# Regional District of Central Kootenay
# Central Composting Facility
# Operational Environmental Monitoring Plan

PRESENTED TO

**Regional District of Central Kootenay**

JANUARY 29, 2024
ISSUED FOR USE
FILE: 704-SWM.SWOP04285-01

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## APPENDICES

# ACRONYMS & ABBREVIATIONS

| Acronyms/Abbreviations | Definition |
|---|---|
| BC | British Columbia |
| BOD | Biological Oxygen Demand |
| CALA | Canadian Association for Laboratory Accreditation |
| COC | Chain-of-Custody |
| COD | Chemical Oxygen Demand |
| DO | Dissolved Oxygen |
| DW | Drinking Water |
| EMP | Environmental Monitoring Plan |
| FWAL | Fresh Water Aquatic Life |
| GW | Groundwater |
| MOECC | Ministry of Environment and Climate Change |
| NCAZ | Northern Contaminant Attenuation Zone |
| PAH | Polycyclic Aromatic Hydrocarbon |
| QA /QC | Quality Assurance / Quality Control |
| RDCK | Regional District of Central Kootenay |
| SCAZ | Southern Contaminant Attenuation Zone |
| SW | Surface Water |
| TSF | Tailings Storage Facility |
| TT | Tetra Tech Canada Inc. |
| VOC | Volatile Organic Compound |

## LIMITATIONS OF REPORT

This report and its contents are intended for the sole use of the Regional District of Central Kootenay and their agents. Tetra Tech Canada Inc. (Tetra Tech) does not accept any responsibility for the accuracy of any of the data, the analysis, or the recommendations contained or referenced in the report when the report is used or relied upon by any Party other than the Regional District of Central Kootenay, or for any Project other than the proposed development at the subject site. Any such unauthorized use of this report is at the sole risk of the user. Use of this document is subject to the Limitations on the Use of this Document attached in the Appendix or Contractual Terms and Conditions executed by both parties.

# 1.0 INTRODUCTION

Tetra Tech Canada Inc. (Tetra Tech) was retained by the Regional District of Central Kootenay (RDCK) to develop an Operational Environmental Monitoring Plan (EMP) for the Central Composting Facility (Facility), adjacent to the Central Landfill (the Site). The Site is located at 550 Emerald Road south of Salmo, British Columbia (BC).

## 1.1 Purpose

The purpose of the EMP is to develop and implement an environmental monitoring program for the Facility, to evaluate the potential for surface water and groundwater impacts derived from Compost Facility operations and interpret analytical results in accordance with applicable standards and guidelines. This EMP is intended to compliment the existing monitoring program that the RDCK undertakes at the Site.

# 2.0 SETTING

The following section presents a summary of the Site setting.

## 2.1 Site Description and History

The Site had active landfilling operations from 1983 until closure in 2014. Currently, the Site operates as a transfer station with some yard waste composting operations, under Operational Certificate 16519 issued by the BC Ministry of Environment (MOECC). The transfer station is accessible at the entrance off Emerald Mine Road while the yard waste composting is approximately 350 metres (m) south of the entrance. The transfer station is comprised of a three-bay bin wall for wood waste and mixed household waste, several front load bins for recycling, and stockpiles for white goods and scrap metal. The new Facility for composting is situated at the south end of the Site, with construction nearing completion.

The former HB Mine operated upslope of the Site from 1912 to 1978 with the tailings facility and tailings pond directly west and down-gradient of the landfill. The mine was owned and operated by Teck Cominco Ltd. (Teck). Commodities produced included lead, zinc, silver, cadmium, copper, gold, and talc (RDCK 2019). Drainage is promoted towards surface water ponds at the northwest area of the Site. The new composting Facility is on an area of the Site historically used as a clay till borrow area and has had no landfilling activities (SRK 2018). The Site is stripped of topsoil because of the previous excavation that has taken place. The Facility is adjacent to a surface water ditch running along a site access road. The Site and location of the Facility area are identified on Figure 1. A detailed Facility layout is presented on Figure 2.

## 2.2 General Hydrology

The Site is located on the western slope of Iron Mountain with the primary direction of surface flow east to west, following the slope. The main water drainage in the area is the southward flowing Salmo River, which is located approximately 1.8 km west of the Site. The new Compost Facility is approximately 300 m east of the HB Tailings Storage Facility (TSF) and 13 m south of the closed landfill.

Immediately west of the landfill is the former HB TSF, with a bedrock ridge on the western edge of the TSF. This bedrock ridge trends north to south and separates the tailings facility from the Salmo River floodplain to the west (RDCK 2019).

The groundwater flow beneath the landfill area is in a semi-radial pattern with the flow directions controlled by the presence of a bedrock ridge beneath Cell 1 in the landfill footprint. The ridge is oriented in an approximate east-west direction on the Site (RDCK 2019). The bedrock ridge under the Landfill acts as an overall local groundwater flow divide that essentially divides the groundwater flow into two directions: towards the north (Northern Contaminant Attenuation Zone [NCAZ]) and towards the south (Southern Contaminant Attenuation Zone [SCAZ]). The bedrock ridge also dictates groundwater flow at the landfill. In terms of groundwater flow, the Compost Facility is hydraulically up-gradient and the closed landfill. Groundwater is approximately 6 m below ground surface in the vicinity of the Compost Facility. The groundwater flow is towards the southwest.

Sheep Creek is approximately 290 m north of the Site and flows from east to west through a steeply incised bank. Sheep Creek joins the Salmo River approximately 1 km northwest of the Facility (Wood 2020).

The Central Composting Facility is at a relatively high point at the Site. The Facility features an asphalt surface, a receiving building, a concrete pad, and a surface water pond. These areas are graded to drain into the contact water pond at the southern edge of the Facility, which has been designed for a 1 in 25-year, 24-hour storm event. The contact water pond liner is composed of 600 mm of clay, a geosynthetic clay liner, and a 60 mil HDPE geomembrane.

Potential impacts to the Site from the Compost Facility include redirecting surface water flow around the Facility and the potential for the contact water pond to overflow. The contact water pond was designed to be impervious to control any potential leachate impacts from the Composting Facility. In the unlikely event that the pond overflows, the overflowing water has a potential to negatively affect groundwater as it flows along existing site ditching towards the surface water ponds (indicated on Figure 2). All other ditching on the Site also flows into these surface water ponds.

## 2.3 Potential Receptors

The following section presents a summary of identified receptors located within 1 km of the Site. The primary water receptors that are proximal to the Site are Sheep Creek and the Salmo River. The nearest dwelling or building structure is located approximately 1,000 m west of the Site. The nearest registered private domestic drinking water well is also located approximately 1,000 m northwest of the Site, amongst several domestic drinking water wells in the region. However, the Facility is further up-gradient of these wells than the landfill footprint and the TSF.

It should be noted that there are domestic surface water licences in the area, most of which are up-gradient from the Site. However, the two down-gradient surface water licenses are registered for fire suppression or irrigation.

# 3.0 EXISTING MONITORING PROGRAM

The RDCK undertakes a monitoring program for the landfill site in accordance with the requirements of Operational Certificate MR-16519 and in general accordance with the BC Landfill Criteria for Municipal Solid Waste (MOECC 2016). This section provides a summary of that program and recent results. It shall be noted that the discussion is based on data presented in the “2018 Annual Operations and Monitoring Report” (RDCK 2019) and the Five-Year Hydrogeological Assessment at the Central Landfill, Salmo BC, completed by Wood Environment and Infrastructure Solutions (Wood), consultant to the RDCK (Wood 2020).

## 3.1 Groundwater

As mentioned, the groundwater flow direction at the Site runs in a semi-radial pattern divided by an east-west bedrock ridge beneath Cell 1 in the landfill footprint. The Facility location is south of the landfill footprint and is interpreted to be hydraulically up-gradient of any potential leachate impacted groundwater relating to the landfill. In general, the groundwater depth decreases from east to west. There are four seepages that occur on the northern edge of the Site property, which are sampled at Seep A, Seep E, Seep G, and Seep I (Figure 1).

The current groundwater monitoring program consists of 29 groundwater monitoring wells within and adjacent to the landfill site and HB TSF. In addition, there are two leachate monitoring locations. These wells are monitored on an annual basis by Masse Environmental Consultants, based on the Environmental Monitoring Program authorized by the MOECC. Residential groundwater monitoring wells are located south of Sheep Creek near the confluence of Sheep Creek and Salmo River, and upstream of the HB Tailings outlet discharge, approximately 1.2 km northwest of the Composting Facility (Wood 2020). All groundwater monitoring locations are included on Figure 1.

### Background Groundwater Quality

Background groundwater quality is measured hydraulically up-gradient of the landfill at MW07-01, S-MW-1, MW-02A-01, and MW-03A-01. The Wood report describes the detectable metal parameters as generally stable, and they typically do not fluctuate more than 50% except for iron and manganese (Wood 2020) at MW07-01. These fluctuations are likely caused by suspended solids being present in the sample. The detectable nutrient concentrations do not fluctuate more than 30% and are typically stable from 2013 to 2019.

Groundwater results for MW-02A-01 and MW-03A-01 were generally below BC Water Quality Guidelines and the Guidelines for Canadian Drinking Water Quality (the Criteria) with the exception of turbidity, total phosphorus, iron, and manganese at MW-02A-01, and total phosphorus, arsenic, and manganese in MW-03A-01. These results are consistent with historical data.

### Groundwater Quality Trends

In their 2020 hydrogeological assessment, Wood has identified two contaminant zones at the Site, the NCAZ and the Zone SCAZ (Wood 2020). The NCAZ flows through the northern portion of the landfill footprint area (designated on Figure 1) and discharges into Sheep Creek. The SCAZ flows westward into the tailings facility and then south along the bedrock valley in which the tailings were historically deposited.

Leachate is generally characterized by elevated concentrations of ammonia, chloride, iron, and manganese. Not only are these parameters typically associated to leachate, they are also relatively mobile and susceptible to migration.

The ammonia, arsenic, boron, cadmium, and iron concentrations noted at MW-99-7D, located up-gradient of most groundwater monitoring locations, in the NCAZ are much higher than what are observed at other groundwater monitoring locations. Additionally, chloride concentrations at MW-99-7D have exceeded the BC relevant criteria at multiple sampling events since 2010. Seep E is located directly down-gradient from MW-99-7D and displays similar water quality trends. Seep E has more recorded exceedances than MW-99-7D and this may be a result of the oxidizing conditions at Seep E. It is likely that there is some leachate influence at these sampling locations (RDCK 2019).

For the SCAZ, sulphide exceedances were recorded at MW06-01, MW02-05, MW05-05, and MW99-3S in 2018. From the data provided, these wells do not have historical sulphide exceedances before 2015. These exceedances could be related to the disposal of septage and organics that are altering the downstream redox conditions within the TSF, changes to TSF conditions (lowering of water levels, tailings regrading, surface water ditching, etc.), or

may be related to sulphate bearing material being present within the recently placed landfill cover material. MW-99-8, MW-99-3S, MW-02S-03, and MW-02D-03 appear to be under the influence of leachate (RDCK 2019).

Tailings affected groundwater is typically characterized by similar compounds to landfill leachate, specifically increased concentrations of iron, manganese, arsenic, cadmium, lead, and zinc (RDCK. 2019). Within the TSF (indicated on Figure 1), chloride concentrations were consistently highest at MW-02S-03, MW-02D-03, and MW-01C-03 (15-42 mg/L) which are located closest to the landfill. Similarly, lead and manganese concentrations are elevated at those wells compared to the well closest to the source concentration leachate (MW-06-01).

The closest groundwater monitoring locations to the Compost Facility location are MW-08-01 (SCAZ) and S-MW-2 (SCAZ). 2018 results indicate that neither of these locations exceed the relevant BC Criteria. However, S-MW-2 has seen increasing sulphide concentrations in recent years (RDCK 2019).

The Facility sits well within the SCAZ and should not have any impacts on NCAZ groundwater. Hence, MW-08-01 and S-MW-2 are the two existing monitoring wells that are relevant to monitoring impacts from the Facility. Future monitoring events at these two wells should consider testing parameters related to composting material (refer to Section 4.1.2). However, these wells are potentially too far north to capture potential impacts from the Compost Facility.

## 3.2 Surface Water

At the Site, there are currently seven monitoring locations, including four groundwater seeps and three surface water locations. Surface water stations are sampled on a biannual basis and the seeps are sampled on an annual basis which coincides with the groundwater monitoring program. These locations include:

- Four seeps located on the northern edge of the landfill site, on the southern slope of Sheep Creek; and
- Three surface water locations along Sheep Creek.

All of the seeps discharge into Sheep Creek, two of which are considered by Wood to be background locations (hydraulically up-gradient) and two are considered to have potential to be impacted by landfill leachate (hydraulically down-gradient). The surface water monitoring points are located both upstream and downstream of the landfill site on Sheep Creek (Wood 2020). The seeps and surface water sampling points are approximately 150 m north of the Facility.

### Background Surface Water Quality

Upstream Seeps I and G, located north of the landfill, appear to not be impacted by leachate, but display elevated metal concentrations at these background locations based on 2018 data. The average total cadmium concentrations are higher at Seeps I and G, which are located up-gradient of the landfill site, than at Seeps A and E. In contrast, the arsenic concentrations measured at Seeps A and E are consistently higher than at Seeps I and G. Seeps A and E are interpreted to be impacted by leachate or septage as indicated by the observed ammonia, arsenic, iron, and manganese exceedances. Samples collected from Sheep Creek had numerous exceedances for cadmium and zinc at all three locations including SW-C, which is the up-gradient sampling location. These results indicate that the landfill has no discernible negative impact to the water quality in Sheep Creek, and this is consistent with historical results.

### Surface Water Quality Trends

2018 results indicate that several upstream surface water samples and upstream seep samples show concentrations of cadmium and zinc above both Freshwater Aquatic Life (FWAL) guidelines and the Drinking Water (DW) guidelines. However, 2018 indicates that results indicate that the landfill has no discernible negative impact

to the water quality in Sheep Creek, and this is consistent with historical results. The potential environmental impacts of Composting Facility at the Site are expected to be lower that the landfill itself.

# 4.0 PROPOSED MONITORING PLAN

This section outlines the proposed additions to the existing monitoring program for the Site. It is recommended that these proposed additions are undertaken concurrent to the existing EMP, which is required under the Site's operating certificate. The MOECC does not specify specific guidance for an EMP for composting facilities, contrary to the strict requirements of landfills in BC. However, this EMP has been developed to align with the existing landfill EMP to closely monitor potential impacts to the environment stemming from the Facility. The proposed additions to the EMP should be reviewed annually to confirm that the locations, parameters, and frequency are meeting the program objectives, and make adjustments if necessary.

In addition to the proposed additions, the RDCK should pay increased attention to the existing groundwater monitoring locations proximal to the Facility, such as MW-08-01 and S-MW-2 (seen on Figure 1). Future environmental monitoring data can be compared to historical data to help identify whether the Facility is having impacts on groundwater in the area.

## 4.1 Groundwater

### 4.1.1 Monitoring Locations and Frequency

The RDCK should utilize the historical groundwater monitoring infrastructure (introduced in Section 3.1) as well as proposed additional wells to monitor potential impacts from the Composting Facility. The monitoring wells shall be used to determine the groundwater quality with respect to the criteria and confirm that the environmental control systems put in place are working effectively. Table 4-1 shows the existing groundwater monitoring locations that Tetra Tech proposes using to help to assess potential impacts from the Composting Facility.

**Table 4-1: Existing Groundwater Monitoring Locations**

| Monitoring Station Identification | Location | Purpose | Additional Monitoring Required |
|---|---|---|---|
| **MW-08-01** | Approx. 70 m west of the Composting Facility | Down-gradient (SCAZ) | ▪ General chemistry (including nutrients)<br>▪ Phosphate<br>▪ Dissolved iron and manganese<br>▪ Total phenols (4AAP)<br>▪ Biological Oxygen Demand (BOD)<br>▪ Chemical Oxygen Demand (COD) |
| **S-MW-2** | Approx. 80 m west of the Composting Facility | Cross-gradient (SCAZ) | ▪ General chemistry (including nutrients)<br>▪ Phosphate<br>▪ Dissolved iron and manganese<br>▪ Total phenols (4AAP)<br>▪ BOD<br>▪ COD |

It is recommended that two new groundwater wells are installed in close proximity to the Facility (as seen on Figure 1), in hydraulically down-gradient positions. The following table presents the proposed groundwater monitoring locations to be added to the existing EMP. It is suggested that the frequency of monitoring is originally set at semi-annually for the first two years of operation to allow for a comparison of water characteristics between dry and wet seasons. After two years, the results should be evaluated to determine whether to decrease the monitoring frequency to annually to align with the broader Site EMP.

**Table 4-2: New Groundwater Monitoring Locations**

| Monitoring Station Identification | Location | Purpose |
|---|---|---|
| **MW1-22** | Approx. 50 m southwest of the Composting Facility | Down-Gradient of Facility (SCAZ) |
| **MW2-22** | Approx. 50 m south of the Composting Facility | Down-Gradient of Facility (SCAZ) |

### 4.1.2 Parameters

The following list of analytes proposed for monitoring is based upon the "*Guidelines for Environmental Monitoring at Municipal Solid Waste Landfills*" (MOECC 1996) and "*The BC Approved and Working Water Quality Guidelines*" (MOECC 2020).

#### 4.1.2.1 Field Measurements

Field measurements shall be measured with a suitable, portable multi-parameter water quality measurement instrument. Field measured water quality parameters to be recorded at the time of groundwater sampling shall include the following:

- Temperature
- pH
- Conductivity
- Dissolved Oxygen (DO).

#### 4.1.2.2 Laboratory Analysis

***General Chemistry***

Laboratory analysis for general chemistry parameters shall include the following:

- Alkalinity
- Ammonia
- Biological Oxygen Demand
- Bromide
- Chloride
- Hardness (dissolved, as CaCO3)
- Sulphate
- Fluoride
- Nitrate
- Nitrite
- Phosphate
- Total Kjeldahl Nitrogen
- Turbidity

***Metals (Dissolved)***

Laboratory analysis for dissolved metal parameters shall include the following:

- Iron
- Manganese.Sampling Protocol

### 4.1.3 Sampling Protocol

To ensure the integrity of samples collected while sampling groundwater from the monitoring wells, the following protocols should be applied:

- Record the static water level of each monitoring well.
- Purge the appropriate volume of water from the monitoring well and record the water level on completion. The purpose of purging is to remove the groundwater from the well until a representative sample of the formation groundwater is obtained. In general, purging is considered complete once sediment-free groundwater is obtained and the specific criteria (conductance, temperature, and pH) of the groundwater stabilizes.
- Collect groundwater samples in the appropriate laboratory-supplied sample containers and preserve as required. Groundwater samples designated for metals analysis should be field filtered, appropriately preserved, packed in a cooler, stored at a temperature of approximately 4°C, and delivered to the laboratory for analysis.
- Ensure that preservatives (as required) are added to the samples after collection to ensure proper sample preservation.
- Field measurements should always be collected using a separate sub-sample that is discarded once the measurements are complete. Field measurements should never be collected using a water sample that is to be submitted for laboratory analyses.
- Samples shall be packed on ice and submitted under a chain-of-custody (COC) to an accredited analytical laboratory certified for environmental analysis by the MOECC. Sampling plans should consider the relatively short holding time of samples for BOD analysis.

## 4.2 Surface Water

### 4.2.1 Monitoring Locations and Frequency

Down-gradient surface water is sampled as part of the existing monitoring program. However, no existing surface water locations are in the vicinity of the Facility. Any potential impacts to surface water at these locations would likely be from other sources, such as the closed landfill.

It is recommended to add one additional surface water monitoring location in the ditch immediately southeast of the pond emergency overflow outlet. This surface water monitoring location is considered background unless the contact water pond overflows in a reportable spill event. Table 4-4 presents the proposed surface water monitoring location. The additional surface water monitoring location should be sampled at the same frequency (semi-annually) as the existing landfill monitoring program. Note, the RDCK should collect water samples from the contact water pond prior to intentionally releasing water into the existing ditch to ensure compliance with current provincial standards. Sampling of the contact water is not required as a proposed regular surface water monitoring location.

**Table 4-4: New Surface Water Monitoring Locations**

| Monitoring Station Identification | Location | Purpose |
|---|---|---|
| **SW2-22** | Approx. 30 m southeast of the Composting Facility | Up-gradient (Down-Gradient of the Contact Water Pond Overflow) |

### 4.2.2 Parameters

The following list of analytes proposed for monitoring is based upon the "*Guidelines for Environmental Monitoring at Municipal Solid Waste Landfills*" (MOECC 1996) and "*The BC Approved and Working Water Quality Guidelines*" (MOECC 2017).

#### 4.2.2.1 Field Measurements

Field measurements shall be measured with a suitable, portable multi-parameter water quality measurement instrument. Field measured water quality parameters to be recorded at the time of surface water sampling shall include the following:

- Temperature
- pH
- Conductivity
- Dissolved Oxygen (DO)

#### 4.2.2.2 Laboratory Analysis

***General Chemistry***

Laboratory analysis for general chemistry parameters shall include the following:

- Alkalinity
- Ammonia
- Biological Oxygen Demand
- Bromide
- Chloride
- Hardness (dissolved, as $CaCO_3$)
- Sulphate
- Fluoride
- Nitrate
- Nitrite
- Phosphate
- Total Kjeldahl Nitrogen
- Turbidity

***Metals (Dissolved and Total)***

Laboratory analysis for dissolved and total metal parameters shall include the following:

- Iron
- Manganese.Sampling Protocol

### 4.2.3 Sampling Protocol

The following protocol for sampling shall be used to collect surface water samples:

- Secure yourself to a solid object on shore (with a safety harness and line, if necessary). If possible/necessary, a second person must be nearby as the first person collects samples.
- Remove lid from a labelled bottle and place into a clean, resealable bag so both hands can be used to take sample. If rinsing is required for the type of bottle, rinse three times.

- Hold the bottle well below the neck or secure it to a pole sampler.
- Reach out (arm length only) and plunge the bottle under the water with the opening fading directly down and immediately orient it into the current. Completely submerge the sample container to avoid collection of any floating debris (approximately 0.15 m below the surface of the water, away from the edges of the surface waterbody).
- When the bottle is full, pull it up through the water while forcing into the current.
- Immediately recap the bottle.
- Ensure that preservations (as required) are added to the samples after collection to ensure proper sample preservation.
- Field measurements should always be collected using a separate sub-sample that is discarded once the measurements are complete. Field measurements should never be collected using a water sample that is to be submitted for laboratory analyses.
- Once collected, the samples will then be stored in coolers with ice and transported to an appropriate Canadian Association for Laboratory Accreditation (CALA) affiliated laboratory, for laboratory analyses with COC documentation. An additional duplicate sample shall be collected during each event for quality assurance/quality control (QA/QC) purposes.

