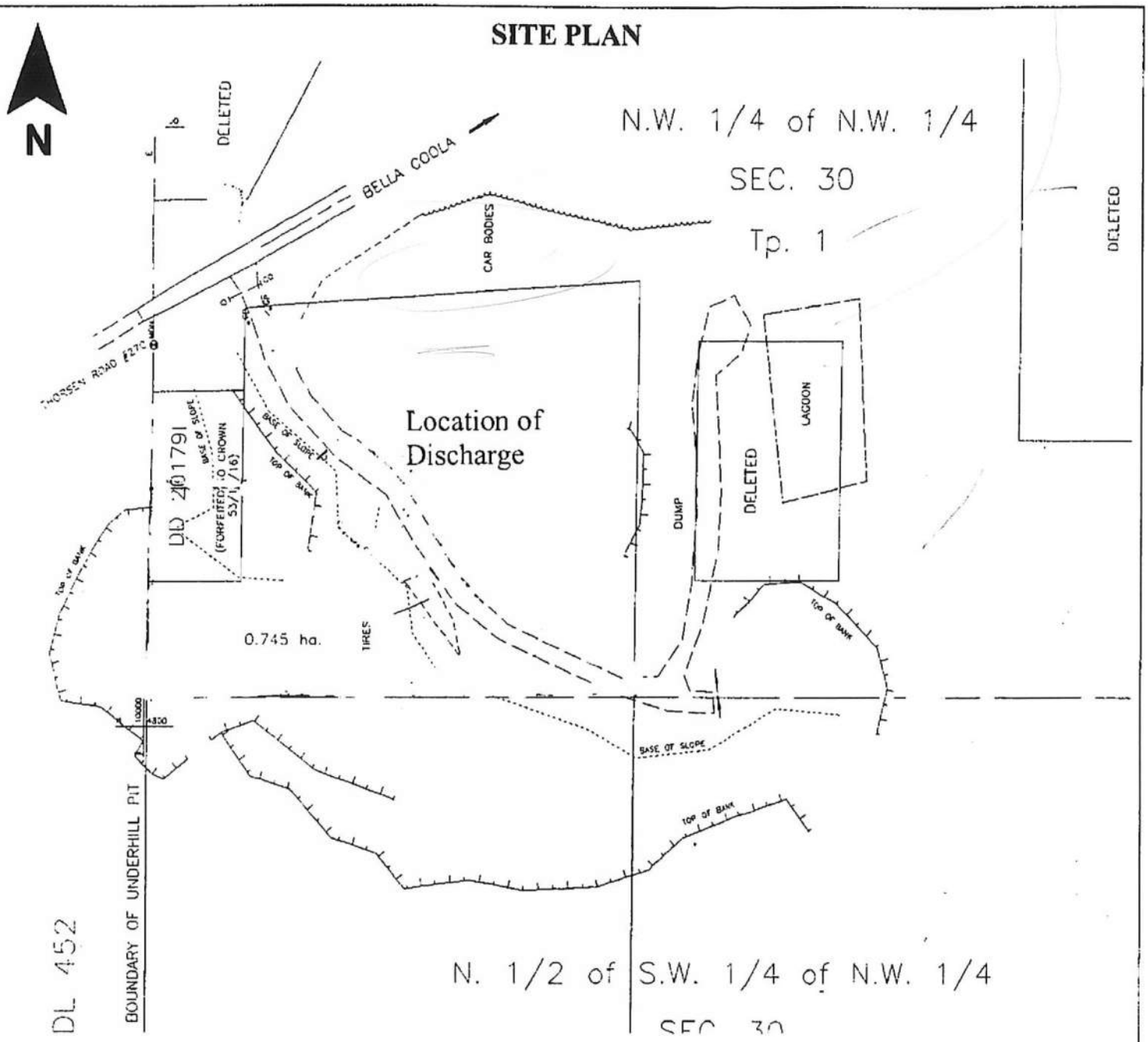
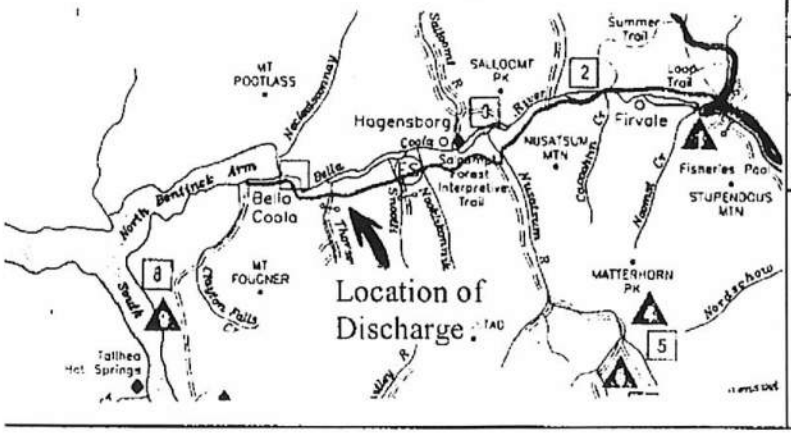
BRITISH COLUMBIA

SITE PLAN



Location Map



Not to Scale

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Cariboo Region