## 4.3 Field Equipment

The following section presents a summary of the specifications for field equipment to be used to record field analytical parameters. A “YSI meter” or equivalent is recommended, as it can collect all required field analytical parameters, listed below:

- **Temperature:** A calibrated electronic or alcohol-filled thermometer capable of producing results within ± 0.5°C of the true temperature.
- **pH:** A calibrated electronic pH or multi-parameter meter capable of recording to the nearest 0.1 pH unit.
- **Conductivity:** A calibrated electronic-specific conductance (electrical conductivity) meter or multi-parameter meter capable of recording to the nearest 1 microsiemens per centimeter (µS/cm).
- **Dissolved Oxygen:** A calibrated multi-parameter meter capable of recording to the nearest 1 milligram per liter.

  Additionally, a water level meter is required for groundwater monitoring, capable of dipping wells up to 20 m depth.

## 4.4 Quality Assurance/Quality Control

A QA/QC program to assess the integrity of the sampling methodology and analytical testing should be implemented as part of the environmental monitoring program for the Site.

The QA/QC protocol will include the following:

- Recording the results of field activities in the field concurrently with the activities.
- Using clean, new sampling gloves at each sampling location.
- Placing samples into new and labelled laboratory-supplied containers, and when warranted, preserving the samples using laboratory-measured and supplied preservatives.

- Transporting temperature-sensitive samples to the analytical laboratory in chilled coolers using COC procedures either on the same day of sampling or within one day of sampling and analyzing the samples within the appropriate holding times.
- When appropriate, forming duplicate samples using industry accepted splitting methods.
- Using CALA-affiliated laboratories that are qualified to analyze the samples using MOECC-approved procedures.
- Submitting duplicate samples to the laboratory as “blind’ samples, meaning that they are not identified as duplicate samples. It is recommended that the RDCK obtains one duplicate sample for every 10 samples obtained.
- One field blank, using distilled water, should be obtained and tested at the laboratory. The results of the blank sample can be compared to field sample results to assess the degree of which sampling-induced errors may lead to inaccuracies in the data.
- Decontaminating sampling equipment between sample locations.
- Reviewing the results of QA/QC analyses, assessing the significance of the analytical results, and identifying this information in this report.

## 4.5 Reporting

The MOECC currently does not require the submission of annual EMP reports for composting facilities, as is the case for landfills. However, it is recommended that the RDCK collects and analyses surface water and groundwater results in a way that mirrors the existing EMP, should it be required by the MOECC in the future.

# 5.0 CLOSURE

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

Respectfully submitted,
Tetra Tech Canada Inc.



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PERMIT TO PRACTICE
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# FIGURES

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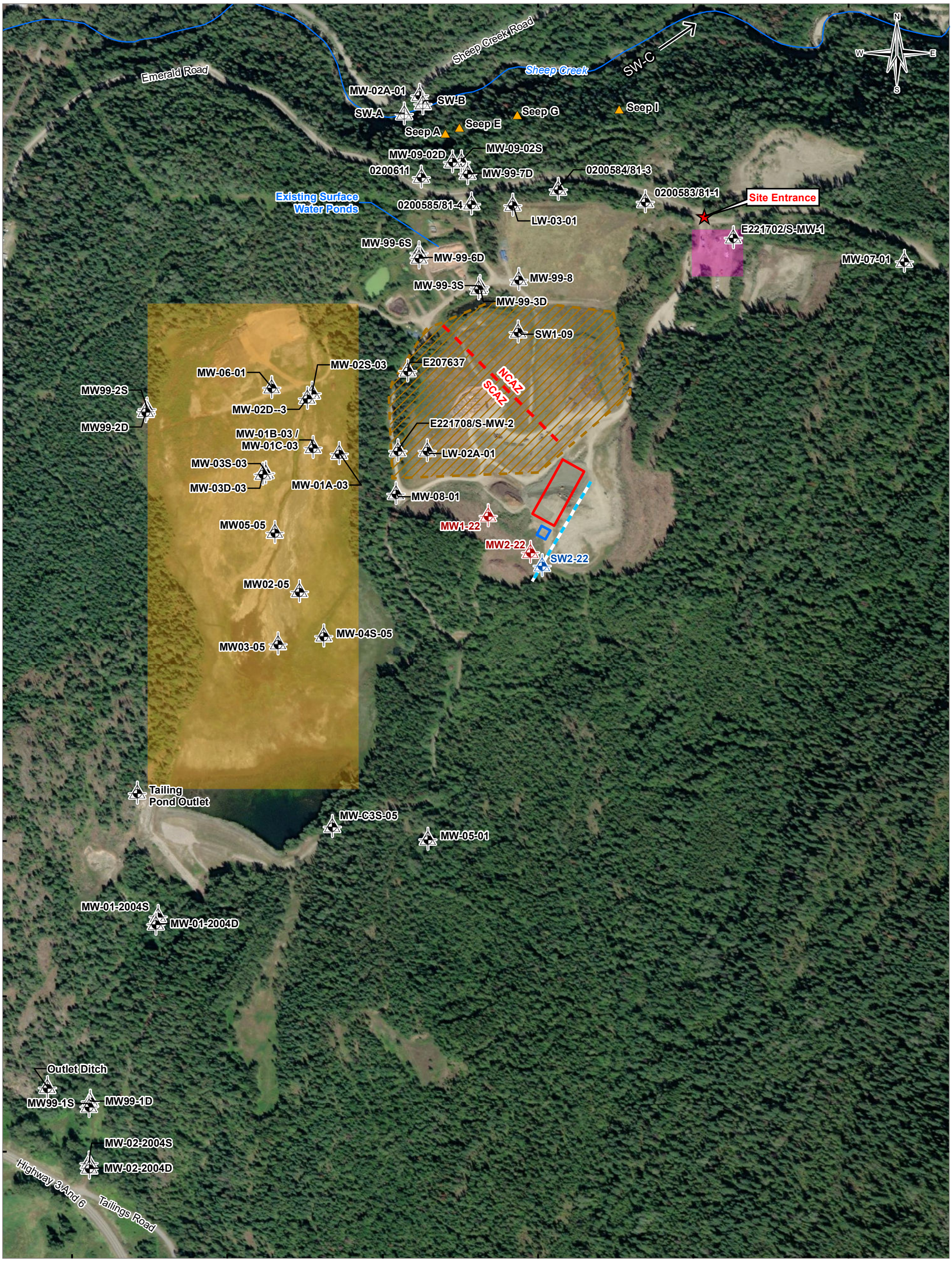



## LEGEND

- Site Entrance
- Monitoring Well
- Proposed Monitoring Well
- Surface Water
- Proposed Surface Water
- Seep
- Facility Location
- Contact Water Pond
- Approximate NCAZ/SCAZ Divide
- Approximate Surface Water Ditch Location
- Tailings Facility
- Transfer Station
- Approximate Landfill Footprint
- Sheep Creek

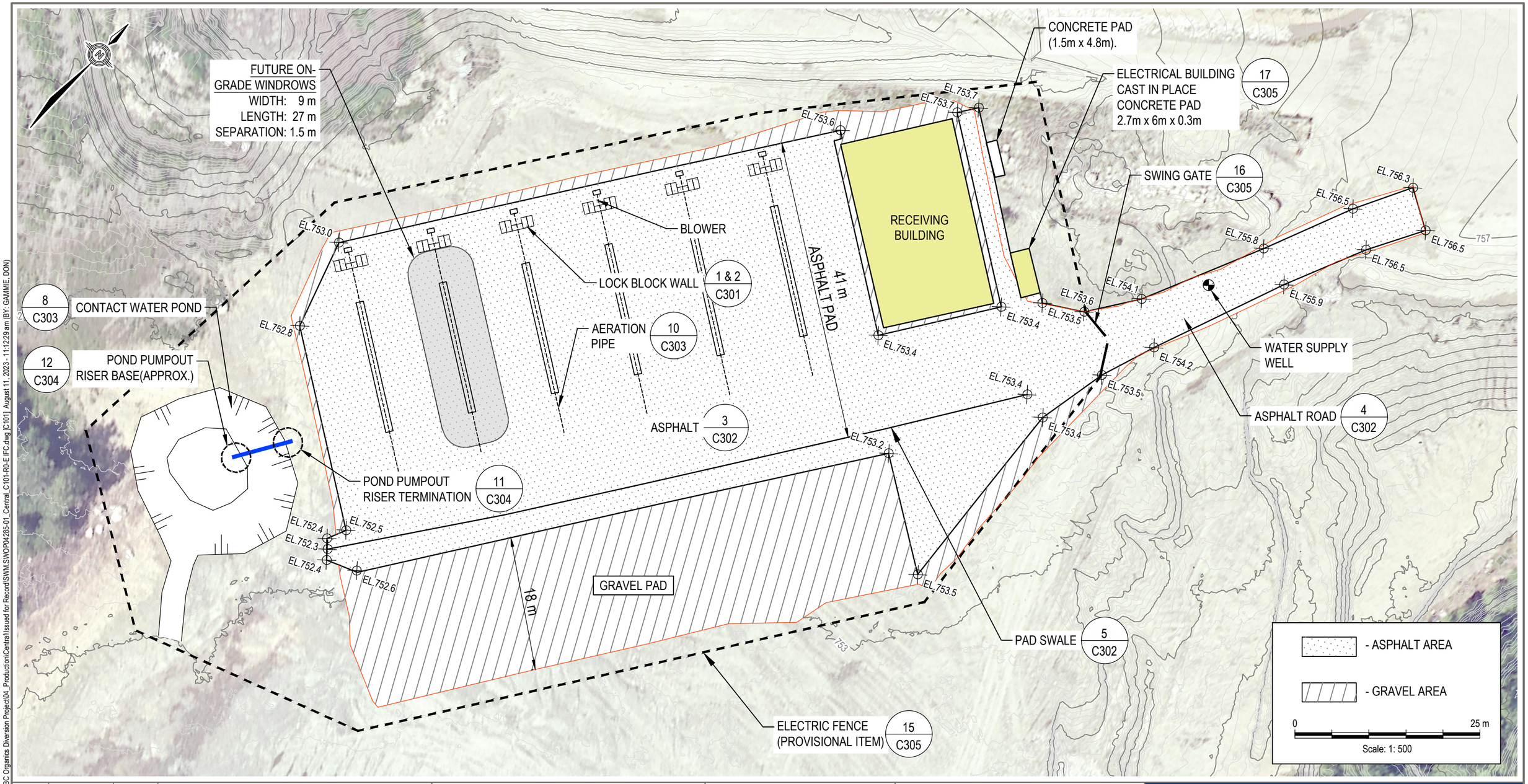
**NOTES**
Imagery: ESRI Maxar (2018)
Base data: Canvec (2019)

**STATUS**
ISSUED FOR REVIEW

**ORGANICS DIVERSION PROJECTS - COMPOSTING FACILITIES AND TS UPGRADES**

# Central Landfill Site Plan

| | | | | | |
|---|---|---|---|---|---|
| PROJECTION: UTM Zone 11 | DATUM: NAD83 | | | | CLIENT: Regional District of Central Kootenay |
| Scale: 1:6,000 (100 50 0 100 Metres) | | | | | TETRA TECH |
| FILE NO.: SWOP04285-01_FIG01_Central_SitePlan.mxd | | | | | |
| OFFICE: Tt-CAL | DWN: BB | CKD: SL | APVD: ZL | REV: 0 | Figure 1 |
| DATE: October 24, 2022 | PROJECT NO.: SWM.SWOP04285-01 | | | | |




| NUM | DATE | APR | DESCRIPTION |
|---|---|---|---|
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| 0 | AUG 2023 | MS | ISSUED FOR RECORD |

**REVISIONS**

| NUM | DATE | APR | DESCRIPTION |
|---|---|---|---|
| D | DEC 2021 | JR | ISSUED FOR TENDER |
| C | JAN 2021 | JR | ISSUED FOR REVIEW - 95% |
| B | DEC 2020 | JR | ISSUED FOR REVIEW - 60% |
| A | SEP 2020 | MS | ISSUED FOR REVIEW - 30% |

**DRAWING STATUS**

**PERMIT TO PRACTICE**
**TETRA TECH CANADA INC.**

**PERMIT NUMBER: 1001972**

PROFESSIONAL SEAL

CLIENT

REGIONAL DISTRICT CENTRAL KOOTENAY

TETRA TECH

# RDCK ORGANICS DIVERSION PROJECT
# CENTRAL COMPOST FACILITY, BRITISH COLUMBIA

## FACILITY LAYOUT PLAN

| PROJECT No. | OFFICE | DES | CKD | REVDRAWING |
|---|---|---|---|---|
| SWM.SWOP04285-01 | EDM | - | ZL | 0 |
| DATE: August 11, 2023 | SHEET No. 2 of 7 | DWN - | APP MS | STATUS - |

**FIGURE 2**

# APPENDIX A

## LIMITATIONS ON THE USE OF THIS DOCUMENT

# LIMITATIONS ON USE OF THIS DOCUMENT

## GEOENVIRONMENTAL

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Both electronic file and/or hard copy versions of TETRA TECH's Instruments of Professional Service shall not, under any circumstances, be altered by any party except TETRA TECH. TETRA TECH's Instruments of Professional Service will be used only and exactly as submitted by TETRA TECH.

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The Client acknowledges that it has fully cooperated with TETRA TECH with respect to the provision of all available information on the past, present, and proposed conditions on the site, including historical information respecting the use of the site. The Client further acknowledges that in order for TETRA TECH to properly provide the services contracted for in the Contract, TETRA TECH has relied upon the Client with respect to both the full disclosure and accuracy of any such information.

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The Client, and any Authorized Party, acknowledges that the Professional Document is based on limited data and that the conclusions, opinions, and recommendations contained in the Professional Document are the result of the application of professional judgment to such limited data.

The Professional Document is not applicable to any other sites, nor should it be relied upon for types of development other than those to which it refers. Any variation from the site conditions present, or variation in assumed conditions which might form the basis of design or recommendations as outlined in this report, at or on the development proposed as of the date of the Professional Document requires a supplementary investigation and assessment.

TETRA TECH is neither qualified to, nor is it making, any recommendations with respect to the purchase, sale, investment or development of the property, the decisions on which are the sole responsibility of the Client.

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In certain instances, the discovery of hazardous substances or conditions and materials may require that regulatory agencies and other persons be informed and the client agrees that notification to such bodies or persons as required may be done by TETRA TECH in its reasonably exercised discretion.

# Sampling and Analysis of Finished Compost

## Purpose:

Finished compost must meet the requirements of both Canadian (CFIA T-4-93) and British Columbia (OMRR) Regulations in order to be sold or distributed without restriction.

## Regulation

The OMRR (BC) requires sampling to be conducted from every 1000 tonnes compost (dry weight), or once per year (Schedule 3 (3)). The compost must meet fecal coliform levels (< 1000 MPN/g) in seven different samples of compost (Schedule 3), and trace element requirements in one composite sample as per Schedule 4. Schedule 4 also limits the foreign matter to less than or equal to 1 percent dry weight, and no sharp foreign matter.

To meet vector attraction reduction requirements (Schedule 2), we have requested the carbon dioxide evolution test (as per CCME Guidelines).

In addition, the compost must meet the requirements of T-4-93 of the CFIA (federal regulation) that requires Salmonella to be non-detectable (composite sample).

## Procedure – Step 1 – Meeting Fecal Coliform Requirements

When the compost process is complete as determined by smell and by re-heating potential, it is recommended to take one representative sample of the finished compost and send to a local laboratory for analysis of fecal coliform only. If the fecal coliform levels are < 1000 MPN/g, seven individual samples for fecal coliform and one composite sample for trace elements can be submitted for analysis.

For the first sample for fecal coliform, it is recommended to take at least 4 representative subsamples from the pile. The samples should be obtained from a depth of 30-90 cm into the pile.

Scrape away at least 15 cm of the surface material and make sure that non of this compost becomes part of the sample. Use a separate tool for scraping away the surface material.

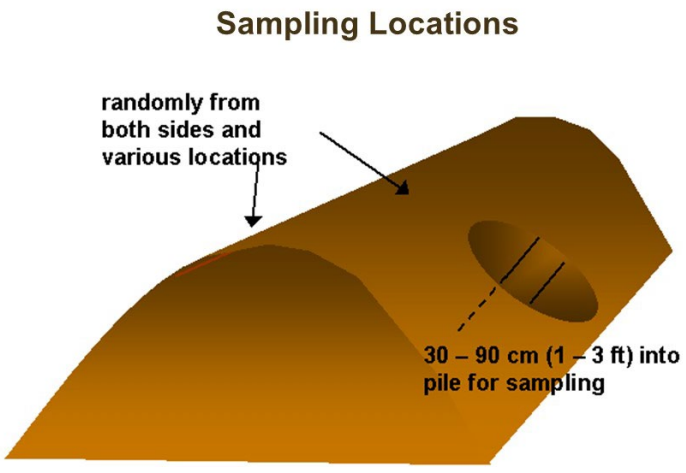


*Figure 1. Sampling protocol for finished compost.*

Use a plastic or latex glove when obtaining a subsample and place in a clean container or plastic bag. When all four subsamples have been obtained, blend thoroughly and close bag.

Refrigerate or place in a cooler with ice and send it to the laboratory for analysis within 24 hours.

**Procedure Step 2 – Full Analysis for Regulatory Compliance**

If the preliminary sample met the fecal coliform limit of < 1000 MPN/g, a full analysis of the finished compost can be completed.

Randomly locate seven different areas in the compost pile. Scrape away the top 15 cm of the pile to reduce the risk of contamination with surface material using a shovel. Obtain each of the seven separate samples from the 30-90 cm depth in the pile. We recommend using a separate latex glove for each of the seven samples.

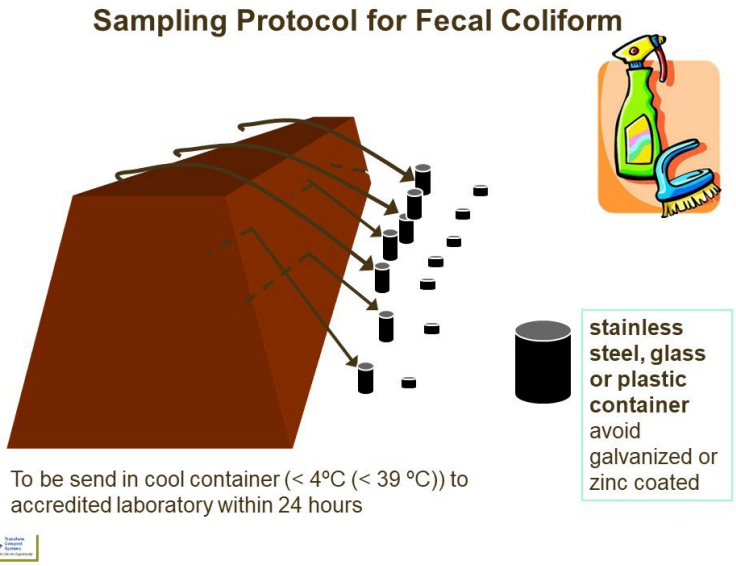


*Figure 2. Obtaining the seven separate samples for fecal coliform and one composite sample for trace elements and respiration.*

When obtaining each of the seven separate samples for fecal coliform analysis, obtain a small additional quantity from each of the seven locations for a composite sample. The composite sample containing the seven subsamples should be thoroughly blended before closing the bag.

Place all samples immediately in a cooler at 4 C or less. Do not freeze the samples. Send to laboratory for analysis within 24 hours.

We recommend that the seven samples for fecal coliform be sent to the same local laboratory as used for Step 1, and the composite sample be sent to A&L Laboratories in London Ontario.

An example of the submission form is found in Appendix A

An example of the analysis result from A&L Labs is found in Appendix B

**Interpreting Results**

The results of the seven separate samples for fecal coliform are simple to interpret. The Regulation requires that all seven samples must have fecal coliform levels of < 1000 MPN/g.

The results of the composite analysis (such as from A&L Labs) invites more understanding and interpretation.

Fecal coliform – must be less than 1000 MPN/g (OMRR pathogen reduction)

Salmonella – must be non-detectable (CFIA regulation)

Respiration – must be less than 4 mg $CO_2$-C/g OM/day (alternate vector attraction reduction OMRR)

Trace Elements – must meet OMRR Schedule 4 limits – usually not an issue with food waste compost

Foreign matter and sharps – less than or equal to 1% dry weight foreign matter and no sharp matter (OMRR Schedule 4 for retail grade organic matter).

***Other relevant Information on Laboratory Report***

The soluble salt concentration is a very important measurement and will determine the use recommendations for the compost.

In principle, the higher the food waste concentration in the compost, the higher the soluble salt content will be. We may see variations from summer to winter depending on the relative proportions of yard waste, food waste and bulking agent used. The higher the soluble salts, there will likely be more available nutrients for the plants.

If the compost has a soluble salt concentration of less than 3 ms/cm, the compost is unlikely to cause any osmotic effects for plants. If the soluble salt concentration is greater than 3 ms/cm, plants cannot be placed directly in the compost. The compost must be diluted with soil.

The total nitrogen content will provide an indication of the nutrient value of the compost. Food waste composts typically contain near or greater than 2% nitrogen, whereas yard waste composts are likely to contain 1 to 1.5% nitrogen.

Prepared by John Paul, PhD, PAg

Appendix A

# A & L CANADA LABORATORIES, INC.

2136 Jetstream Road · London, Ontario N5V 3P5 · Tel: 519/457-2575 Fax: 519/457-2664

**Website : www.alcanada.com** **e-mail: aginfo@alcanada.com**

## COMPOST SUBMISSION FORM

| | |
|---|---|
| **CLIENT NAME:** | |
| Address: | |
| | |
| Province: | Postal Code: |
| Phone: | Fax: |
| E-mail: | |
| Attention: | |
| P.O. # | |
| Composting Council of Canada Member: Yes ◉ No ○ | |
| Account # | CQA I.D. # |

*** IF REQUESTING CQA, PLEASE LIST THE COMPOST SOURCE MATERIALS OR FEED STOCK ***

food and yard waste compost

**SPECIAL INSTRUCTIONS AND/OR COMMENTS:**

| | *Client Sample Identification* | *Collection Date/Time* | *Sample Matrix* | *Selected Analysis* CQA | Basic Monitoring Analysis Plus | Environmental Trace Elements | Soil Suitability Analysis (S8C) | Compost Nutrient Content (CFIA) | Manure Compost (MC) | Other | *Lab Number* |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Creston compost | *Date:* May 30, 2023<br>*Time:* 1:00 PM<br>*Initials:* JP | Finished Compost ✔<br>Immature Compost<br>Feedstock | ✔ | | | | | | | |
| 2 | | *Date:*<br>*Time:*<br>*Initials:* | Compost<br>Immature Compost<br>Feedstock | | | | | | | | |
| 3 | | *Date:*<br>*Time:*<br>*Initials:* | Compost<br>Immature Compost<br>Feedstock | | | | | | | | |
| 4 | | *Date:*<br>*Time:*<br>*Initials:* | Compost<br>Immature Compost<br>Feedstock | | | | | | | | |

**LAB ANALYSIS RESULTS BY:** **FAX** ☐ **COURIER*** ☐ **E-MAIL:** ✔ **REG. MAIL** ☐ * Client Cost

Analysis Authorized By:

Custody Relinquished By:

Date: May 30, 2023 Received By A & L: _____ Date: _____

**NO ANALYTICAL WORK WILL BEGIN WITHOUT SIGNED AUTHORIZATION**

*** PLEASE NOTE THAT THE CQA IS MEANT FOR FINISHED COMPOST ONLY ***

Please visit www.compost.org for more information

REPORT NO. [redacted]-70007

ACCOUNT NUMBER [redacted]

# A & L Canada Laboratories Inc.

2136 Jetstream Road, London, ON, N5V 3P5 Tel: (519) 457-2575 Fax: (519) 457-2664

TO: [redacted]

FOR [redacted]

Phone: [redacted]

Compost Analysis Proficiency Testing Program

## CERTIFICATE OF ANALYSIS



PROJECT NO:
PO# [redacted]
LAB NUMBER [redacted]
SAMPLE ID [redacted]

SAMPLE MATRIX: COMPOST
DATE SAMPLED: 2023-05-30
DATE RECEIVED: 2023-06-02
DATE REPORTED:
DATE PRINTED: 2023-06-12

| PARAMETER | RESULT | UNIT | DETECTION LIMIT | METHOD REFERENCE |
|---|---|---|---|---|
| Arsenic | 3.44 | ug/g | 1.00 | EPA 3050B/6010B(mod) * |
| Cadmium | 1.07 | ug/g | 1.00 | EPA 3050B/6010B(mod) * |
| Cobalt | 9.69 | ug/g | 1.00 | TMECC 4.06;EPA 3050/6010(mod)* |
| Chromium | 21.34 | ug/g | 1.00 | TMECC.04.06;EPA 3050/6010(mod* |
| Copper | 37.29 | ug/g | 1.00 | TMECC 4.06;EPA 3050/6010(mod)* |
| Mercury | BDL | ug/g | 0.10 | EPA 7471 * |
| Molybdenum | BDL | ug/g | 1.0 | TMECC.04.06;EPA 3050/6010(mod* |
| Nickel | 15.24 | ug/g | 1.00 | TMECC 4.06;EPA 3050/6010(mod)* |
| Lead | 5.75 | ug/g | 1.00 | EPA 3050B/6010B(mod) * |
| Selenium | BDL | ug/g | 1.00 | EPA 3050/6010 (mod) * |
| Zinc | 70.65 | ug/g | 1.00 | TMECC 4.06;EPA 3050/6010(mod)* |

**Comment:**

Results reported on a dry weight basis
* - accredited test
BDL - Below detectable levels

**The results of this report relate to the sample submitted and analyzed. All results are released based on acceptable QC data.**

[redacted]

**Results Authorized By:**

**Haifeng Song, Ph.D., C.Chem. Lab Director**

A&L Canada Laboratories Inc. is accredited by the Standards Council of Canada for specific tests as listed on www.scc.ca and by the Canadian Association for Laboratory Accreditation as listed on www.cala.ca
Additional information available upon request

REPORT NO. [redacted]-70007

ACCOUNT NUMBER [redacted]

# A & L Canada Laboratories Inc.

2136 Jetstream Road, London, ON, N5V 3P5 Tel: (519) 457-2575 Fax: (519) 457-2664

TO: [redacted]

FOR [redacted]

Phone: [redacted]

Compost Analysis Proficiency Testing Program

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PO# [redacted]
LAB NUMBER [redacted]
SAMPLE ID [redacted]

SAMPLE MATRIX: COMPOST
DATE SAMPLED: 2023-05-30
DATE RECEIVED: 2023-06-02
DATE REPORTED:
DATE PRINTED: 2023-06-12

| PARAMETER | RESULT | UNIT | DETECTION LIMIT | METHOD REFERENCE |
|---|---|---|---|---|
| E. coli | >1000 | MPN/g dry | 3 | TMECC 07.01 |
| Salmonella spp. | NEGATIVE | P-A/25.0g(ml) | 1 CFU | MFLP-75 * |
| Fecal Coliform | >1000 | MPN/g dry | 3 | TMECC 07.01 |
| Total sharps > 2.8 mm* | BDL | pieces/500ml | | TMECC 03.08 |
| Total sharps > 12.5 mm | BDL | pieces/500ml | | TMECC 03.08 |
| Total FM > 2.8 mm* | 0.05 | % | 0.01 | TMECC 03.08 |
| Total FM > 25 mm | BDL | pieces/500ml | | TMECC 03.08 |
| Total plastics > 2.8 mm* | 0.05 | % | 0.01 | TMECC 03.08 |
| Total Organic Matter @ 550 deg C | 33.27 | % | 0.10 | LOI@550C |
| Moisture | 52.85 | % | 0.10 | TMECC.03.09-A |
| Conductivity (@25 deg C 1:5) | 0.03 | ms/cm | 0.02 | TMECC.04.10 |
| Sieve 2 Inch (% Passing) | 100.00 | % | 0.10 | ASTMD422 |
| Sieve 1 Inch (% Passing) | 100.00 | % | 0.10 | ASTMD422 |
| Sieve 1/2 Inch (% Passing) | 100.00 | % | 0.10 | ASTMD422 |
| Sieve 3/8 Inch (% Passing) | 96.00 | % | 0.01 | ASTMD422 |
| Sieve 1/4 Inch (% Passing) | 82.20 | % | 0.10 | ASTMD422 |
| Compost Stability Index | 8 | --- | | TMECC.05.08-B |
| Respiration-mgCO2-C/g OM/day | BDL | mgCO2-C/gOM/day | 0.01 | TMECC.05.08-B |
| Respiration - mgCO2-C/g TS/day | BDL | mgCO2-C/gTS/day | 0.01 | TMECC.05.08-B |

**Comment:**

Maturity Index: 8 - Inactive, highly matured compost, very well aged, possibly over-aged, like soil; no limitations for usage.

Results reported on a dry weight basis
* - accredited test
BDL - Below detectable levels

**The results of this report relate to the sample submitted and analyzed. All results are released based on acceptable QC data.**

[redacted]

**Results Authorized By:**

**Haifeng Song, Ph.D., C.Chem. Lab Director**

REPORT NO.
[redacted]-70007

ACCOUNT NUMBER
[redacted]

# A & L Canada Laboratories Inc.

2136 Jetstream Road, London, ON, N5V 3P5 Tel: (519) 457-2575 Fax: (519) 457-2664

TO: [redacted]

FOR [redacted]

Phone: [redacted]

Compost Analysis Proficiency Testing Program

## CERTIFICATE OF ANALYSIS



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PO# [redacted]
LAB NUMBER [redacted]
SAMPLE ID [redacted]

SAMPLE MATRIX: COMPOST
DATE SAMPLED: 2023-05-30
DATE RECEIVED: 2023-06-02
DATE REPORTED:
DATE PRINTED: 2023-06-12

| PARAMETER | RESULT | UNIT | DETECTION LIMIT | METHOD REFERENCE |
|---|---|---|---|---|

1.FM(Foreign matter) = glass,metal,plastic
2.Sharps = foreign matter pieces of a size or shape that can cause human or animal injury
3.8 mesh screen = 2.36mm
4.*2.8mm screen is used since 3.0mm screen does not exist

Results reported on a dry weight basis
* - accredited test
BDL - Below detectable levels

**The results of this report relate to the sample submitted and analyzed. All results are released based on acceptable QC data.**

[redacted]

**Results Authorized By:**

**Haifeng Song, Ph.D., C.Chem. Lab Director**

Report Number: [redacted]
Account Number: [redacted]

# A & L Canada Laboratories Inc.

2136 Jetstream Road, London, Ontario, N5V 3P5
Telephone: (519) 457-2575 Fax: (519) 457-2664

[redacted]

To: [redacted]

For: [redacted]

P.O. Number: [redacted]

Reported Date:
Printed Date: Jun 12, 2023

## COMPOST REPORT



| Sample Number | Lab Number | pH | Lime Index | Available Organic Matter % | Phosphorus P ppm | Potassium K ppm | Magnesium Mg ppm | Calcium Ca ppm |
|---|---|---|---|---|---|---|---|---|
| [redacted] | | **6.8** | **6.6** | **27.2** | **260** | **975** | **708** | **5479** |

| Sulfur S ppm | Zinc Zn ppm | Manganese Mn ppm | Iron Fe ppm | Copper Cu ppm | Boron B ppm | Sodium Na ppm | Nitrate-N NO3-N ppm | Soluble Salt ms/cm | Nitrogen (Total) (%) | Chloride ppm |
|---|---|---|---|---|---|---|---|---|---|---|
| **13** | **22.3** | **46** | **269** | **2.8** | **2.1** | **296** | **28** | **0.3** | **1.18** | **50** |

### INTERPRETATION

| CEC | | Percent Base Saturation | | | | Proportional Equivalents (meq) | | | | Cation Ratio | | C/N Ratio |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| meq/100g | % BS | % K | % Mg | % Ca | % Na | K | Mg | Ca | Na | Mg/K | Ca/Mg | |
| **37.0** | **100.0** | **6.76** | **15.73** | **74.03** | **3.48** | **2.50** | **5.82** | **27.39** | **1.29** | **2:1** | **5:1** | **15:1** |
| Optimum Range: | | 3 - 5 | 8 - 20 | 60 - 80 | | 0.5 - 1.3 | | | | 7:1 | 5:1 | |

CQA

* Results reported on a dry weight basis.
**The results of this report relate to the sample submitted and analyzed. All results are released based on acceptable QC data.**
* Crop yield is influenced by a number of factors in addition to soil fertility.
**No guarantee or warranty concerning crop performance is made by A & L.**

**Results Authorized By:** BWood **Beth Wood, Agronomist**

# A & L Canada Laboratories Inc.

2136 Jetstream Rd, London, Ontario, N5V 3P5

Telephone: (519) 457-2575 Fax: (519) 457-2664


**REPORT NUMBER:** C[redacted]

**ACCOUNT NUMBER:** 0[redacted]

# REPORT OF ANALYSIS

**TO:** [redacted]

CANADA

**RE:** [redacted]

**DATE RECEIVED:** 2023-06-02

**DATE REPORTED:** 2023-06-12



**P.O. NUMBER:** TCP 2023-2

| LAB NO. | SAMPLE ID | ANALYSIS | RESULT | UNIT | METHOD |
|---|---|---|---|---|---|
| 34366 | [redacted] | Nitrogen (Total) | 1.2 | % | TMECC.04.02-D |

[redacted]

**Results Authorized By:** BWood

## Central Post-Closure Landfill and HB Dam Sampling Schedule

| EMS Number | Well Depth (m BTOR) | Ground Water | Surface Water | Field Designation | Unit | Purpose | April or May | October or November | Comment |
|---|---|---|---|---|---|---|---|---|---|
| **Source Concentration** | | | | | | | | | |
| E252598 | 12.1 | 1 | | LW-02A-01 | R/OB | Leachate characterization | 1 | | |
| E252599 | 9.72 | 1 | | LW-03-01 | OB | Leachate characterization | 1 | | |
| E252594 | 4.03 | 1 | | MW-06-01 | OB | Upgradient tailings water quality | 1 | | |
| **Background** | | | | | | | | | |
| --- | | | | MW-01A-01 | OB | Background | dry | | |
| E221702 | 5.07 | 1 | | E221702/S-MW-1 | OB/BR | Background | 1 | | |
| E252591 | 9 | 1 | | MW-02A-01 | OB | Background | 1 | | |
| E252592 | 15.84 | 1 | | MW-03A-01 | OB | Background | 1 | | |
| E252595 | 6.11 | 1 | | MW-07-01 | OB | Background | 1 | | |
| **Northern CAZ Performance** | | | | | | | | | |
| E240505 | 20.72 | 1 | | MW-99-7D | OB | Northern boundary | 1 | | |
| --- | | | | MW-99-7S | OB | Northern boundary | | | |
| E252601 | 13.7 | 1 | | MW-09-02S | OB | Northern boundary | 1 | | |
| E252600 | 26 | 1 | | MW-09-02D | OB | Northern boundary | 1 | | |
| 200583 | 16.6 | 1 | | 0200583/81-1 | OB | Northern boundary | 1 | | |
| 200584 | 6.3 | 1 | | 0200584/81-3 | OB | Northern boundary | 1 | | |
| 200585 | 11.02 | 1 | | 0200585/81-4 | OB | Northern boundary | 1 | | |
| 200611 | 12.56 | 1 | | 200611 | OB | Northern boundary | 1 | | |
| E242832 | | | 1 | Seep A | Seep | Discharge to Sheep Creek | 1 | 1 | |
| E242833 | | | 1 | Seep E | Seep | Discharge to Sheep Creek | 1 | 1 | |
| E242835 | | | 1 | Seep G | Seep | Discharge to Sheep Creek | 1 | | |
| E242836 | | | 1 | Seep I | Seep | Discharge to Sheep Creek | 1 | | |
| E242837 | | | 1 | SW-C | Creek | Sheep Creek upstream of seeps | 1 | | |
| E242838 | | | 1 | SW-B | Creek | Sheep Creek mixing zone of seeps | 1 | | |
| E242839 | | | 1 | SW-A | Creek | Sheep Creek downstream of seeps | 1 | | |
| **Southern CAZ Performance (Overburden)** | | | | | | | | | |
| E207637 | 7.88 | 1 | | E207637 | OB | Western buffer | 1 | | |
| E221703 | 10.19 | 1 | | E221703/S-MW-2 | OB | Western buffer | 1 | | |
| E275564 | 9.93 | 1 | | MW99-3S | OB | Western buffer | 1 | | |
| E254762 | 18.27 | 1 | | MW99-6S | OB | Western buffer | 1 | | |
| E240506 | 6.81 | 1 | | MW99-8 | OB | Western buffer | 1 | | |
| E254755 | 5.08 | 1 | | MW-02S-03 | OB | Tailings deposition area | 1 | | |
| E254756 | 12.58 | 1 | | MW-02D-03 | OB | Tailings deposition area | 1 | | |
| E254758 | 15.96 | | | MW-01B-03 | OB | Tailings deposition area | | | |
| E254759 | 11.38 | 1 | | MW-01C-03 | OB | Tailings deposition area | 1 | | |
| E254760 | 16.08 | 1 | | MW-03S-03 | OB | Tailings deposition area | 1 | | |
| E254761 | 36.13 | | | MW-03D-03 | OB | Tailings deposition area | | | |
| E266344 | 14.61 | | | MW-01-05 | OB | Tailings deposition area | damaged | | |
| E266346 | 15.14 | 1 | | MW-02-05 | OB | Tailings deposition area | 1 | | |
| E266348 | 12.86 | 1 | | MW-03S-05 | OB | Tailings deposition area | 1 | | |
| E266349 | 18.01 | 1 | | MW-04S-05 | OB | Tailings deposition area | 1 | | |
| E266350 | 15.38 | 1 | | MW-05-05 | OB | Tailings deposition area | 1 | | |
| **Southern CAZ Performance (Bedrock)** | | | | | | | | | |
| E240503 | 14.61 | 1 | | MW99-3D | BR | Western buffer | 1 | | |
| E254757 | 23.5 | 1 | | MW-01A-03 | BR | Tailings deposition area | 1 | | |
| **Residential** | | | | | | | | | |
| E242840 | | 1 | | 1780 Airport Rd. | | Residential water well | 1 | | |
| E252604 | | 1 | | 111 Emerald Rd. | | Residential water well | 1 | | |
| E252605 | | 1 | | 110 Emerald Rd. | | Residential water well | 1 | | |
| --- | | | | 1785 Airport Rd. | | Residential water well | | | |

## Central Post-Closure Landfill and HB Dam Sampling Schedule

| EMS Number | | Ground Water | Surface Water | Field Designation | Unit | Purpose | April or May | October or Novembe | Comment |
|---|---|---|---|---|---|---|---|---|---|
| **HB Mines Southern CAZ** | | | | | | | | | |
| E275563 | 17.15 | 1 | | MW99-1(S) | OB | Downgradient along Southern Flowpath | 1 | | |
| E240501 | 29.71 | 1 | | MW99-1(D) | BR | Downgradient along Southern Flowpath | 1 | | |
| E275543 | 4.32 | 1 | | MW99-2(S) | BR | West Side of Tailing | 1 | | |
| E240502 | 24 | 1 | | MW99-2(D) | BR - Artesian | West Side of Tailing | 1 | | |
| E252593 | 4.71 | 1 | | MW-05-01 | OB | Background east of Tailings Pond | 1 | | Sample in spring every other year |
| --- | 5.99 | 1 | | MW-01-2004(S) | OB | Downgradient along Southern Flowpath | 1 | | |
| --- | 16 | 1 | | MW-01-2004(D) | BR | Downgradient along Southern Flowpath | 1 | | |
| --- | 10.55 | 1 | | MW-02-2004(S) | OB | Downgradient along Southern Flowpath | 1 | | |
| --- | 53.6 | 1 | | MW-02-2004(D) | BR | Downgradient along Southern Flowpath | 1 | | |
| E242841 | | 1 | | Ross Residence | | due diligence | 1 | | |
| **HB Mines Surface Water** | | | | | | | Spring | Fall | |
| --- | | | 1 | SW1-07 | Surface Water | | 1 | 1 | |
| --- | | | 1 | SW2-07 | Surface Water | | 1 | 1 | |
| --- | | | 1 | SW3-07 | Surface Water | | 1 | 1 | |
| --- | | | 1 | SW4-07 | Surface Water | | 1 | 1 | |
| E252602 | | | 1 | Tailings Pond Outlet | Surface Water | | 1 | 1 | |
| E252603 | | | 1 | Outlet Ditch | Surface Water | | 1 | 1 | |

| **Summary of Analytical Program** | **Spring** | **Fall** |
|---|---|---|
| Total Number of Locations Sampled | 55 | 8 |
| Duplicates (specified at 1 duplicate for every 10 samples) | 5 | 1 |
| Total Number of Analyses per Year | 60 | 9 |

**Duplicates** **Specified at 1 duplicate for every 10 samples.**

**Central and HB Summary of Specified Sampling Requirements**

| Parameters | | Surface Water | Ground Water | Comments |
|---|---|---|---|---|
| Field Measured | | | | |
| Temperature | | 1 | 1 | |
| Conductivity | | 1 | 1 | |
| Dissolved Oxygen | | 1 | 1 | |
| pH | | 1 | 1 | |
| Turbidity | | 1 | | Not necessary for groundwater. |
| Sulphide - Field Measured | | 1 | 1 | Field test is preferred for sulphide. |
| Lab Measured | | | | |
| Total Alkalinity | | 1 | 1 | Anions can be measured in a single |
| Chloride | | 1 | 1 | |
| Bromide | | 1 | 1 | |
| Sulphate | | 1 | 1 | |
| Hardness | | Calculated | Calculated | Calculated from calcium and magnesiu |
| TOC | | 1 | 1 | |
| TIC | | 1 | 1 | Compare values with Total Alkalinity |
| Total Metals - Standard | | 1 | | |
| Dissolved Metals - Standard | | | 1 | |
| Phosphate | | 1 | 1 | Total phosphate from metals analysis. |
| Ammonia | | 1 | 1 | |
| TKN | | 1 | 1 | Measures ammonia and organic nitrog |
| Nitrate | | 1 | 1 | From anion chromatography. |
| Nitrite | | 1 | 1 | |
| | | | | Anion chromatography package |
| | | | | From Metals Package |

Note: Water depth is measured and recorded at each well during each Site's sampling events.

# Regional District of Central Kootenay
# Creston Composting Facility
# Operational Environmental Monitoring Plan

PRESENTED TO

**Regional District of Central Kootenay**

JANUARY 29, 2024
ISSUED FOR USE
FILE: 704-SWM.SWOP04285-01

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# TABLE OF CONTENTS



# APPENDIX SECTIONS

## FIGURES



## APPENDICES

# ACRONYMS & ABBREVIATIONS

| Acronyms/Abbreviations | Definition |
|---|---|
| BC | British Columbia |
| COC | Chain-of-Custody |
| DO | Dissolved Oxygen |
| EMP | Environmental Monitoring Plan |
| GW | Groundwater |
| MOECC | Ministry of Environment and Climate Change |
| PAH | Polycyclic Aromatic Hydrocarbon |
| RDCK | Regional District of Central Kootenay |
| SW | Surface Water |
| VOC | Volatile Organic Compounds |

## LIMITATIONS OF REPORT

This report and its contents are intended for the sole use of the Regional District of Central Kootenay and their agents. Tetra Tech Canada Inc. (Tetra Tech) does not accept any responsibility for the accuracy of any of the data, the analysis, or the recommendations contained or referenced in the report when the report is used or relied upon by any Party other than the Regional District of Central Kootenay, or for any Project other than the proposed development at the subject site. Any such unauthorized use of this report is at the sole risk of the user. Use of this document is subject to the Limitations on the Use of this Document attached in the Appendix or Contractual Terms and Conditions executed by both parties.

# 1.0 INTRODUCTION

Tetra Tech Canada Inc. (Tetra Tech) was retained by the Regional District of Central Kootenay (RDCK) to develop an Operational Environmental Monitoring Plan (EMP) for the Creston Composting Facility (herein referred to as the "Facility"), adjacent to the Creston Landfill (the Site). The Site is located at 1501 Mallory Road in Creston, British Columbia (BC).

## 1.1 Purpose

The purpose of the EMP is to develop and implement an environmental monitoring program for the Facility, to evaluate the potential for surface water and groundwater impacts derived from Facility operations and interpret analytical results in accordance with applicable standards and guidelines.

# 2.0 SETTING

The following section presents a summary of the site setting.

## 2.1 Site Description and History

The site is located approximately 4 km south of the Town of Creston, approximately 100 m east of Highway 21. The site is bounded to the west by the Lower Kootenay Band Reserve, to the north and east by provincial crown land, and to the south by the RDCK owned property. The entrance to the site is from Mallory Rd. from the east. The site has been operational as a landfill since 1972 (Conestoga-Rovers and Associates 2005) with a small recycling transfer station. According to the RDCK, the Site is intended to be operational until 2050.

The open-air windrow composting facility, constructed in 2021, is located approximately 300 m northeast of the active landfill, adjacent to the site entrance. The Facility has been operational since Spring 2022. From discussions with the site operator, this area of the site was previously used as farmland and has had no landfilling activities. The Site and location of the Facility area are identified on Figure 1. A detailed facility layout is presented on Figure 2.

## 2.2 General Geology and Hydrology

General geology and hydrology information has been compiled from Conestoga-Rovers and Associates (CRA) Report *Geotechnical Investigation and Slope Stability Assessment – Creston Landfill (2005),* and RDCK's *2018 Annual Operations and Monitoring Report – Creston Landfill (2019).*

In general, the soil found on the Site ranges from silt to clayey silt, which extends down to the bedrock. The depth to the bedrock from the ground surface varies significantly across the Site, from 14.5 m (eastern edge of the site) to 3.4 m (western edge of the site). This is due to the presence of a slope towards the Kootenay River to the west (CRA 2005). Groundwater depths typically range from 0.34 m (western edge of the site) to 17.38 m (eastern edge of the site), characterizing the general groundwater flow from east to west. Seasonally, the groundwater rises to the ground surface along the western edge of the Site, resulting in seepage (RDCK 2019).

The Lower Kootenay River flood plains are the major surface water feature in the vicinity, located approximately 1 km west of the site (CRA 2005). Further, Whiskey Creek resides approximately 350 m west of the Facility, which flows to the southwest towards the Kootenay River. In general, surface water at the Site is directed to the northwest,

discharging into an unnamed stream (locally named China Cup Creek), which discharges directly into Whiskey Creek. This is defined as the “Unnamed Watercourse” on Figure 1.

There are two small ephemeral streams located directly west of the Facility (denoted on Figure 1), which are dry for most of the year. It is recommended that the RDCK assess these locations during the winter months to determine whether there is enough water to sample. If so, it is recommended that they are incorporated into this EMP.

## 2.3 Potential Receptors

The following section presents a summary of identified receptors located within 1 km of the Site. The primary water receptors that are proximal to the site are China Cup Creek (labeled as “Unnamed Watercourse” on Figure 1), Whiskey Creek, Kootenay River, and the Kootenay River Wetlands. The nearest dwelling or building structure is located approximately 400 m north of the Site. The nearest registered private domestic drinking water well is located approximately 550 m southeast (up-gradient) of the Site.

It should be noted that there are domestic surface water licences in the area, including the Kutenai Band’s potable water supply. However, all surface water and potable groundwater licenses are noted to be up-gradient and/or west of the landfill. Thus, they are not considered receptors based on the known groundwater conditions of the Site (RDCK 2019).

# 3.0 EXISTING MONITORING PROGRAM

The RDCK undertakes a monitoring program for the Site in accordance with the requirements of Operational Certificate MR-16513 and in general accordance with the British Columbia Landfill Criteria for Municipal Solid Waste (MOECC 2016). This section provides a summary of that program and recent results.

## 3.1 Groundwater

The groundwater flow direction at the Site runs from east to west. The Facility location is at the eastern edge of the property, interpreted to be hydraulically up-gradient of any potential leachate impacted groundwater relating to the landfill. The groundwater depth decreases from east to west. At MW25, the nearest groundwater sampling well to the Facility location (Figure 1), the groundwater exceeds 24 m depth (RDCK 2019). There are seasonal seepages that occur on the western edge of the Site property, which are sampled at SW-4 and SW-5.

The current groundwater monitoring program consists of 14 wells which are sampled on a quarterly basis, as required in the BC Ministry of Environment and Climate Change (MOECC) Environmental Monitoring Program. This includes one background well, eight hydraulically down-gradient wells, and five wells located west of the landfill. Samples are analyzed for general chemistry parameters, nutrients, and dissolved metals. Volatile Organic Compounds (VOC) and Polycyclic Aromatic Hydrocarbons (PAH) are also analyzed on an annual basis (RDCK 2019).

In 2004, the RDCK had installed an additional six groundwater monitoring wells (04-MW-10 through 04-MW-15) north of the landfill to assess the potential for landfill expansion. While these wells are not included in the Site’s current EMP, they are situated in the vicinity of the constructed Facility. In 2021, the RDCK set out to re-develop these wells and determine their suitability for use. The majority of these groundwater wells could be used for analysis of groundwater near the Facility with the exception of 04-MW-13 and 04-MW-15 (as seen on Figure 1).

Historical groundwater results at the Site indicate that the wells directly down-gradient from the landfill are the most effected by leachate with a decrease in leachate impact with distance. This observation was consistent across traditional leachate indicators, including, chloride, sulphate, ammonia, nitrate, dissolved iron, and dissolved manganese. Across the 2018 monitoring events, the conductivity of groundwater from wells more proximal to the landfill ranged from 612 µs/cm to 2190 µs/cm, with further down-gradient wells showing an overall lower conductivity. This trend was also observed for chloride (RDCK 2019). In general, the landfill leachate plume does not appear to be growing, though some temporal groundwater contamination trends may be forming in areas away from the landfill (RDCK 2019). For example, the furthest groundwater well from the landfill has elevated sulphate concentrations in its groundwater, indicating the possible influence of chemical fertilizer application for agricultural purposes (Sperling Hansen Associates 2015), underlying peat soils, or road salt from the nearby highway (RDCK 2019).

## 3.2 Surface Water

There are currently nine surface water monitoring locations at the Site, including two background locations and seven down-gradient locations as outlined on Figure 1. Surface water monitoring occurs quarterly for all nine locations, which are typically analyzed for general chemistry parameters, nutrients, and total metals.

As previously mentioned, two of the surface water locations (SW-4 and SW-5) capture seasonal groundwater seepage at the western edge of the landfill footprint. These locations are sampleable during the spring monitoring event but are typically dry during the other three quarterly events. All other surface water locations are sampleable year-round. The background surface water locations are SW-3, which is an up-gradient location from the unnamed creek east of the site and SW-7 which is along the Kootenay River up-gradient of the landfill. Surface water locations SW-3, SW-4 and SW-5 are sampleable during the spring monitoring event but are typically dry during the other three quarterly events. Down-gradient Whiskey Creek is analyzed at SW-6. The remaining surface water locations (SW-1, SW-2, and SW-8) are on the Kootenay River and cross-gradient of the Site and down-gradient of Whiskey Creek.

2018 results indicate that landfill leachate may be impacting all surface water locations hydraulically down-gradient from the landfill. Some observed characteristics include elevated conductivity chloride, sulphate, ammonia, and nitrate. Other potential impacts that may be affecting the surface water include chemical fertilizer application and highway runoff (RDCK 2019).

# 4.0 PROPOSED MONITORING PLAN

This section outlines the proposed additions to the existing monitoring program for the Site. It is recommended that these proposed additions are undertaken concurrent to the existing EMP, which is required under the Site's operating certificate. The MOECC does not specify specific guidance for an EMP, contrary to the strict requirements of landfills in BC. However, this EMP has been developed to align with the existing landfill EMP to closely monitor any potential impacts to the environment stemming from the Facility. The proposed additions to the EMP should be reviewed annually to confirm that the locations, parameters, and frequency are meeting the program objectives, and make adjustments if necessary.

In addition to the proposed additions, the RDCK should pay increased attention to the existing groundwater and surface water monitoring locations proximal to the Facility, such as SW-6 and the Whiskey Creek Sampling Location (seen on Figure 1). Future environmental monitoring data can be compared to historical data to pinpoint whether the Facility is having any impacts on groundwater in the area.

## 4.1 Groundwater

### 4.1.1 Monitoring Locations and Frequency

The RDCK shall utilize the historical groundwater monitoring infrastructure introduced in Section 3.1 to monitor potential impacts from the Facility. With the exception of 04-MW-13 and 04-MW-15, the unused groundwater monitoring wells shall provide insight into the up-gradient and down-gradient groundwater conditions of the Facility without the need to drill new wells. The monitoring wells shall be used to determine the groundwater quality and quantity with respect to the criteria, and to ensure that the environmental control systems put in place area working effectively. The following table presents the proposed groundwater monitoring locations to be added to the existing EMP. It is suggested that the additional groundwater monitoring locations are sampled at the same frequency (quarterly) as the current landfill monitoring program.

**Table 4-1: Groundwater Monitoring Locations**

| Monitoring Station Identification | Location | Purpose |
|---|---|---|
| 04-MW-10 | Approximately 70 m west of the Facility | Down-Gradient |
| 04-MW-11 | Approximately 30 m east of the Facility | Up-Gradient (Background) |
| 04-MW-12 | Approximately 150 m north of the Facility | Down-Gradient |
| 04-MW-13[1] | Approximately 340 m northwest of the Facility | Down-Gradient Hydraulic Monitoring |
| 04-MW-14 | Approximately 340 m west of the Facility | Down-Gradient |

[1] It is Tetra Tech's understanding that 04-MW-13 was located during the September Monitoring Event, but was found with no casing or cap and is unsuitable for environmental monitoring. Tetra Tech would recommend assessing to determine if the well remains intact below surface and replace the surface casing if the well is useable. This would provide another point for monitoring the groundwater level at relatively low cost.

It is recommended that the environmental monitoring program include hydraulic measurements of groundwater elevation at all monitoring wells. This would require a topographic survey to be completed to establish vertical and horizontal control for all monitoring wells (ground surface and top of casing). Measurements will occur in conjunction with the groundwater sampling program.

### 4.1.2 Parameters

The following list of analytes proposed for monitoring is based upon the "*Guidelines for Environmental Monitoring at Municipal Solid Waste Landfills*" (MOECC 1996) and "*The BC Approved and Working Water Quality Guidelines*" (MOECC 2020).

#### 4.1.2.1 Field Measurements

Field measurements shall be measured with a suitable portable multi-parameter water quality measurement instrument. Field measured water quality parameters to be recorded at the time of groundwater sampling shall include the following:

- Temperature
- pH
- Conductivity
- Dissolved Oxygen (DO)

#### 4.1.2.2 Laboratory Analysis

***General Chemistry***

Laboratory analysis for general chemistry parameters shall include the following:

- Alkalinity
- Ammonia
- Chloride
- Sulphate
- Fluoride
- Nitrate
- Nitrite
- Total Kjeldahl Nitrogen

***Metals (Dissolved)***

Laboratory analysis for dissolved metal parameters shall include the following:

- Aluminum;
- Antimony;
- Arsenic;
- Barium;
- Beryllium;
- Bismuth;
- Boron;
- Cadmium
- Calcium
- Cesium
- Chromium;
- Cobalt;
- Copper;
- Iron;
- Lead;
- Lithium;
- Magnesium;
- Manganese;
- Molybdenum;
- Nickel
- Phosphorus
- Potassium
- Rubidium
- Selenium
- Silicon
- Silver
- Sodium
- Strontium
- Sulfur
- Tellurium
- Thallium
- Thorium
- Tin
- Titanium
- Tungsten
- Uranium
- Vanadium
- Zinc
- Zirconium

### 4.1.3 Sampling Protocol

To ensure the integrity of samples collected while sampling groundwater from the monitoring wells, the following protocols should be applied:

- Record the static water level of each monitoring well.
- Purge the appropriate volume of water from the monitoring well and record the water level on completion. The purpose of purging is to remove the groundwater from the well until a representative sample of the formation groundwater is obtained. In general, purging is considered complete once sediment-free groundwater is obtained and the specific criteria (conductance, temperature, and pH) of the groundwater stabilizes.
- Collect groundwater samples in the appropriate laboratory-supplied sample containers and preserve as required. Groundwater samples designated for metals analysis should be field filtered, appropriately preserved, packed in a cooler, stored at a temperature of approximately 4°C, and delivered to the laboratory for analysis.
- Ensure that preservatives (as required) are added to the samples after collection to ensure proper sample preservation.
- Field measurements should always be collected using a separate sub-sample that is discarded once the measurements are complete. Field measurements should never be collected using a water sample that is to be submitted for laboratory analyses.
- Samples shall be packed on ice and submitted under a chain-of-custody (COC) to an accredited analytical laboratory certified for environmental analysis by the MOECC.

## 4.2 Surface Water

### 4.2.1 Monitoring Locations and Frequency

It is recommended to add one additional up-gradient (background) surface water location at the Site, as indicated on Figure 1. Down-gradient surface water is already sampled as part of the existing monitoring program (SW-6, Whiskey Creek). The following table presents the proposed surface water monitoring location. It is suggested that the additional surface water monitoring location is sampled at the same frequency (quarterly) as the existing landfill monitoring program.

**Table 4-2: New Surface Water Monitoring Location**

| Monitoring Station Identification | Location | Purpose |
|---|---|---|
| 22-SW-9 | Approx. 120 m northeast of the Facility | Up-Gradient (Background) |

### 4.2.2 Parameters

The following list of analytes proposed for monitoring is based upon the "*Guidelines for Environmental Monitoring at Municipal Solid Waste Landfills*" (MOECC 1996) and "*The BC Approved and Working Water Quality Guidelines*" (MOECC 2017).

#### 4.2.2.1 Field Measurements

Field measurements shall be measured with a suitable portable multi-parameter water quality measurement instrument. Field measured water quality parameters to be recorded at the time of surface water sampling shall include the following:

- Temperature
- pH
- Conductivity
- Dissolved Oxygen (DO)
- Flow Conditions (including the approximate depth of stream, flow velocity, apparent turbidity)

#### 4.2.2.2 Laboratory Analysis

***General Chemistry***

Laboratory analysis for general chemistry parameters shall include the following:

- Alkalinity
- Ammonia
- Chloride
- Sulphate
- Fluoride
- Nitrate
- Nitrite
- Total Kjeldahl Nitrogen

***Metals (Total)***

Laboratory analysis for total metal parameters shall include the following:

- Aluminum;
- Antimony;
- Arsenic;
- Barium;
- Beryllium;
- Bismuth;
- Boron;
- Cadmium
- Calcium
- Cesium
- Chromium;
- Cobalt;
- Copper;
- Iron;
- Lead;
- Lithium;
- Magnesium;
- Manganese;
- Molybdenum;
- Nickel
- Phosphorus
- Potassium
- Rubidium
- Selenium
- Silicon
- Silver
- Sodium
- Strontium
- Sulfur
- Tellurium
- Thallium
- Thorium
- Tin
- Titanium
- Tungsten
- Uranium
- Vanadium
- Zinc
- Zirconium

### 4.2.3 Sampling Protocol

The following protocol for sampling shall be used to collect surface water samples:

- Secure yourself to a solid object on shore (with a safety harness and line, if necessary). If possible/necessary, a second person must by nearby as the first person collects samples.
- Remove lid from a labelled bottle and place into a clean resealable bag so both hands can be used to take sample. If rinsing is required for the type of bottle, rinse three times.
- Hold the bottle well below the neck or secure it to a pole sampler.
- Reach out (arm length only) and plunge the bottle under the water with the opening fading directly down and immediately orient it into the current. Completely submerge the sample container to avoid collection of any floating debris (approximately 0.15 m below the surface of the water, away from the edges of the surface waterbody).
- When the bottle is full, pull it up through the water while forcing into the current.
- Immediately recap the bottle.
- Ensure that preservations (as required) are added to the samples after collection to ensure proper sample preservation.
- Field measurements should always be collected using a separate sub-sample that is discarded once the measurements are complete. Field measurements should never be collected using a water sample that is to be submitted for laboratory analyses.
- Once collected, the samples will then be stored in coolers with ice and transported to an appropriate Canadian Association for Laboratory Accreditation (CALA) affiliated laboratory, for laboratory analyses, for laboratory analyses with COC documentation. An additional duplicate sample shall be collected during each event for quality assurance/quality control (QA/QC) purposes.

## 4.3 Field Equipment

The following section presents a summary of the specifications for field equipment to be used to record field analytical parameters. A “YSI meter” or equivalent is recommended, as it can collect all required field analytical parameters, listed below:

- **Temperature:** A calibrated electronic or alcohol-filled thermometer capable of producing results within ± 0.5°C of the true temperature.
- **pH:** A calibrated electronic pH or multi-parameter meter capable of recording to the nearest 0.1 pH unit.
- **Conductivity:** A calibrated electronic-specific conductance (electrical conductivity) meter or multi-parameter meter capable of recording to the nearest 1 microsiemens per centimeter (µS/cm).
- **Dissolved Oxygen:** A calibrated multi-parameter meter capable of recording to the nearest 1 milligram per liter.

Additionally, a water level meter is required for groundwater monitoring, capable of dipping wells up to 20 m depth.

## 4.4 Quality Assurance/Quality Control

A QA/QC program to assess the integrity of the sampling methodology and analytical testing should be implemented as part of the environmental monitoring program for the Site.

The QA/QC protocol will include the following:

- Recording the results of field activities in the field concurrently with the activities.
- Using clean, new sampling gloves at each sampling location.
- Placing samples into new and labelled laboratory-supplied containers, and when warranted, preserving the samples using laboratory-measured and supplied preservatives.
- Transporting temperature-sensitive samples to the analytical laboratory in chilled coolers using COC procedures either on the same day of sampling or within one day of sampling, and analyzing the samples within the appropriate holding times.
- When appropriate, forming duplicate samples using industry accepted splitting methods.
- Using CALA-affiliated laboratories that are qualified to analyze the samples using MOECC-approved procedures.
- Submitting duplicate samples to the laboratory as “blind” samples, meaning that they are not identified as duplicate samples. It is recommended that the RDCK obtains one duplicate sample for every 10 samples obtained.
- One field blank, using distilled water, should be obtained and tested at the laboratory. The results of the blank sample can be compared to field sample results to assess the degree of which sampling-induced errors may lead to inaccuracies in the data.
- Decontaminating sampling equipment between sample locations.
- Reviewing the results of QA/QC analyses, assessing the significance of the analytical results, and identifying this information in this report.

## 4.5 Reporting

The MOECC currently does not require the submission of annual EMP reports for composting facilities, as is the case for landfills. However, it is recommended that the RDCK collects and analyses Surface Water and Groundwater results in a way that mirrors the existing EMP should it be required by the MOECC in the future.

# 5.0 CLOSURE

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

Respectfully submitted,
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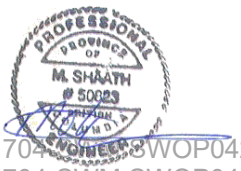




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PERMIT TO PRACTICE
TETRA TECH CANADA INC.
PERMIT NUMBER: 1001972

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# FIGURES

M:\ENVIRONMENTAL\SWM\SWOP04285-01\Maps\Feb2022\SWOP04285-01_FIG01_Creston_SitePlan.mxd modified 2022-02-11 by Brittney.Bietz


## LEGEND

- Site Entrance
- Monitoring Well
- Monitoring Well Requiring Repairs *
- Monitoring Well Not Located
- Surface Water
- Facility Location
- Surface Water Pond
- Metal and Wood Recycling Storage Area
- Approximate Landfill Footprint
- Wetland Area
- Watercourse
- Minor Ephemeral Stream

**NOTES**

*** Tetra Tech recommends repairing this well for hydraulic monitoring if possible**

Imagery: ESRI Maxar (2016)
Base data: Canvec (2019)

**STATUS**
ISSUED FOR REVIEW

# ORGANICS DIVERSION PROJECTS - COMPOSTING FACILITIES AND TS UPGRADES

## Creston Landfill Site Plan

| PROJECTION | DATUM | CLIENT |
|---|---|---|
| UTM Zone 11 | NAD83 | Regional District of Central Kootenay |

Scale: 1:4,000
80 40 0 80
Metres

TETRA TECH

**FILE NO.** SWOP04285-01_FIG01_Creston_SitePlan.mxd

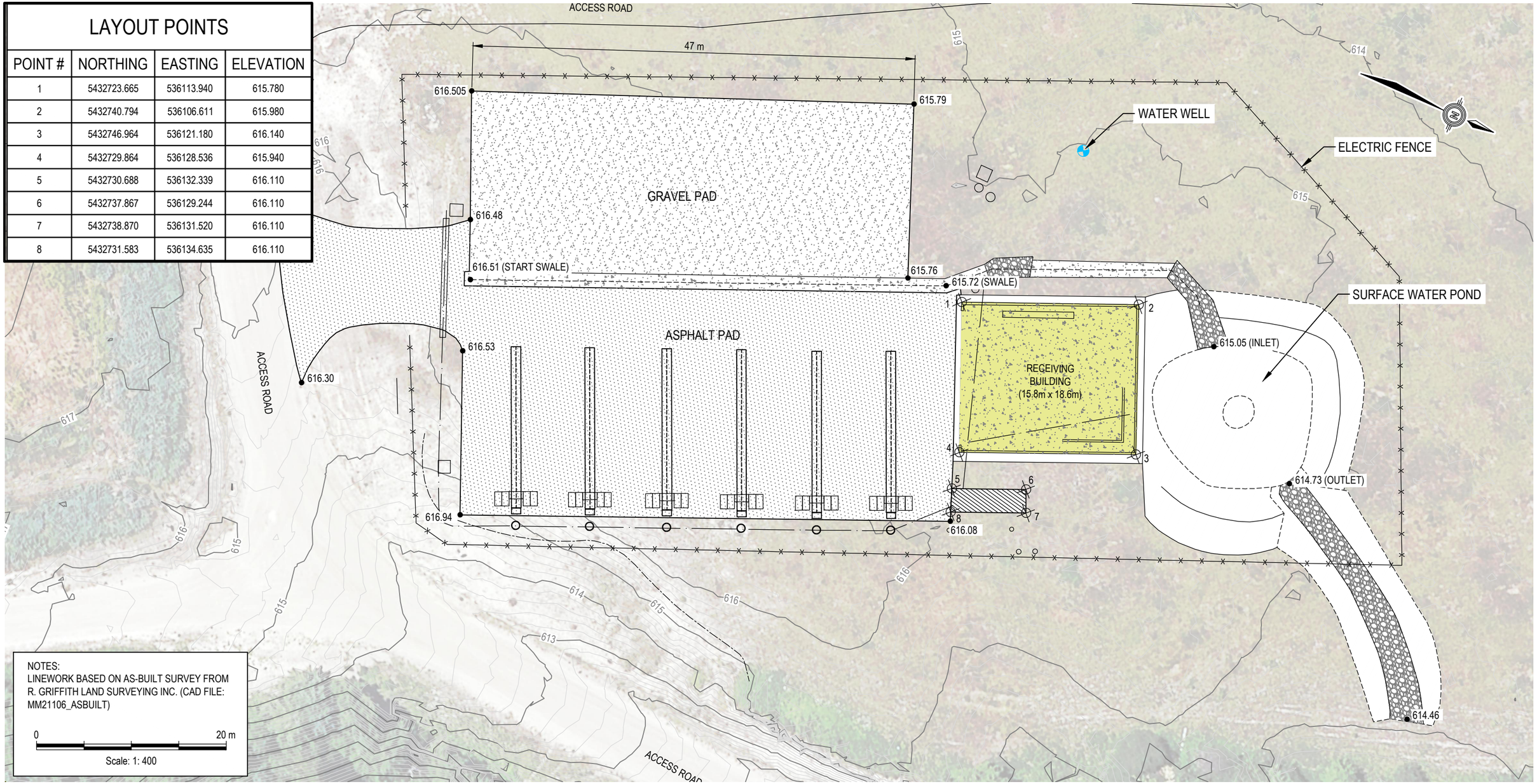
| OFFICE | DWN | CKD | APVD | REV |
|---|---|---|---|---|
| Tt-CAL | BB | SL | ZL | 0 |

| DATE | PROJECT NO. |
|---|---|
| February 11, 2022 | SWM.SWOP04285-01 |

**Figure 1**

## LAYOUT POINTS

| POINT # | NORTHING | EASTING | ELEVATION |
|---|---|---|---|
| 1 | 5432723.665 | 536113.940 | 615.780 |
| 2 | 5432740.794 | 536106.611 | 615.980 |
| 3 | 5432746.964 | 536121.180 | 616.140 |
| 4 | 5432729.864 | 536128.536 | 615.940 |
| 5 | 5432730.688 | 536132.339 | 616.110 |
| 6 | 5432737.867 | 536129.244 | 616.110 |
| 7 | 5432738.870 | 536131.520 | 616.110 |
| 8 | 5432731.583 | 536134.635 | 616.110 |




NOTES:
LINEWORK BASED ON AS-BUILT SURVEY FROM R. GRIFFITH LAND SURVEYING INC. (CAD FILE: MM21106_ASBUILT)

0 20 m

Scale: 1: 400

| NUM | DATE | APR | DESCRIPTION |
|---|---|---|---|
| | | | |
| | | | |
| 0 | JUNE 30/23 | MS | ISSUED FOR RECORD |
| **REVISIONS** | | | |
| E | JUN 2021 | MS | ISSUED FOR CONSTRUCTION |
| D | MAR 2021 | MS | ISSUED FOR TENDER |
| C | JAN 2021 | MS | ISSUED FOR REVIEW - 90% |
| B | DEC 2020 | MS | ISSUED FOR REVIEW - 60% |
| NUM | DATE | APR | DESCRIPTION |

**DRAWING STATUS**

FILE NO: SWM.SWOP04285-01
FILE NO: SWM.SWOP04285-01
FILE NO: SWM.SWOP04285-01

PROFESSIONAL SEAL

CLIENT

REGIONAL DISTRICT CENTRAL KOOTENAY

TETRA TECH

# RDCK ORGANICS DIVERSION PROJECT
# CRESTON COMPOST FACILITY, BRITISH COLUMBIA

## FACILITY LAYOUT PLAN

| PROJECT No. | OFFICE | DES | CKD | REV | DRAWING |
|---|---|---|---|---|---|
| SWM.SWOP04285-01 | EDM | - | JR | 0 | FIGURE 2 |
| DATE: June 30, 2023 | SHEET No. 3 of 8 | DWN - | APP MS | STATUS - | |

Q:\Edmonton\Drafting\00_MASTER PROJECT BASE PLANS\RDCK-BC Organics Diversion Project\04_Production\Creston\RECORD\SWM.SWOP04285-01_Creston_REC_R0.dwg [C102] June 22, 2023 - 4:13:14 pm (BY: GAMMIE, DON)

# APPENDIX A

## LIMITATIONS ON THE USE OF THIS DOCUMENT

# LIMITATIONS ON USE OF THIS DOCUMENT

## GEOENVIRONMENTAL

### 1.1 USE OF DOCUMENT AND OWNERSHIP

This document pertains to a specific site, a specific development, and a specific scope of work. The document may include plans, drawings, profiles and other supporting documents that collectively constitute the document (the "Professional Document").

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Both electronic file and/or hard copy versions of TETRA TECH's Instruments of Professional Service shall not, under any circumstances, be altered by any party except TETRA TECH. TETRA TECH's Instruments of Professional Service will be used only and exactly as submitted by TETRA TECH.

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If any error or omission is detected by the Client or an Authorized Party, the error or omission must be immediately brought to the attention of TETRA TECH.

### 1.4 DISCLOSURE OF INFORMATION BY CLIENT

The Client acknowledges that it has fully cooperated with TETRA TECH with respect to the provision of all available information on the past, present, and proposed conditions on the site, including historical information respecting the use of the site. The Client further acknowledges that in order for TETRA TECH to properly provide the services contracted for in the Contract, TETRA TECH has relied upon the Client with respect to both the full disclosure and accuracy of any such information.

### 1.5 INFORMATION PROVIDED TO TETRA TECH BY OTHERS

During the performance of the work and the preparation of this Professional Document, TETRA TECH may have relied on information provided by persons other than the Client.

While TETRA TECH endeavours to verify the accuracy of such information, TETRA TECH accepts no responsibility for the accuracy or the reliability of such information even where inaccurate or unreliable information impacts any recommendations, design or other deliverables and causes the Client or an Authorized Party loss or damage.

### 1.6 GENERAL LIMITATIONS OF DOCUMENT

This Professional Document is based solely on the conditions presented and the data available to TETRA TECH at the time the data were collected in the field or gathered from available databases.

The Client, and any Authorized Party, acknowledges that the Professional Document is based on limited data and that the conclusions, opinions, and recommendations contained in the Professional Document are the result of the application of professional judgment to such limited data.

The Professional Document is not applicable to any other sites, nor should it be relied upon for types of development other than those to which it refers. Any variation from the site conditions present, or variation in assumed conditions which might form the basis of design or recommendations as outlined in this report, at or on the development proposed as of the date of the Professional Document requires a supplementary investigation and assessment.

TETRA TECH is neither qualified to, nor is it making, any recommendations with respect to the purchase, sale, investment or development of the property, the decisions on which are the sole responsibility of the Client.

### 1.7 NOTIFICATION OF AUTHORITIES

In certain instances, the discovery of hazardous substances or conditions and materials may require that regulatory agencies and other persons be informed and the client agrees that notification to such bodies or persons as required may be done by TETRA TECH in its reasonably exercised discretion.

# Sampling and Analysis of Finished Compost

## Purpose:

Finished compost must meet the requirements of both Canadian (CFIA T-4-93) and British Columbia (OMRR) Regulations in order to be sold or distributed without restriction.

## Regulation

The OMRR (BC) requires sampling to be conducted from every 1000 tonnes compost (dry weight), or once per year (Schedule 3 (3)). The compost must meet fecal coliform levels (< 1000 MPN/g) in seven different samples of compost (Schedule 3), and trace element requirements in one composite sample as per Schedule 4. Schedule 4 also limits the foreign matter to less than or equal to 1 percent dry weight, and no sharp foreign matter.

To meet vector attraction reduction requirements (Schedule 2), we have requested the carbon dioxide evolution test (as per CCME Guidelines).

In addition, the compost must meet the requirements of T-4-93 of the CFIA (federal regulation) that requires Salmonella to be non-detectable (composite sample).

## Procedure – Step 1 – Meeting Fecal Coliform Requirements

When the compost process is complete as determined by smell and by re-heating potential, it is recommended to take one representative sample of the finished compost and send to a local laboratory for analysis of fecal coliform only. If the fecal coliform levels are < 1000 MPN/g, seven individual samples for fecal coliform and one composite sample for trace elements can be submitted for analysis.

For the first sample for fecal coliform, it is recommended to take at least 4 representative subsamples from the pile. The samples should be obtained from a depth of 30-90 cm into the pile.

Scrape away at least 15 cm of the surface material and make sure that non of this compost becomes part of the sample. Use a separate tool for scraping away the surface material.

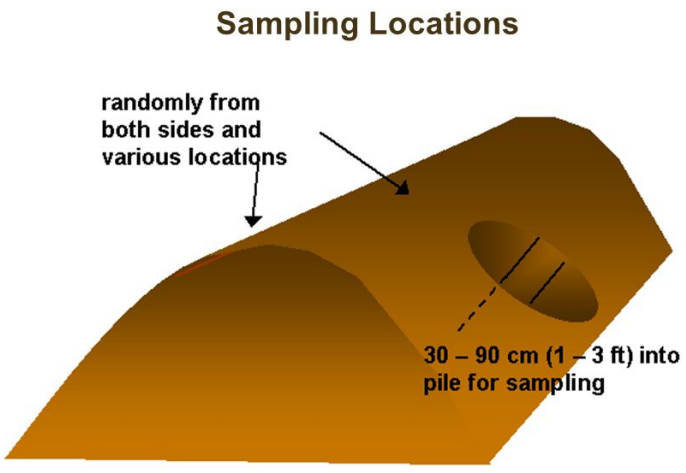



*Figure 1. Sampling protocol for finished compost.*

Use a plastic or latex glove when obtaining a subsample and place in a clean container or plastic bag. When all four subsamples have been obtained, blend thoroughly and close bag.

Refrigerate or place in a cooler with ice and send it to the laboratory for analysis within 24 hours.

**Procedure Step 2 – Full Analysis for Regulatory Compliance**

If the preliminary sample met the fecal coliform limit of < 1000 MPN/g, a full analysis of the finished compost can be completed.

Randomly locate seven different areas in the compost pile. Scrape away the top 15 cm of the pile to reduce the risk of contamination with surface material using a shovel. Obtain each of the seven separate samples from the 30-90 cm depth in the pile. We recommend using a separate latex glove for each of the seven samples.

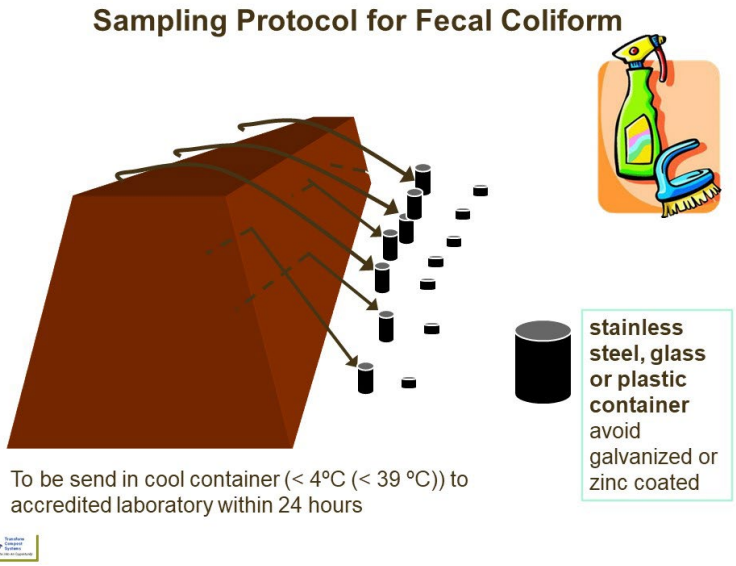



*Figure 2. Obtaining the seven separate samples for fecal coliform and one composite sample for trace elements and respiration.*

When obtaining each of the seven separate samples for fecal coliform analysis, obtain a small additional quantity from each of the seven locations for a composite sample. The composite sample containing the seven subsamples should be thoroughly blended before closing the bag.

Place all samples immediately in a cooler at 4 C or less. Do not freeze the samples. Send to laboratory for analysis within 24 hours.

We recommend that the seven samples for fecal coliform be sent to the same local laboratory as used for Step 1, and the composite sample be sent to A&L Laboratories in London Ontario.

An example of the submission form is found in Appendix A

An example of the analysis result from A&L Labs is found in Appendix B

**Interpreting Results**

The results of the seven separate samples for fecal coliform are simple to interpret. The Regulation requires that all seven samples must have fecal coliform levels of < 1000 MPN/g.

The results of the composite analysis (such as from A&L Labs) invites more understanding and interpretation.

Fecal coliform – must be less than 1000 MPN/g (OMRR pathogen reduction)

Salmonella – must be non-detectable (CFIA regulation)

Respiration – must be less than 4 mg $CO_2$-C/g OM/day (alternate vector attraction reduction OMRR)

Trace Elements – must meet OMRR Schedule 4 limits – usually not an issue with food waste compost

Foreign matter and sharps – less than or equal to 1% dry weight foreign matter and no sharp matter (OMRR Schedule 4 for retail grade organic matter).

***Other relevant Information on Laboratory Report***

The soluble salt concentration is a very important measurement and will determine the use recommendations for the compost.

In principle, the higher the food waste concentration in the compost, the higher the soluble salt content will be. We may see variations from summer to winter depending on the relative proportions of yard waste, food waste and bulking agent used. The higher the soluble salts, there will likely be more available nutrients for the plants.

If the compost has a soluble salt concentration of less than 3 ms/cm, the compost is unlikely to cause any osmotic effects for plants. If the soluble salt concentration is greater than 3 ms/cm, plants cannot be placed directly in the compost. The compost must be diluted with soil.

The total nitrogen content will provide an indication of the nutrient value of the compost. Food waste composts typically contain near or greater than 2% nitrogen, whereas yard waste composts are likely to contain 1 to 1.5% nitrogen.

Prepared by John Paul, PhD, PAg

Appendix A

# A & L CANADA LABORATORIES, INC.

2136 Jetstream Road · London, Ontario N5V 3P5 · Tel: 519/457-2575 Fax: 519/457-2664

**Website : www.alcanada.com** **e-mail: aginfo@alcanada.com**

## COMPOST SUBMISSION FORM

| | |
|---|---|
| **CLIENT NAME:** | |
| Address: | |
| | |
| Province: | Postal Code: |
| Phone: | Fax: |
| E-mail: | |
| Attention: | |
| P.O. # | |
| Composting Council of Canada Member: Yes ○ No ○ | |
| Account # | CQA I.D. # |

*** IF REQUESTING CQA, PLEASE LIST THE COMPOST SOURCE MATERIALS OR FEED STOCK ***

food and yard waste compost

**SPECIAL INSTRUCTIONS AND/OR COMMENTS:**

| | *Client Sample Identification* | *Collection Date/Time* | *Sample Matrix* | *Selected Analysis* CQA | Basic Monitoring Analysis Plus | Environmental Trace Elements | Soil Suitability Analysis (S8C) | Compost Nutrient Content (CFIA) | Manure Compost (MC) | Other | *Lab Number* |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Creston compost | *Date:* May 30, 2023<br>*Time:* 1:00 PM<br>*Initials:* JP | Finished Compost ✔<br>Immature Compost<br>Feedstock | ✔ | | | | | | | |
| 2 | | *Date:*<br>*Time:*<br>*Initials:* | Compost<br>Immature Compost<br>Feedstock | | | | | | | | |
| 3 | | *Date:*<br>*Time:*<br>*Initials:* | Compost<br>Immature Compost<br>Feedstock | | | | | | | | |
| 4 | | *Date:*<br>*Time:*<br>*Initials:* | Compost<br>Immature Compost<br>Feedstock | | | | | | | | |

**LAB ANALYSIS RESULTS BY:** **FAX** ☐ **COURIER*** ☐ **E-MAIL:** ✔ **REG. MAIL** ☐ * Client Cost

Analysis Authorized By:
Custody Relinquished By:

Date: May 30, 2023 Received By A & L: _____ Date: _____

**NO ANALYTICAL WORK WILL BEGIN WITHOUT SIGNED AUTHORIZATION**
*** PLEASE NOTE THAT THE CQA IS MEANT FOR FINISHED COMPOST ONLY ***

Please visit www.compost.org for more information

REPORT NO. [redacted]-70007

ACCOUNT NUMBER [redacted]

# A & L Canada Laboratories Inc.

2136 Jetstream Road, London, ON, N5V 3P5 Tel: (519) 457-2575 Fax: (519) 457-2664

TO: [redacted]

FOR [redacted]

Phone: [redacted]

Compost Analysis Proficiency Testing Program

## CERTIFICATE OF ANALYSIS



PROJECT NO:
PO# [redacted]
LAB NUMBER [redacted]
SAMPLE ID [redacted]

SAMPLE MATRIX: COMPOST
DATE SAMPLED: 2023-05-30
DATE RECEIVED: 2023-06-02
DATE REPORTED:
DATE PRINTED: 2023-06-12

| PARAMETER | RESULT | UNIT | DETECTION LIMIT | METHOD REFERENCE |
|---|---|---|---|---|
| Arsenic | 3.44 | ug/g | 1.00 | EPA 3050B/6010B(mod) * |
| Cadmium | 1.07 | ug/g | 1.00 | EPA 3050B/6010B(mod) * |
| Cobalt | 9.69 | ug/g | 1.00 | TMECC 4.06;EPA 3050/6010(mod)* |
| Chromium | 21.34 | ug/g | 1.00 | TMECC.04.06;EPA 3050/6010(mod* |
| Copper | 37.29 | ug/g | 1.00 | TMECC 4.06;EPA 3050/6010(mod)* |
| Mercury | BDL | ug/g | 0.10 | EPA 7471 * |
| Molybdenum | BDL | ug/g | 1.0 | TMECC.04.06;EPA 3050/6010(mod* |
| Nickel | 15.24 | ug/g | 1.00 | TMECC 4.06;EPA 3050/6010(mod)* |
| Lead | 5.75 | ug/g | 1.00 | EPA 3050B/6010B(mod) * |
| Selenium | BDL | ug/g | 1.00 | EPA 3050/6010 (mod) * |
| Zinc | 70.65 | ug/g | 1.00 | TMECC 4.06;EPA 3050/6010(mod)* |

**Comment:**

Results reported on a dry weight basis
* - accredited test
BDL - Below detectable levels

**The results of this report relate to the sample submitted and analyzed. All results are released based on acceptable QC data.**

[redacted]

**Results Authorized By:**

**Haifeng Song, Ph.D., C.Chem. Lab Director**

A&L Canada Laboratories Inc. is accredited by the Standards Council of Canada for specific tests as listed on www.scc.ca and by the Canadian Association for Laboratory Accreditation as listed on www.cala.ca
Additional information available upon request

REPORT NO. [redacted]-70007

ACCOUNT NUMBER [redacted]

# A & L Canada Laboratories Inc.

2136 Jetstream Road, London, ON, N5V 3P5 Tel: (519) 457-2575 Fax: (519) 457-2664

TO: [redacted]

FOR [redacted]

Phone: [redacted]

Compost Analysis Proficiency Testing Program

## CERTIFICATE OF ANALYSIS



PROJECT NO:
PO# [redacted]
LAB NUMBER [redacted]
SAMPLE ID [redacted]

SAMPLE MATRIX: COMPOST
DATE SAMPLED: 2023-05-30
DATE RECEIVED: 2023-06-02
DATE REPORTED:
DATE PRINTED: 2023-06-12

| PARAMETER | RESULT | UNIT | DETECTION LIMIT | METHOD REFERENCE |
|---|---|---|---|---|
| E. coli | >1000 | MPN/g dry | 3 | TMECC 07.01 |
| Salmonella spp. | NEGATIVE | P-A/25.0g(ml) | 1 CFU | MFLP-75 * |
| Fecal Coliform | >1000 | MPN/g dry | 3 | TMECC 07.01 |
| Total sharps > 2.8 mm* | BDL | pieces/500ml | | TMECC 03.08 |
| Total sharps > 12.5 mm | BDL | pieces/500ml | | TMECC 03.08 |
| Total FM > 2.8 mm* | 0.05 | % | 0.01 | TMECC 03.08 |
| Total FM > 25 mm | BDL | pieces/500ml | | TMECC 03.08 |
| Total plastics > 2.8 mm* | 0.05 | % | 0.01 | TMECC 03.08 |
| Total Organic Matter @ 550 deg C | 33.27 | % | 0.10 | LOI@550C |
| Moisture | 52.85 | % | 0.10 | TMECC.03.09-A |
| Conductivity (@25 deg C 1:5) | 0.03 | ms/cm | 0.02 | TMECC.04.10 |
| Sieve 2 Inch (% Passing) | 100.00 | % | 0.10 | ASTMD422 |
| Sieve 1 Inch (% Passing) | 100.00 | % | 0.10 | ASTMD422 |
| Sieve 1/2 Inch (% Passing) | 100.00 | % | 0.10 | ASTMD422 |
| Sieve 3/8 Inch (% Passing) | 96.00 | % | 0.01 | ASTMD422 |
| Sieve 1/4 Inch (% Passing) | 82.20 | % | 0.10 | ASTMD422 |
| Compost Stability Index | 8 | --- | | TMECC.05.08-B |
| Respiration-mgCO2-C/g OM/day | BDL | mgCO2-C/gOM/day | 0.01 | TMECC.05.08-B |
| Respiration - mgCO2-C/g TS/day | BDL | mgCO2-C/gTS/day | 0.01 | TMECC.05.08-B |

**Comment:**

Maturity Index: 8 - Inactive, highly matured compost, very well aged, possibly over-aged, like soil; no limitations for usage.

Results reported on a dry weight basis
* - accredited test
BDL - Below detectable levels

**The results of this report relate to the sample submitted and analyzed. All results are released based on acceptable QC data.**

[redacted]

**Results Authorized By:**

**Haifeng Song, Ph.D., C.Chem. Lab Director**

REPORT NO.
[redacted]-70007

ACCOUNT NUMBER
[redacted]

# A & L Canada Laboratories Inc.

2136 Jetstream Road, London, ON, N5V 3P5 Tel: (519) 457-2575 Fax: (519) 457-2664

TO: [redacted]

FOR [redacted]

Phone: [redacted]

Compost Analysis Proficiency Testing Program

## CERTIFICATE OF ANALYSIS



PROJECT NO:
PO# [redacted]
LAB NUMBER [redacted]
SAMPLE ID [redacted]

SAMPLE MATRIX: COMPOST
DATE SAMPLED: 2023-05-30
DATE RECEIVED: 2023-06-02
DATE REPORTED:
DATE PRINTED: 2023-06-12

| PARAMETER | RESULT | UNIT | DETECTION LIMIT | METHOD REFERENCE |
|---|---|---|---|---|

1.FM(Foreign matter) = glass,metal,plastic
2.Sharps = foreign matter pieces of a size or shape that can cause human or animal injury
3.8 mesh screen = 2.36mm
4.*2.8mm screen is used since 3.0mm screen does not exist

Results reported on a dry weight basis
* - accredited test
BDL - Below detectable levels

**The results of this report relate to the sample submitted and analyzed. All results are released based on acceptable QC data.**

[redacted]

**Results Authorized By:**

**Haifeng Song, Ph.D., C.Chem. Lab Director**

Report Number: [redacted]
Account Number: [redacted]

# A & L Canada Laboratories Inc.

2136 Jetstream Road, London, Ontario, N5V 3P5
Telephone: (519) 457-2575 Fax: (519) 457-2664

[redacted]

To: [redacted]

For: [redacted]

P.O. Number: [redacted]

Reported Date:
Printed Date: Jun 12, 2023

## COMPOST REPORT



| Sample Number | Lab Number | pH | Lime Index | Available Organic Matter % | Phosphorus P ppm | Potassium K ppm | Magnesium Mg ppm | Calcium Ca ppm |
|---|---|---|---|---|---|---|---|---|
| [redacted] | | **6.8** | **6.6** | **27.2** | **260** | **975** | **708** | **5479** |

| Sulfur S ppm | Zinc Zn ppm | Manganese Mn ppm | Iron Fe ppm | Copper Cu ppm | Boron B ppm | Sodium Na ppm | Nitrate-N NO3-N ppm | Soluble Salt ms/cm | Nitrogen (Total) (%) | Chloride ppm |
|---|---|---|---|---|---|---|---|---|---|---|
| **13** | **22.3** | **46** | **269** | **2.8** | **2.1** | **296** | **28** | **0.3** | **1.18** | **50** |

### INTERPRETATION

| CEC | | Percent Base Saturation | | | | Proportional Equivalents (meq) | | | | Cation Ratio | | C/N Ratio |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| meq/100g | % BS | % K | % Mg | % Ca | % Na | K | Mg | Ca | Na | Mg/K | Ca/Mg | |
| **37.0** | **100.0** | **6.76** | **15.73** | **74.03** | **3.48** | **2.50** | **5.82** | **27.39** | **1.29** | **2:1** | **5:1** | **15:1** |
| Optimum Range: | | 3 - 5 | 8 - 20 | 60 - 80 | | 0.5 - 1.3 | | | | 7:1 | 5:1 | |

CQA

* Results reported on a dry weight basis.
**The results of this report relate to the sample submitted and analyzed. All results are released based on acceptable QC data.**
* Crop yield is influenced by a number of factors in addition to soil fertility.
**No guarantee or warranty concerning crop performance is made by A & L.**

**Results Authorized By:** BWood **Beth Wood, Agronomist**

# A & L Canada Laboratories Inc.

2136 Jetstream Rd, London, Ontario, N5V 3P5

Telephone: (519) 457-2575 Fax: (519) 457-2664


**REPORT NUMBER:** C[redacted]

**ACCOUNT NUMBER:** 0[redacted]

# REPORT OF ANALYSIS

**TO:** [redacted]

CANADA

**RE:** [redacted]

**DATE RECEIVED:** 2023-06-02

**DATE REPORTED:** 2023-06-12



**P.O. NUMBER:** TCP 2023-2

| LAB NO. | SAMPLE ID | ANALYSIS | RESULT | UNIT | METHOD |
|---|---|---|---|---|---|
| 34366 | [redacted] | Nitrogen (Total) | 1.2 | % | TMECC.04.02-D |

[redacted]

**Results Authorized By:** BWood

# Environmental Monitoring Program

## Creston Landfill

| Sampling Location | | | | | | | | Monitoring Plan | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Field Designation | EMS Number | Matrix | Well Depth (m BTOR) | Ground Water | Surface Water | Purpose | Location Description | Q1 | Q2 | Q3 | Q4 | Hydraulic Monitoring |
| MW-3 | E221708 | groundwater | 9.08 | 1 | | | west property boundary | 1 | 1, 2 | 1 | 1 | quarterly |
| MW-6 | E234710 | groundwater | 6.93 | 1 | | | west property boundary | 1 | 1, 2 | 1 | 1 | quarterly |
| MW-7 | E234712 | groundwater | 9.2 | 1 | | | west property boundary | 1 | 1, 2 | 1 | 1 | quarterly |
| MW-8 | E234713 | groundwater | 10.8 | 1 | | | west of Hwy 21 | 1 | 1,5 | 1 | 1 | quarterly |
| MW-9 | E234714 | groundwater | 15 | 1 | | | west of Hwy 21 | 1 | 1,5 | 1 | 1 | quarterly |
| Whiskey Creek | E243769 | surface water | | | 1 | | mouth of creek; north of landfill | 3 | 3,4,5 | 3 | 3,4 | - |
| MW-17 | none | groundwater | 14.17 | 1 | | | west property boundary, adjacent to gate | 1 | 1,5 | 1 | 1 | quarterly |
| MW-19 | E274230 | groundwater | 3.1 | 1 | | | CAZ | 1 | 1,5 | 1 | 1 | quarterly |
| MW-20 | E274231 | groundwater | 4.1 | 1 | | | CAZ | 1 | 1,5 | 1 | 1 | quarterly |
| MW-21 S | none | groundwater | 10.72 | 1 | | | hay field to west | 1 | 1,5 | 1 | 1 | quarterly |
| MW-21 D | none | groundwater | 4.44 | 1 | | | hay field to west | 1 | 1,5 | 1 | 1 | quarterly |
| MW-22S | none | groundwater | 7 | 1 | | | hay field to west | 1 | 1,5 | 1 | 1 | quarterly |
| MW-22 D | none | groundwater | 12.24 | 1 | | | hay field to west | 1 | 1,5 | 1 | 1 | quarterly |
| MW-23 | none | groundwater | 6.5 | 1 | | | hay field to west | 1 | 1,5 | 1 | 1 | quarterly |
| MW-25 | E274229 | groundwater | 24.02 | 1 | | background | on upland plateau 300 m east of the NE corner of the landfill | 1 | 1,5 | 1 | 1 | quarterly |
| SW-1 | none | surface water | | | 1 | | southern portion of Kootenay River Wetlands | 3 | 3,4,5 | 3 | 3,4 | - |
| SW-2 | E274245 | surface water | | | 1 | | northern portion of Kootenay River Wetlands | 3 | 3,4,5 | 3 | 3,4 | - |
| SW-3 | none | surface water | | | 1 | background | east of landfill | 3 | 3,4,5 | 3 | 3,4 | - |
| SW-4 | none | surface water | | | 1 | | immediately southwest of landfill | 3 | 2,3,4 | 3 | 3,4 | - |
| SW-5 | none | surface water | | | 1 | | west of landfill near old access road | 3 | 3,4,5 | 3 | 3,4 | - |
| SW-6 | E274248 | surface water | | | 1 | | China Creek, north of landfill | 3 | 2,3,4 | 3 | 3,4 | - |
| SW-7 | E274244 | surface water | | | 1 | | southern portion of Kootenay River Wetlands | 3 | 3,4,5 | 3 | 3,4 | - |
| SW-8 | none | surface water | | | 1 | | northern portion of Kootenay River Wetlands | 3 | 3,4,5 | 3 | 3,4 | - |

Note: Water depth is measured and recorded at each well during each Site's sampling events.

**Parameters**

1 - Ground water: field measurements (water level, pH, conductivity, temperature), alkalinity, chloride, sulphate, ammonia, nitrate, nitrite, TKN, TOC, ICP/MS Scan for trace heavy metals, COD

2 - Ground and surface water: PAH and volatiles annually in Q2

3 - Surface water: field measurements (pH, conductivity, temperature, dissolved oxygen), lab pH, alkalinity, chloride, sulphate, ammonia, nitrate, nitrite, TOC, ICP/MS Scan for trace heavy metals, COD

4 - Surface water: trace dissolved heavy metals bi annually (only for locations showing leachate impact) - environmental consultant and RDCK to evaluate prior to Q2 each year

5 - Ground and surface water: PAH and volatiles in Q2 every three years beginning 2017

**Duplicates**

One randomly selected duplicate sample per sampling event

# EAST SHORE - Crawford Bay Destiny Bay
# Environmental Monitoring Program

| Destiny Bay and Crawford Bay Closed Landfills | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Field Designation** | **EMS Number** | **Matrix** | **Location** | **Q1** | **Q2** | **Q3** | **Q4** |
| ACD | none | surface water | Akokli Creek Down | | | √ | |
| ACU | none | surface water | Akokli Creek Up | | | √ | |
| ACW | none | surface water | Akokli Creek Wetland | | | √ | |
| CCD | none | surface water | Crawford Creek Down | | | √ | |
| CCU | none | surface water | Crawford Creek Up | | | √ | |

| Parameters |
|---|
| Alkalinity (speciated) |
| Chloride |
| Sulphate |
| Hardness |
| pH |
| Specific Conductance |
| Total Suspended Solids (TSS) |
| Ammonia-N |
| Nitrate |
| Nitrite |
| Phosphorus (total) |
| Total Organic Carbon (TOC) |
| Total ICP Metals (Surface) |

# GROHMAN NARROWS -
# Environmental Monitoring Program

| Grohman Transfer Station | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Field Designation** | **EMS Number** | **Matrix** | **Location** | **Q1** | **Q2** | **Q3** | **Q4** |
| CCU | none | surface water | Insight | To occur once per year in low water | | | |

| Parameter |
|---|
| Alkalinity (speciated) |
| Chemical Oxygen Demand (COD) |
| Chloride |
| Sulphate |
| Hardness |
| pH |
| Specific Conductance |
| Ammonia-N |
| Nitrate |
| Nitrite |
| Total Organic Carbon (TOC) |
| Dissolved ICP Metals (Ground) |
| Ionic Balance |

**PERMIT AMENDMENT**

**APPROVING HB MINE TAILINGS FACILITY RECLAMATION AND CLOSURE PLAN**

Permit: **M-218** Mine No: **1101163**

Issued to: **Regional District of Central Kootenay**
**Box 590, 202 Lakeside Drive**
**Nelson, British Columbia**
**V1L 5R4**

for work located at the:

**HB Mine Tailings**

Amended at Victoria, British Columbia this 18th day of May in the year 2021.

J. Lowell Constable, P.Eng.
Deputy Chief Permitting Officer
Major Mines Office

**PREAMBLE**

An application entitled "*HB Mine Tailings Facility Remediation and Closure Plan*" prepared by the Regional District of Central Kootenay (RDCK) (Document 1) was filed with the Chief Permitting Officer on July 22, 2019, in accordance with Section 10(6) of the *Mines Act* and forms the application permitted under this *Mines Act* M-218 permit amendment. The version of Document 1 approved by this permit is dated August 2020.

Additional documents were submitted to the Chief Permitting Officer, and also form part of the application, including:

- Memo entitled "*HB Dam Stability Analysis Update*" dated January 9, 2020, prepared by SRK Consulting (Canada) Inc. (Document 2)
- Memo entitled "*Response to Geotechnical Review of HB Dam Stability Analysis Update (ISSUE ID's 139 to 148, 40, 52, 54, and 55)*" dated February 24, 2020, prepared by SRK Consulting (Canada) Inc. (Document 3)
- Memo entitled "*Issue ID #131 ITRB Comments and Recommendations*" dated December 13, 2019, prepared by SRK Consulting (Canada) Inc. (Document 4)
- Letter entitled "*Issue ID #37 – Detailed Engineering Design*" dated December 13, 2019, prepared by SRK Consulting (Canada) Inc. (Document 5)
- Report entitled "*Technical Specifications – HB Mine Tailings Facility Closure and Remediation – Revision 01*" dated October 2019, prepared by SRK Consulting (Canada) Inc. (Document 6)
- Drawings 1 and 2 entitled "*Surface Water and Groundwater Monitoring Locations*" and "*Metals Uptake, Re-Vegetation and Wildlife Monitoring Locations*", respectively, dated February 28, 2020, prepared by SLR Consulting (Canada) Ltd. (Document 7)
- Report entitled "*HB Mine Tailings Facility – 2016 Tailings Characterization Factual Report*" dated May 2017, prepared by SRK Consulting (Canada) Inc. (Document 8)

This permit contains the requirements of the Ministry of Energy, Mines and Low Carbon Innovation. It is also compatible, to the extent possible, with the requirements of other provincial ministries. However, nothing in this permit limits the authority of other provincial ministries to set other condition, or to act independently, under their respective permits and legislation.

The mine is located within the consultative territory of the Ktunaxa National Council, Shuswap Indian Band, Okanogan Indian Band, Okanogan National Alliance, Lower Similkameen Indian Band, Penticton Indian Band and Upper Nicola Indian Band.

## TABLE OF CONTENTS

## CONDITIONS

The Chief Permitting Officer hereby approves the application subject to compliance with the following conditions:

### A. General

1. Compliance with *Mines Act* and Code

The Permittee shall ensure that all work is in compliance with all sections and parts of the *Mines Act* and the Health, Safety and Reclamation Code for Mines in B.C. (Code), and the Permittee shall obey all orders issued by the Chief Inspector of Mines (Chief Inspector) or the Chief Inspector's delegate.

2. Departure from Approval

The Permittee shall notify the Chief Permitting Officer in writing of any intention to depart from the Mine Plan and Reclamation Program approved under this *Mines Act* permit (M-218) to any substantial degree, and shall not proceed to implement the proposed changes without the written authorization of the Chief Inspector.

3. Permit Approval

The Permittee is authorized under this permit (M-218) for development and works outlined in Document 1, within the area encompassing approximately 62.6 Ha (Figure 1 – Permitted Mine Area), including a management buffer around the approved disturbance area. This permit does not approve borrow sources located outside of the Permitted Mine Area.

4. Permit

This Permit is non-transferable of assignable.

5. Maintenance of Mine

The Permittee shall maintain mine facilities and infrastructure in a manner to meet design objectives, environmental protection requirements and reclamation requirements.

6. Sign-off by a Qualified Professional

Unless otherwise approved in writing by the Chief Inspector, the Permittee shall ensure that all reports required to be submitted under this permit are signed by a qualified professional with applicable experience and registered in the province of British Columbia.

7. First Nations Information Sharing

Unless otherwise requested by the Chief Inspector, the Permittee shall provide to the Ktunaxa National Council, Shuswap Indian Band, Okanogan Indian Band, Okanogan National Alliance, Lower Similkameen Indian Band, Penticton Indian Band and Upper Nicola Indian Band all material reports and plans required to be submitted under this permit, including annual monitoring reports.

8. Compliance Status Report

The Permittee shall track compliance status of all permit conditions and inspection orders in a form acceptable to the Chief Inspector. The Permittee shall maintain an up-to-date tracking table. The Permittee shall ensure that the tracking table is available at the mine site at all times and to a Mines Inspector upon request. The Permittee shall prepare and submit an annual Compliance Status report to the Chief Inspector by March 31st and shall include a summary of outstanding non-compliance issues and an action plan, to the satisfaction of the Chief Inspector, for achieving compliance.

## B. Geotechnical

1. General

(a) The Permittee shall ensure that all geotechnical designs, specification, work plans, monitoring requirements and reports required to be prepared under section (B) are completed to the satisfaction of the Chief Inspector, are maintained on site during construction and are made available to any Inspector of Mines, upon request.

(b) The Permittee shall ensure construction is completed under the supervision of a Professional Engineer and that sufficient field reviews have been conducted to ensure that all facilities are built in general conformance of the design, accepted engineering practices, and the Code.

(c) The Permittee shall ensure recommendations by a Professional Engineer, relating to health and safety, geotechnical stability or environmental protection are followed, unless a suitable alternative course of action is approved in writing by a Professional Engineer.

(d) The Permittee shall submit an Advice of Geotechnical Incident form to the Chief Inspector for any geotechnical incident that is classified as a dangerous occurrence or any other incident as described in the current EMPR Advice of Geotechnical Incident form.

2. Tailings Storage Facility

(a) The Permittee shall ensure that the Tailings Storage Facility (TSF) Operations, Maintenance and Surveillance (OMS) manual includes quantitative performance objectives (QPOs) and Trigger-Action Response Plans (TARPs). The Permittee shall ensure that QPOs and TARPs are developed in consultation with the Engineer of Record.

(b) The Permittee shall ensure that a minimum freeboard in the TSF is defined by the Engineer of Record and included in the QPOs.

(c) The Permittee shall prepare and implement a Safe Work Procedure (SWP) for all work conducted on or around the tailings surface including, but not limited to, upstream riprap excavation, fill placement and liner installation. The Permittee shall ensure the SWP is developed in consultation with the TSF Engineer of Record and is submitted to the Chief Inspector at least 30 days prior to start of construction.

(d) The Permittee shall ensure a TSF construction monitoring plan is prepared by the Engineer of Record, is implemented, and is submitted to the Chief Inspector at least 30 days prior to commencing construction activities at the TSF. The Permittee shall ensure that the TSF construction monitoring plan includes, but is not limited to, monitoring frequencies and thresholds to be implemented during the following works:

(i) Foundation preparation;
(ii) Upstream riprap excavation;
(iii) Fill placement;
(iv) Liner installation; and
(v) Spillway construction.

3. Soil, Overburden and Rock Ore Stockpiles

The Permittee shall ensure that all soil, overburden and rock stockpiles are constructed in accordance with designs prepared by a Professional Engineer and are constructed and inspected to ensure stability and erosion control is maintained, unless exempt in writing from the Chief Inspector.

4. Borrow Pits and Quarry Excavations

The Permittee shall ensure that all borrow pits and quarry excavations are constructed in accordance with designs prepared by a Professional Engineer, and are constructed and inspected to ensure stability and erosion control is maintained.

## C. Protection of Land and Watercourses

1. Environmental Management System

(a) The Permittee shall develop and implement an Environmental Management System (EMS) consisting of Environmental Management Plans (EMPs) and Standard Operating Procedures (SOPs). The Permittee shall ensure the EMS references relevant policies and establishes proactive procedures to provide direction for effective operational management and monitoring on-site. The Permittee shall submit the EMS and plans by May 31, 2021, to the satisfaction of the Chief Inspector.

(b) The Permittee shall ensure the EMS is reviewed annually, revised as soon and as often as required, and made available at the mine site at all times and to an Inspector of Mines upon request. The findings of the annual review of the EMS shall be reported in the Annual Reclamation Report.

(c) The Permittee shall ensure that mine site employees and contractors are knowledgeable and accountable to act consistently with the requirements of the EMPs and SOPs that form the EMS.

2. Environmental Site Management

The Permittee shall ensure that a qualified Environmental Site Manager is assigned. The Environmental Site Manager shall have the authority to implement remedial actions as may be necessary to ensure maintenance of environmental standards and permit requirements. If suspension of construction or operations occurs due to environmental concerns, the Permittee shall immediately notify the Chief Inspector.

3. Metal Leaching (ML) and Acid Rock Drainage (ARD)

(a) General

(i) The Permittee shall ensure that all materials with the potential to generate ML/ARD are placed in a manner that minimizes the production and release of metals and contaminants to levels that are protective of environmental quality.

(ii) The Permittee shall ensure that, unless otherwise approved, all plans for the prediction, prevention, mitigation and management of metal leaching and acid rock drainage are prepared in accordance with the *Guidelines for Metal Leaching and Acid Rock Drainage at Minesites in British Columbia* (1998).

(iii) The Permittee shall not make changes to the criteria for ML/ARD definition in C.3(b), waste handling procedures, mitigation strategies, or the materials monitoring program without the written approval of the Chief Inspector.

(iv) Concurrent with remediation and closure activities, the Permittee shall characterize excavated materials to determine ML/ARD generating potential, validate pre-construction predictions, guide material management decisions and confirm effectiveness of material handling procedures.

(v) The Permittee shall maintain an inventory of rock and overburden material, including information on composition, volume, source, history of excavation and geochemical monitoring data.

(vi) The Permittee shall not use PAG materials for construction purposes.

(vii) The Permittee shall ensure that no PAG rock is stored on surface after December 31, 2021.

(b) Definition of Potentially ARD Generating (PAG) and Metal Leaching (ML) Materials

(i) Tailings, overburden and construction materials are defined as PAG if NP/AP is < 2:1, where acid potential (AP) is calculated using total sulphur and neutralization potential (NP) is determined by the modified Sobek NP method.

(ii) Tailings, overburden and construction materials containing soluble metal concentrations (as determined by shake flask extraction) higher than the receiving water objectives are defined as having a potential for metal leaching.

(c) Analytical Requirements

The Permittee shall ensure that all water quality and solid material samples are analyzed by a certified off-site laboratory.

(d) ML/ARD Reporting

The Permittee shall ensure results of the ML/ARD analytical testwork be reported and assessed in the Annual Reclamation Report and any significant changes or trends shall be discussed, and implications for materials handling shall be identified.

4. Surface and Ground Water Management and Monitoring

(a) The Permittee shall develop and submit a Water Management and Monitoring Plan by May 31, 2021 to the satisfaction of the Chief Inspector. The Permittee shall ensure the plan includes, but is not limited to, surface water, tailings porewater, seepage, and groundwater quality and quantity monitoring locations, frequencies and parameters. The Permittee shall ensure that an effective QA/QC program for the surface water, groundwater and seepage monitoring programs is included and implemented.

(b) The Permittee shall ensure that water quality monitoring results, including interpretation of results, are reported and assessed in the Annual Reclamation Report. The Permittee shall ensure that any significant changes or trends in water quality or quantity are discussed, and those that require additional evaluation and management are identified in the report.

(c) The Permittee shall include a comparison of water quality monitoring results to source term concentrations in the Annual Reclamation Report. The Permittee shall ensure that the implications of the results to source term refinement, water quality mitigation, source control and adaptive management are discussed in the report.

5. Tailings Geochemistry Monitoring and Assessment

(a) The Permittee shall develop and implement a Tailings Geochemistry Monitoring and Assessment Report, and shall submit to the Chief Inspector by March 31, 2024. The Permittee shall ensure that the report includes, but is not limited to, the following:

(i) A summary of pre-covered and post-covered tailings porewater quality, and unsaturated zone monitoring results;

(ii) A post-covered tailings sampling and characterization program, which includes total solid-phase concentrations, bulk mineralogy and the presence of authigenic phases;

(iii) Comparisons of pre-covered and post-covered tailings porewater, solid-phase composition, and geochemical modelling results;

(iv) An updated assessment of the long-term geochemical stability of the tailings; and

(v) A schedule for reporting subsequent tailings geochemistry monitoring and assessment results.

6. Model Validation and Updated Water Quality Predictions

(a) The Permittee shall track water quality and flow monitoring data to enable updating and refinement of water quality predictions based on site-specific monitoring and cover performance information.

(b) The Permittee shall submit to the Chief Inspector by October 31, 2025, for review and approval, an updated Water Quality Prediction Model. The Permittee shall ensure that the updated model incorporates updated groundwater modelling, the mine water balance, and the results of the tailings geochemical assessment. In addition, the Permittee shall clearly describe all changes that are applied to the updated model.

(c) The Permittee shall update the water quality model every five years, beginning October 31, 2025, as part of the Reclamation and Closure Plan update, or more frequently as necessary to inform reclamation and closure planning and mitigation design and engineering.

7. Construction Environmental Management

The Permittee shall implement the Construction Environmental Management Plan (CEMP) (Document 1). The Permittee shall ensure that construction activities are overseen by a qualified and trained construction environmental monitor on site. The construction environmental monitor shall have the authority to implement remedial actions as may be necessary to ensure maintenance of environmental standards and permit requirements. If the environmental monitor suspends works for any reason, the Permittee shall ensure that the Chief Inspector is notified.

8. Erosion and Sediment Control

(a) During the construction period, the Permittee shall ensure inspections are conducted daily during rain events and the snowmelt period on the mine site. The Permittee shall implement immediate remedial action where excessive sediment-laden runoff is observed.

(b) The Permittee shall appropriately characterize any significant releases of sediment-laden water from the mine boundary, defined as an unauthorized discharge to the receiving environment, with respect to extent and loading, and report the occurrence to the Chief Inspector with recommendations for improvement to the water management system, if required.

(c) The Permittee shall ensure the characterization of unauthorized discharges of sediment-laden runoff includes, at a minimum, flow, total suspended solids, turbidity, pH, conductivity, temperature, dissolved oxygen, and total and dissolved metals, of both the effluent and the receiving water.

9. Soil Salvage and Stockpiling

(a) The Permittee shall salvage and stockpile topsoil, overburden, and organic material including large woody debris for use in reclamation.

(b) The Permittee shall ensure that a qualified professional monitor directs soil sampling, salvage, segregation, and stockpiling activities on-site.

(c) The Permittee shall ensure that materials salvaged for use in reclamation are segregated based on salvage origin and measured suitability for reclamation purposes. Prior to mixing with other sources and/or applying on-site, the Permittee shall characterize and evaluate the suitability for reclamation any materials with the potential to be contaminated.

(d) The Permittee shall maintain an inventory of stockpiles of salvaged soil, overburden and organic matter including large woody debris specifying the locations, origins, and quantities of material. The Permittee shall report this information in the Annual Reclamation Report.

(e) The Permittee shall protect stockpiles from erosion, degradation, and contamination through revegetation and/or other practices.

(f) The Permittee shall ensure that stockpiles are clearly marked to ensure that they are protected during construction and mine operations.

(g) The Permittee shall not use soil suitable for use in reclamation as fill.

10. Vegetation Management

(a) The Permittee shall limit disturbance to vegetation to those areas approved by this permit.

(b) The Permittee shall manage and control weeds that establish on the site and shall ensure that weeds do not migrate from the site to adjacent areas. The Permittee shall consider using non-toxic means for weed control. The Permittee shall ensure that all seed used on-site is certified weed free.

11. Wildlife Protection

(a) Pursuant to Part 1.6.9 of the Code, the Permittee shall incorporate in the mine safety program, a no hunting and shooting policy for the mine permit area (Figure 1).

(b) The Permittee shall implement a policy of no fishing and hunting for all employees and contractors while on company business or while commuting to and from the mine.

12. Archaeological Resources

(a) Prior to beginning any mechanized surface disturbance on undisturbed lands, the Permittee shall conduct field surveys consistent with archaeological and cultural heritage resources management procedures consistent with the provisions of the BC Heritage Conservation Act.

(b) For those sites that cannot be avoided, the Permittee shall contact the Archaeology Branch of the Ministry of Forests, Lands and Natural Resource Operations and Rural Development and make arrangements to scientifically excavate and record findings.

13. Ongoing Reclamation Research

(a) The Permittee shall submit to the Chief Inspector by March 31, 2022, a Reclamation Research Program that includes details for achieving the research requirements outlined in this permit with a schedule for implementation and a description for how results will be utilized and reported. The Permittee shall ensure that the Reclamation Research Program includes a TSF cover performance assessment for achieving the end land use objective.

(b) The Permittee shall ensure a detailed summary of all research being conducted under this section is provided in the Annual Reclamation Report, including description of research activities, results, and outcomes.

(c) The Permittee shall conduct research to determine the viability of revegetation with native plant species, including culturally important species. This includes vegetation metal uptake studies to determine if allowing woody vegetation to establish is an acceptable risk.

(d) The Permittee shall establish test plots that will be used to evaluate the reclamation approaches and prescriptions applied to confirm that ecological trajectories consistent with the land use and capability targets are being achieved.

(e) The Permittee shall develop and implement a monitoring program designed to evaluate the success of revegetation, habitat restoration, soil development and erosion control. The Permittee shall include in this program ecosystem-specific sampling parameters and performance criteria.

(f) The Permittee shall develop and implement a monitoring program for evaluating metal uptake in exposed terrestrial and aquatic ecosystems, which specifies sampling requirements and performance criteria. Where harmful levels are found, the Permittee shall take any corrective action necessary to mitigate to ensure levels are safe for plant and animal life.

## D. Reclamation and Closure Program

1. Reclamation Security

(a) The Permittee shall cause to be deposited with the Minister of Finance security in the amount of Two Million Seven Hundred Sixty Nine Thousand Four Hundred Seventy Nine ($2,769,479.00) dollars. The security shall be posted in accordance with the schedule shown below. The security will be held by the Minister of Finance for the proper performance of the approved program and all conditions of the M-218 permit in a manner satisfactory to the Chief Permitting Officer.

| Date | Amount |
|---|---|
| December 31, 2025 | $2,769,000.00 |

(b) The Permittee shall submit to the Chief Permitting Officer a report outlining compliance with the schedule of Post-Closure monitoring identified in Document 1 (Appendix K) by March 31, 2025, to the satisfaction of the Chief Permitting Officer. The Permittee shall ensure the report includes the following Post-Closure monitoring:

(i) Annual groundwater and surface water quality monitoring
(ii) Annual geotechnical monitoring
(iii) Minimum of one Dam Safety Review
(iv) Minimum of three years of revegetation monitoring

(c) Following the submission of the report required in condition D.1(b), with the approval of the Chief Permitting Officer in writing, the Permittee will not be required to post the security required in condition D.1(a).

(d) Notwithstanding the security posted as a condition of this Permit, the Permittee remains responsible for covering all closure and reclamation costs associated with reclamation and environmental protection.

2. Land Use

(a) The Permittee shall ensure that the land surface is reclaimed with the intent of re-establishing average pre-mining capability to the end land use objectives of Wildlife Habitat and Industrial.

(b) The Permittee shall ensure that borrow pits and quarries are reclaimed to the approved end land use once no longer required.

3. Erosion Control

The Permittee shall achieve reduction of erosion through landform configuration, development of maintenance-free vegetation covers, and the development of stable, self-sustaining drainage control features and watercourses.

4. Re-vegetation

The Permittee shall ensure the land is revegetated to a self-sustaining state using appropriate and/or native plant species including culturally important native species.

5. Growth Medium

(a) The Permittee shall monitor soil replacement operations to ensure the minimum depths are achieved. The Permittee shall develop a confirmation sampling plan to ensure quality of soil used for reclamation purposes will achieve end land use objectives. The Permittee shall report all results in the Annual Reclamation Report.

(b) The Permittee shall ensure that areas to be reclaimed are decompacted to the minimum depth required to adequately address the severity of compaction prior to placement of soil and or vegetation, in a manner intended to achieve end land use objectives and erosion control, with the exception of areas where closure plans require compaction prior to placement of growth medium in order to reduce infiltration and contact water.

6. Surface Water Management Ponds and Channels

(a) The Permittee shall reclaim all surface water management ponds and water diversions once no longer required to satisfy stability and erosion control requirements and the approved end land use.

7. Mine Roads

(a) The Permittee shall ensure all mine roads are reclaimed, in accordance with recommendations of a qualified professional, to satisfy the approved end land use objectives, including all reasonable efforts to fully re-configure to conform to the adjacent landscape where long-term stability is not compromised, unless permanent access is required.

(b) Individual mine roads may be exempted from the requirement for total reclamation under condition (a) if:

(i) The Permittee demonstrates that an agency of the Crown has explicitly accepted responsibility for the operation, maintenance and ultimate deactivation and abandonment of the road, or

(ii) The Permittee demonstrates that another private party has explicitly agreed to accept responsibility for the operation, maintenance and ultimate deactivation and abandonment of the road and has, in this regard, agreed to comply with all the terms and conditions, including bonding provisions, of this reclamation permit, and with all other relevant provincial government (and federal government) regulatory requirements.

8. Reclamation Program and Closure Plan Update

The Permittee shall develop and submit an updated Reclamation and Closure Plan to the satisfaction of the Chief Inspector by March 31, 2025, which includes, but is not limited to, the following information:

(a) The current status of the reclamation obligations based on the approved end land use;

(b) A compilation and interpretation of all monitoring for life of mine, including ML/ARD prediction, water quality and quantity, modelling predictions, metal uptake studies, soil, vegetation and reclamation programs;

(c) Detailed closure and maintenance activities;

(d) A compilation and interpretation of any research program used to inform closure planning strategies;

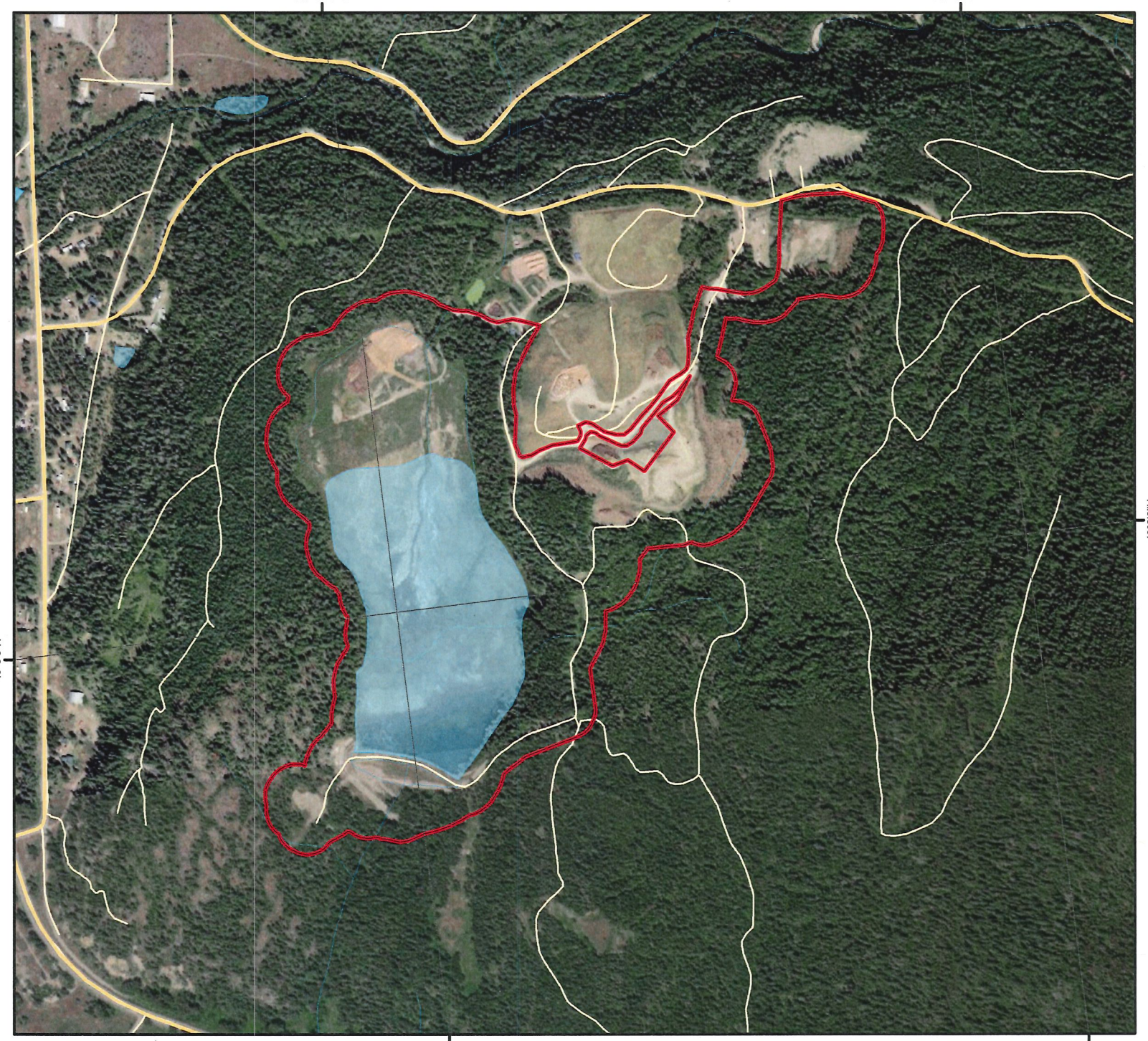
(e) Detailed contingency/remediation plans;

(f) Detailed schedule for completion of reclamation/closure works;

(g) Closure Management Manual that details monitoring and maintenance activities for post closure; and

(h) A breakdown of outstanding liabilities and associated costs including activities detailed for remediation and post closure.

**Figure 1 – Permitted Mine Area**



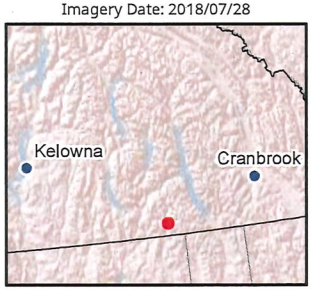

BRITISH COLUMBIA
www.gov.bc.ca

# HB Tailings Landfill
# M-218

## Figure 1
## Draft Permitted Mine Area

Permitted Mine *64.3*

Imagery Date: 2018/07/28




0 100 200 300
Meters

N

Base Data:
BC Geographic Warehouse & ESRI Imagery
NAD 1983 BC Environment Albers
Date: 2021/03/30 10:08:16 AM
Prepared By: NHEIDECK

Document Path: W:\em\mmd\Workarea\Victoria\Reclamation & Permitting\MajorMine\M-10 Kitsault\Figure1_PermitAmendment\mxds\Figure1_M_218_HBMine_PMAAmendment_2021Mar30_8_5x11.mxd

# Water Quality Management and Monitoring Plan – 2022 Update

**Regional District of Central Kootenay**

SLR Project No: 204.03242.00008

August 2022

# Water Quality Management Plan – 2022 Update

## HB TAILINGS MANAGEMENT FACILITY

## SALMO, BC

## SLR Project No: 204.03242.00008

Prepared by
SLR Consulting (Canada) Ltd.
8 West St. Paul Street
Kamloops, BC V2C 1G1

for

Regional District of Central Kootenay
Box 590, 202 Lakeside Drive
Nelson, BC V1L 5R4

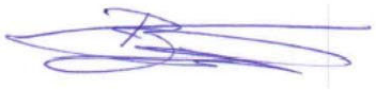
24 August 2022

The Association of Professional Engineers and Geoscientists of the Province of British Columbia
Permit to Practice #1001562

Prepared by:

**Celine Totman, M.Sc., R.P Bio.**
Senior Environmental Scientist

Reviewed by:



**Benjamin Foulger, P.Ag.**
Senior Scientist

**Michael Venhuis, M.Sc., P.Geo.**
Senior Hydrogeochemist

CONFIDENTIAL

Distribution: 1 electronic copy – Regional District of Central Kootenay
1 electronic copy – Ministry of Energy, Mines and Low Carbon Innovation
1 electronic copy – SLR Consulting (Canada) Ltd.

# CONTENTS

# TABLES



# TABLES SECTION



# DRAWINGS

# 1.0 INTRODUCTION

This report presents the Water Quality Management and Monitoring Plan (WQMMP) for the HB Mine Tailings Management Facility (TMF), also referred to as "the Site" located approximately six kilometres (km) south of the Village of Salmo, British Columbia. The TMF stores tailings from Cominco Limited's (Teck Resources Limited) historic operations at the nearby HB Mine. The TMF has been under the care of the Regional District of Central Kootenay (RDCK) since 1998. The TMF is located within Parcel "A" (Explanatory Plan 88745I) of District Lot 1236, Sub-lot 36, Kootenay District Plan X69 (Except (1) Parts Included in Plans 8646, 14234, and (2) Part Included in SRW Plan14948). The site location is provided on Drawing 1.

A comprehensive Remediation and Closure Plan (RCP) for the HB Mine Tailings Management Facility was prepared by the RDCK and submitted to the Ministry of Energy, Mines and Low Carbon Innovation (EMLI) on July 22, 2019. The RCP was prepared in accordance with Section 10 of the *Mines Act* and the Health, Safety and Reclamation Code for Mines in British Columbia, and was designed to meet the requirements of all applicable provincial and federal legislation. The RCP was prepared as part of an application to amend Permit No. M-218, in which the RDCK applied to complete closure construction works, remediate and reclaim the areas formerly disturbed by historical tailings storage operations, and transition the facility through the closure active-care phase to the passive-closure phase, as defined by the Canadian Dam Association (CDA). The focus of the RCP was to ensure the long-term physical and chemical stability of the facility, remediate and control tailings erosion and transport, maintain acceptable water quality, protect public health and safety, minimize environmental risk of the escape of fine tailings contamination, and restore productive end land use.

Permit No. M-128 was amended on May 18, 2021 to approve the HB Mine Tailings Management Facility Remediation and Closure Plan. As part of the amendment, EMLI stipulated that "*the Permittee shall develop and submit a Water Management and Monitoring Plan by May 31, 2021 to the satisfaction of the Chief Inspector"* (EMLI, 2021). A Water Quality Management and Monitoring Plan (WQMMP) was prepared and submitted accordingly (SLR, 2021). This current report presents the 2022 WQMMP (i.e., 2021 updated WQMP) developed to satisfy EMLI Permit No. M-128 amendment.

The 2022 WQMMP applies to the site conditions post-remediation. A Construction Environmental Management Plan (CEMP), presented under separate cover, was also developed to ensure compliance with environmental protection and mitigation requirements during remediation. The CEMP includes requirement for surface water and groundwater management and monitoring during construction. The WQMMP generally followed and built upon the existing Environmental Monitoring Program (EMP) implemented by RDCK for the TMF, which is detailed in the site's Annual Reclamation Report (RDCK, 2019).

The environmental media considered in the 2022 WQMMP were surface water and groundwater. The Remediation and Closure Plan for the TMF included removal of the current Tailings Pond, which may result in an overall lowering of the water table within the tailings. Permit M-218 required characterization of pre-construction tailings porewater, for this reason porewater was added to the environmental media considered in the 2022 WQMMP.

Site closure works completed in 2021 included dewatering and backfilling of the tailings pond, lowering and rebuilding the spillway, construction of the dam toe berm and upstream beach, placement of surface cover and landform stockpiling. The tailings pond dewatering was completed between June 8, and 18, 2021. Water quality monitoring and sampling completed during discharge of tailing pond water and during the construction environmental monitoring is documented under separate cover (SLR, 2021).

Anticipated scope to be completed in 2022 includes completion of tailing surface and landform cover placement, construction of the lined surface water channels as well as seeding areas of exposed soils in the tailing and borrow pit areas.

## 1.1 Objectives

The 2022 WQMMP is intended to outline monitoring, reporting, and QA/QC program for water resources (e.g. surface water, tailings porewater, seepage and groundwater) at the HB Mine TMF following remediation and closure. The goal of the WQMMP will be to ensure the works constructed as part of the remediation and closure plan are performing as intended and that there are no adverse effects on the environment or human health.

## 1.2 Annual Document Review Tracker

This current report provides an update to the 2021 WQMMP. Table 1, presented after the text, provides a log of the changes made to the original text, tables and/or figures.

# 2.0 KEY SITE CHARACTERISTICS

The following sections describe the key characteristic of the TMF as they pertain to water resources. The information presented below is sourced from the HB Mine Tailings Management Facility Remediation and Closure Plan, prepared by the RDCK (RDCK, 2020).

## 2.1 Topography and Surface Drainage Features

The site is located between the Nelson and Barrington Ranges of the Selkirk Mountains and at the base of the western slope of Iron Mountain. Drawing 2 illustrates the catchment area that reports to the TMF as well as the significant surface drainage features under current pre-remediation and closure conditions.

The major drainage in the area is the Salmo River, located in the floodplain area west of the site. A bedrock ridge trending north-south separates the Salmo River floodplain from the TMF. Sheep Creek is located north of the site and flows westward to the Salmo River. The Central Landfill and Iron Mountain are located east of the site on moderate well-treed slopes.

The tailings deposition area measures approximately 30 hectares and occupies the mid to low portion of a hanging valley that drains to the south. Water from the dam, and recently removed tailings pond, discharges towards the south into the Outlet Ditch located a narrow valley. Drainages crosses Highway 3 via a culvert and flows through a man-made ditch system on the Salmo River floodplain to the Salmo River (RDCK, 2020). The ditch system was rebuilt during remedial works conducted on the downstream property by Teck Resources Ltd. (Teck) in 2021.

## 2.2 Climate

The climate for the region is characterized by warm, dry to moderately moist summers and cool, snowy winters. Snowfall typically starts accumulating in November with maximum accumulation occurring in March. Snow melt at the facility generally occurs in late March and April. Meteorological parameters are not measured at HB Mine Tailings Management Facility (elevation 710 meters (m)). The closest active station to the facility is Castlegar Airport, BC (Climate ID: 1141455), located approximately 36 km northwest of the Facility in an adjacent valley at an elevation of 495 m.

Historically, an Environment Canada climate data station was located in Salmo, BC (Climate ID: 1146944) that operated from 1972 to 1980. The comparison of the climate data indicates that precipitation in Salmo (elevation 670 m), is slightly higher and temperatures generally cooler than in Castlegar, BC. Based on the Castlegar Airport climate normal data, the site is expected to be snow covered an average of 90 days per year. In addition, temperatures at the site are zero degrees Celsius or below for an average of 120 days per year.

A hydrological analysis of the site was undertaken as part of the HB Mine Tailings Management Facility Remediation and Closure Plan to develop inputs to the hydraulic designs of the spillway and other conveyance structures at the facility. A regional analysis was implemented that included data from 22 climate stations within 150 km to establish a long-term synthetic period of record for air temperature, precipitation, wind speed, and snowmelt. Probabilistic climate change modelling was incorporated into the analysis to address climate change trends and effects that may occur at the facility in the future.

The complete analysis is provided in Appendix C-1 of the Remediation and Closure Plan (RDCK, 2020).

## 2.3 Groundwater Hydrogeology

Groundwater monitoring data from the landfill and tailings areas indicate that groundwater flow occurs primarily within the overburden granular/sandy soils that overly generally competent and less permeable bedrock. Bedrock generally consists of phyllite, schist, micaceous quartzite, with minor limestone. An outcropping of granite is observed in the southwestern portion of the site at the west abutment of the tailings dam. The depth to bedrock is less than 10m across the tailings facility (RDCK, 2020). Much of the overburden at the site is composed of relatively permeable sands and sandy gravels. Discontinuous layers of low-permeability silts and silty clays are also evident (CRA 2005a).

Ridges east and west of the facility represent groundwater recharge areas and the tailings pond is an area of groundwater discharge. An east-west bedrock ridge underlies the landfill footprint and provides the northern boundary of the groundwater catchment. Groundwater flows primarily towards the south beneath the tailings, within the valley axis towards the valley bottom aquifer (AMEC, 2014).

Between the landfill and the tailings area, evaluation through single-well response tests indicate that the hydraulic conductivity of the overburden is about $1.8 \times 10^{-5}$ m/s, which is typical of silty sand (CRA, 2005). The calculated groundwater velocity within the tailings area is estimated at 5 to 10 m/year due to the lower hydraulic gradient through the tailings deposition area and the lower hydraulic conductivity of the tailings (RDCK, 2020).

Groundwater is typically encountered less than 1 metre (m) below the ground surface within the tailings deposition area and approximately 4 m below ground surface downgradient of the dam (RDCK, 2020).

The interpreted groundwater elevation contours in the Central Landfill and tailings areas are provided in Drawing 3.

## 2.4 Site Components

The site components that comprise the facility pre and post closure include: the tailings deposition area and tailings pond, the tailings dam, spillway, downstream channel, associated access roads, granite rock quarry, and borrow areas. These elements and their history are discussed in detail in Section 3.0 of the HB Mine Tailings Facility Remediation and Closure Plan (RDCK, 2020).

The pre-remediation and closure tailings deposition area measured approximately 30 hectares and occupied the mid to low portion of a hanging valley that drains to the south. The tailings pond was drained, and the pond was backfilled with fill from the borrow pit in 2021 as part of closure works. Surface water conveyance channels as well as application of remaining surface and vegetation cover will be completed in 2022.

## 2.5 Closure Measures

The post closure project area will include the existing facility as well as the expansion of the toe berm, spillway, rock quarry, and two existing borrow areas located on the south and east sides of the Central Landfill. The majority of closure measures were completed in 2021 with surface water channel and final tailings surface cover to be completed in 2022. Closure measures are discussed in detail in Section 6.0 of the RCP (RDCK, 2020).

The resulting closure components of the remediation consist of the following features:

- Dam upgrades: toe berm expansion and upstream till beach.
- Lowered spillway and elimination of the pond upstream of the dam.
- Tailings cover.
- Lined surface water channels over the tailings facility

The post closure site components pertaining to surface water are briefly described below.

Lined surface water channels will be built over the tailings cover system to convey flows from the Central Landfill wetland area (Main Channel) and from two small ephemeral streams that enter the tailings deposition area (North Spur Channel and South Spur Channel are depicted on Drawing 4. Flows from the three drainage channels will report to the spillway channel at the west abutment of HB Dam and will discharges through the man-made ditch system to the Salmo River. Vegetation growth will be promoted in the channels as a stand-along erosion protection measure to minimize long-term maintenance requirements.

The surface drainage channels are described in Appendix C-6 of the HB Mine Tailings Facility Remediation and Closure Plan (RDCK, 2020).

# 3.0 REGULATORY FRAMEWORK

The BC Ministry of Environment (ENV) is the lead provincial environmental regulatory agency responsible for the administration of contaminated sites policy and management. Key provincial acts and regulations include the following:

- *Environmental Management Act (*EMA*)*, Province of BC, 2003 with amendments to March 24, 2021.
- *Contaminated Sites Regulation* (CSR), Province of BC, 1997, with amendments to March 11, 2021.
- *Hazardous Waste Regulation* (HWR; formerly Special Waste Regulation), Province of BC, 1988, with amendments to November 1, 2017.

This section presents an overview of the regulatory framework, monitoring requirements, and environmental guidelines and standards in the context of the lagoons and receiving environment.

## 3.1 Permit No. M-218 Requirements

The remediation and closure activities at the site are permitted under Permit No. M-128 last amended on May 18, 2021. The following conditions apply under Permit No. M-128 to surface and groundwater management and monitoring:

*4. Surface and Ground Water Management and Monitoring*

*(a) The Permittee shall develop and submit a Water Management and Monitoring Plan by May 31, 2021 to the satisfaction of the Chief Inspector. The Permittee shall ensure the plan includes, but is not limited to, surface water, tailings porewater, seepage, and groundwater quality and quantity monitoring locations, frequencies and parameters. The Permittee shall ensure that an effective QA/QC program for the surface water, groundwater and seepage monitoring programs is included and implemented.*

*(b) The Permittee shall ensure that water quality monitoring results, including interpretation of results, are reported and assessed in the Annual Reclamation Report. The Permittee shall ensure that any significant changes or trends in water quality or quantity are discussed, and those that require additional evaluation and management are identified in the report.*

*(c) The Permittee shall include a comparison of water quality monitoring results to source term concentrations in the Annual Reclamation Report. The Permittee shall ensure that the implications of the results to source term refinement, water quality mitigation, source control and adaptive management are discussed in the report.*"

Conditions applying to porewater monitoring are provided in Clause C.5 of Permit No. M-128 under Tailings Geochemistry Monitoring and Assessment:

*(a) The Permittee shall develop and implement a* Tailings Geochemistry Monitoring and Assessment Report and *shall submit to the Chief Inspector by March 31, 2024. The Permittee shall ensure that the report includes, but is not limited to, the following.*

*(i) A summary of pre-covered and post-covered tailings porewater quality, and unsaturated zone monitoring results;*
*(…)*

*(ii) Comparison of pre-covered and post-covered tailings porewater, solid-phase composition, and geochemical modeling results.*

## 3.2 Contaminated Sites Regulation

The Contaminated Sites Regulation (CSR) under the Environmental Management Act (EMA) is the principal regulatory document defining requirements for contaminated sites management in British Columbia. The CSR came into effect on April 1, 1997 and was amended most recently on March 11, 2021. Under section 63.1 of the EMA, the director's interim standards are legally binding. Protocols under section 64 specify additional legal obligations. The Hazardous Waste Regulation (HWR) may also apply where contaminated media are transported and managed or disposed of off-site.

The EMA and CSR have provisions for incorporating numerical and risk-based standards approaches to managing site contamination. The legislation outlines site assessment procedures, remediation requirements, and application processes for environmental closure for a property. Numerical standards are an essential component of CSR requirements, as they define whether a site is contaminated or has been satisfactorily remediated when using the numerical standards approach.

Technical Guidance, Administrative Guidance, Procedure and Policy documents issued by the BC Ministry of Environment and Climate Change Strategy (ENV) clarify the interpretation of regulatory standards and requirements and provide information regarding their application. Provisions in these documents are not legally binding but indicate the expectations of the ENV.

## 3.3 Guidelines and Standards

The following sections present the water quality guidelines (WQGs) and standards that will be used to assess surface and groundwater quality as part of the WQMP. There are no guidelines for pore water quality. However, any metals that are mobilized from porewater are likely to report to groundwater or potentially surface water and would; therefore, be assessed against groundwater and/or surface water quality guidelines.

### 3.3.1 Surface Water

The BC Approved WQGs (ENV, 2021a) and Working WQGs (ENV, 2021b) will be the preferred source of guidelines for the evaluation of surface water quality, including seepage. Specifically, the surface water quality on-site will be compared to WQG for the protection of the following water uses:

- Freshwater aquatic life (AWF - long-term chronic and short-term acute values;) and,
- Wildlife

The surface water quality in the receiving environment (Salmo River) will be compared to WQG for the protection of the following water uses:

- Freshwater aquatic life (AWF - long-term chronic and short-term acute values);
- Drinking Water;
- Livestock watering;
- Wildlife; and,
- Irrigation.

In the absence of BC ENV Approved and Working WQGs, the Canadian Council of Ministers of the Environment (CCME) WQGs will be used to evaluate the surface water quality.

Specifically, the CCME surface water quality guidelines for the protection of AWF will be selected to evaluate the results for dissolved zinc. The BC ENV Approved WQG for the protection of AWF for zinc applies to total zinc. The BC ENV zinc guideline factsheet indicates that "*soluble species of zinc are readily available for biological reactions and, therefore, most toxic*". For this reason, BC ENV recommended that the zinc guideline should be interpreted in terms of the dissolved metal fraction. The CCME (2018) has recently derived a dissolved zinc WQG for the protection of AWF. This WQG will be applied to the dissolved zinc results.

The BC CSR Generic Numerical Water Standard (Schedule 3.2) AWF divided by 10 will be used for parameters without BC ENV or CCME WQGs.

In addition, to the above WQGs and standards, toxicity reference values (TRVs) were derived as part of the Human Health and Ecological Risk Assessment (HHERA Report SLR 2019: Section 3.4; Appendix E) and to support the dewatering of the tailings pond (SLR,2020). The TRVs will also be used to evaluate the results of the surface water samples (see Section 4.1.3 of this current report).

### 3.3.2 Groundwater

The following CSR standards are applicable to the groundwater at the site:

- BC CSR Schedule 3.2 Generic Numerical Water Standards for freshwater aquatic life (AWF);
- BC CSR Schedule 3.2 Generic Numerical Water Standards for drinking water (DW).

For parameters not regulated under the CSR, the BC Approved and Working WQGs for AWF multiplied by a factor of ten (to account for dilution along the groundwater flow path prior to discharge to surface water) (10x BC WWQG AWF) will be applied to groundwater.

# 4.0 WATER MONITORING

Post-construction water quality monitoring will be required to ensure the constructed works are performing as intended and that there are no adverse effects on the environment or human health.

This section provides a summary of water quality before construction, water quality observed in 2021 and predicted water quality and presents the surface and groundwater management and monitoring program that will be implemented post construction.

As indicated in the introduction, the surface, groundwater and porewater monitoring programs presented in this section generally follows and builds upon the existing Environmental Monitoring Program, which is detailed in the site's Annual Reclamation Report (RDCK, 2019).

## 4.1 Surface Water Monitoring

### 4.1.1 Summary of Surface Water Quality Conditions

#### 4.1.1.1 Pre-construction Water Quality Conditions

Surface water quality has been monitored as part of the reclamation monitoring program in the tailings area in the spring and fall of each year since 2002. Surface water samples have been collected from six locations: SW1-07, SW2-07, SW3-07, SW4-07, Tailings Pond Outlet, and Outlet Ditch as depicted on Drawing 5.

Locations SW2-07 and SW3-07 are located upgradient of the tailings storage facility and to the south of the landfill and have been used to characterize background water quality for tailings storage facility.

In October 2018 an additional sample location - seepage area upstream of the v-notch weir below the dam was added to the program. In addition, in April and October 2019, three surface water samples (Tailings Pond East, Tailings Pond SE and Tailings Pond West) were collected from within the tailings pond at different depths to characterize the water quality in the tailings pond (SLR, 2020). The samples were analyzed by ALS and Bureau Veritas, both Canadian Association for Laboratory Accreditation certified laboratories located in Burnaby BC. The samples were analyzed for general parameters, anions, nutrients, and total and dissolved metals.

The results were compared to the guidelines listed in Section 0 of this current report.

Metals and nutrients including aluminum, cadmium, copper, iron, lead, manganese, selenium, uranium, zinc and nitrate (as N) have been detected in surface water at the site above the applicable guidelines since 2016 (RDCK, 2020; SLR, 2020).

In May 2021, a Baseline Water Quality Program was implemented by SLR to characterize surface water quality prior to draining the tailings pond. Three tailings pond water samples, and one tailings pond outlet sample were collected to determine concentrations prior to the tailings pond dewatering. The results were compared to the limits specified in ENV Authorization (Number 110450 – ENV 2021d) to drain the pond. All concentrations were less than the authorized limits. Two samples were also collected in the Salmo River samples (upstream and downstream of the drainage ditch discharge). The results were compared to the guidelines listed in Section 0 of this current report.

All parameters were less that the WQGs AWF except for dissolved copper.

#### 4.1.1.2 Summary of Current Water Quality Conditions

Current water quality is defined in this report as water quality obtained after the main tailings pond draining activities that occurred in June 2021. Surface water samples were obtained from six locations in the winter 2021/2022. SW1-07, SW2-07, SW3-07 and the Outlet Ditch were sampled on December 16, 2021, as depicted on Drawing 5. The Tailings Pond Outlet and the Seepage Weir were sampled on January 20, 2022.

Four parameters exceeded the BC Approved or Working WQGs for the protection of aquatic life: sulfide (as $H_2S$), total cadmium, total iron and total zinc. Sulphide only exceeded the WQG AWF at the Landfill Outlet (SW07-1). Total cadmium and total zinc only exceeded the WQG AWF at the Tailings Ponds Outlet. The WQG for cadmium applies to dissolved cadmium. In the absence of dissolved cadmium results the total concentrations were compared to the WQG. This is conservative and it likely that dissolved cadmium concentrations would be lower.

Similarly, ENV indicates that dissolved zinc should be assessed when total zinc concentrations exceed the WQG. Dissolved zinc concentrations were not available. Total iron exceeded the WQG AWF at the background location SW2-07.

Total cobalt exceeded the WQG DW value at the background location SW07-2.

Manganese exceeded the WQG IW value at the background location SW07-2, the landfill outlet (SW07-1), the Tailings Pond Outlet and the Seepage Weir. All parameters were below the applicable guidelines at the outlet ditch.

### 4.1.2 Summary of Predicted Water Quality Conditions

SRK Consulting (SRK) used a water and load balance model to predict water quality concentrations for the drainage ditch downstream of the tailings pond under post-closure conditions. Full details of the water and load balance are provided in Appendix I of the Remediation and Closure Plan (RDCK, 2020).

A summary of the results of the predictive modelling for post-closure conditions is provided below.

The model considered inputs from the upland landfill, runoff from upstream catchments, direct precipitation onto the facility, and outflows through the spillway and downstream seepage. The water balance made use of annual precipitation inputs and of the average monthly discharge distributions from the Salmo River to model volumetric flow rates from upstream catchment areas to the TMF. The model was calibrated by comparing the calculated flows with observed flows from select monitoring stations. The water quality parameters that are monitored seasonally (spring and fall) were further applied in the calculations of mass-balance loadings.

The mass balance accounted for loading sources within the model domain, as well as fluxes in and out of the model domain. Loading rates were estimated by assigning source water quality concentrations to the inflows for the corresponding sub-catchments estimated in the water balance. Parameter concentrations at each model node was determined by summing the parameter load reporting to that node and dividing by the total volume at that node. For most parameters, loadings were assumed to be conservative (i.e., not attenuated). Aluminum, iron, manganese, and zinc were overestimated using this approach, and estimates of attenuation, developed based on calibration with monitoring data, were applied for these parameters.

The model was set up and calibrated for existing conditions. The calibrated inputs were then applied to the current TMF configuration using average hydrological conditions and average source terms including attenuation estimates for some parameters (Current Condition), and to the post-closure TMF configuration including covered tailings. The model's assumptions were evaluated with sensitivity analyses for infiltration rates, source terms, attenuation factors, and hydrological conditions.

Water quality predictions were developed for aluminum, cadmium, chromium, copper, iron, lead, manganese, sulphate, sulphide, and zinc based on the fact that these parameters have been observed to exceed the applicable WQGs for the protection of aquatic life .

The following conclusions were made by SRK based on the water quality modelling exercise regarding the sources:

- The tailings material is the primary source of sulphate, cadmium, iron, lead, and zinc; the cover is predicted to reduce concentrations of these parameters at the Outlet Ditch.
- The background catchment runoff is the primary source of chromium, copper, manganese and sulphide.
- The cover material is the primary source of aluminum; however, this could be an artifact of source-term development based on total metals, which includes both the dissolved and suspended fractions. The suspended fraction will not act conservatively as water flows through the facility.

The water quality prediction model indicates that the tailings closure and remediation will results in reduced concentrations of sulphate, iron, lead and manganese in surface water. These parameters are predicted to be below the applicable WQGs post closure. Concentrations of aluminum, cadmium, copper and zinc in surface water are predicted to still exceed the applicable WQG for the protection of aquatic life post closure; although the cover will result in decreases in cadmium, copper and zinc concentrations.

Water quality guidelines are conservative benchmarks used to evaluate water quality and inform the need for further study. Guidelines exceedances do not mean that adverse effects are occurring. For this reason, scientific-based methods are in place to inform site remediation. One such tool is risk assessment. A risk assessment was completed to evaluate the significance of the surface water exceedances (SLR, 2019). The risk assessment indicated that the risks associated with the WQG exceedances would be low and would not warrant active water treatment. The WQMMP subject of this current report will confirm the risk assessment findings.

### 4.1.3 Surface Water Monitoring Program

The following sections present the locations, frequency and parameters analyzed as part of the surface water monitoring program. Detailed monitoring and sampling result are included in the HB TMF annual reclamation report (RDCK, 2021) and are summarized below.

#### 4.1.3.1 Surface Water Sampling Locations

The recommended surface water sampling locations have been selected to correspond to previous sampling locations; this allows for comparisons of water quality with pre-construction values and for trends analysis. Drawing 6 provides the surface water sampling locations and Table 4-1 provides location descriptions.

**Table 4-1:**
**Surface Water Sampling Locations and Rationale for Selection**

| Sampling ID | Location Description | Rationale |
|---|---|---|
| *TMF Surface Water Sampling Locations* | | |
| SW1-07 | Central Landfill outflow collected immediately upstream of the tailings facility in the Main Channel | Characterize background surface water quality before it drains over the reclaimed TMF and account for landfill influences. |
| SW2-07 | Collected from the seasonal stream located upstream of the North and South Spur Channels | Characterize background surface water quality before it drains over the reclaimed TMF. |
| SW5-19 | Background sample collected from the seasonal North Spur Channel upstream of the TMF. | Characterize background surface water quality in the North Spur Channel before it drains over the reclaimed TMF. |
| SW3-07 | Background sample collected from the seasonal South Spur Channel upstream of the TMF. | Characterize background surface water quality in the South Spur Channel before it drains over the reclaimed TMF. |
| SW9 | In the Main Channel immediately upstream of its confluence with the North Spur Channel. | Characterize surface water quality in Main Channel after it flows over reclaimed TMF and before inputs from North and South Spur Channels. |

| Sampling ID | Location Description | Rationale |
|---|---|---|
| SW10 | In North Spur Channel upstream of its confluence with the Main Channel. | Characterize surface water quality in the North Spur Channels after it flows over reclaimed TMF. |
| SW11 | In South Spur Channel upstream of its confluence with the Main Channel. | Characterize surface water quality in the South Spur Channels after it flows over reclaimed TMF. |
| Spillway Inlet | Collected in the spillway inlet area at a location downstream of the TMF. | Characterize surface water quality draining from the reclaimed TMF. |
| Spillway Outlet | Collected immediately downstream of the stilling basin. | Characterize surface water quality draining from the reclaimed TMF downstream from the spillway. |
| Outlet Ditch | Collected upstream of the culvert crossing Highway 3. | Characterize surface water quality draining from the property onto the Salmo River floodplain. |
| *Salmo Surface Water Sampling Locations* | | |
| Salmo – Upstream | Collected approximately 100m upgradient of the point of discharge where the downstream channel intersects the Salmo River. | Characterize background surface water quality in Salmo River upstream of the point of discharge. |
| Salmo - Downstream | Collected approximately 100m downgradient of the point of discharge where the downstream channel intersects the Salmo River. | Characterize surface water quality in Salmo River downstream of the point of discharge. |

The three surface drainage channels will be lined with a geosynthetic liner to reduce infiltration into the tailings and prevent erosion of the tailings. In addition, turf reinforcement mats will be placed in the channels to provide immediate erosion protection and promote grass vegetation growth as a stand-alone protection against erosion (RDCK, 2020). Locations SW9, SW10 and SW11 are intended to characterize the surface water quality in the drainage channels after they drained over the TMF to confirm that the drainage channels function as intended. Location SW5-19 will characterize water quality North Spur Channel upstream of the TMF. These four locations will be monitored once the lined channels are constructed. There were no parameters exceeding the applicable guidelines in samples obtained at the Ditch Outlet location in 2021. It is recommended that the Salmo Upstream and Downstream locations be added to the program only if exceedances are observed at the Ditch Outlet location The number and/or locations of TMF surface water sampling stations will be reviewed each year based on the WQMP results.

#### 4.1.3.2 Sampling Frequency

The post closure sampling program for the TMF locations will consist of quarterly monitoring to capture seasonal variation and high and flows (April/May (freshet), July, October, December).

The drainage channel flows will vary seasonally, and the channel may be dry in the summer and frozen in the winter; thus sampling in the winter and summer will depend on available flows. The discharge channel is also ephemeral and flows generally only reach the Salmo River during freshet. For this reason, the locations in the Salmo River, upstream and downstream of the discharge, will only be sampled when the discharge channel is flowing into the Salmo River. The monitoring frequencies will be reviewed as part of the annual report and are expected to be reduced to an annual frequency in the long-term, once it can be demonstrated that the facility is physical and chemically stable.

#### 4.1.3.3 Surface Water Sampling Methodology

Surface water sampling will be conducted by RDCK-contracted environmental technician Standardized procedures should be used for surface water sampling to maintain consistency in data collection and to prevent cross-contamination. Surface water sampling should be carried out in accordance with the procedures described in the "British Columbia Field Sampling Manual, 2013 Edition", or most recent edition, or by procedures accepted by BC ENV. The following procedure summary is recommended based on generally accepted environmental practices and ENV guidance for surface water monitoring. Scientifically defensible modifications to the procedures outlined below may be acceptable but should be supported by appropriate rationale.

Prior to sampling, *in situ* parameters (pH and temperature) at the point of sampling should be measured (field pH and temperature along with laboratory analyzed DOC and hardness should be used to calculate the WQG for some metals such as dissolved copper). Surface water samples should be collected directly from the waterbodies. Laboratory prepared sample bottles should be attached to a pole sampler, if required, then lowered directly into the water and allowed to fill. Preservatives should be added as required. The samples should be labelled and stored in ice filled coolers. The samples along with completed chain of custody forms should be transported to an accredited laboratory for analysis within the acceptable holding times.

#### 4.1.3.4 Surface Water Quality Analyses

The parameters for laboratory and field analyses of water quality samples are summarized in Table 4-2. In addition to the parameters listed below, flow measurements utilizing a flow meter (L/s) and water depth should be recorded at all locations.

**Table 4-2:**
**Surface Water Samples Analytes**

| Parameter Group | Analytes |
|---|---|
| Physical Parameters | Field temperature, dissolved oxygen, conductivity*<br>hardness (as CaCO3), turbidity*, total suspended solids (TSS) and pH* |
| Anions and Nutrients | Total alkalinity, ammonia, bromide, chloride, nitrate, nitrite, total Kjeldahl Nitrogen, phosphorus (P)-total, sulphate, un-ionized sulfide |
| Organic carbon | Total organic carbon, dissolved organic carbon |
| Total and dissolved metals | Total and dissolved metals (by ICP-MS, sufficient to meet BC Aquatic Life criteria including mercury and speciated chromium analysis) |

**Note:**

*in situ and laboratory analytes.

#### 4.1.3.5 Surface Water Quality Evaluation and Reporting

Comprehensive annual reports should be prepared for submission to EMLI including description of sampling activities, tables of analytical results compared against applicable standards/guidelines and TRV, site plans and laboratory reports.

The report should also include a review of spatial and temporal trends and identify increases in contaminant loadings between the inflows and outflows of the TMF.

In addition, as per requirement of Permit M-218, the post-closure surface water quality monitoring results should be used to update the water and load balance model.

## 4.2 Groundwater Monitoring

### 4.2.1 Summary of Current Water Quality Conditions

Groundwater quality has been monitored as part of the reclamation monitoring program in the tailings area since 2005. Recent monitoring has included collection of groundwater samples from 12 monitoring wells; MW99-1(S) and(D), MW99-2(S and (D), MW-05-01, MW-01-2004(S) and (D), MW-02-2004(S) and (D), MW-02A-01, MW-03A-01 and MW-06-01. These wells are screened in both overburden/tailings and bedrock. Water quality from wells MW-02A-01, MW-03A-01 and MW-05-01 represent background water quality. A residential well located at 8102 Hwy 3 is part of the annual reclamation monitoring; however, no recent sampling has been completed at this location.

Sampling is typically completed twice per year in spring and fall. Samples are submitted to Bureau Veritas Laboratories and/or ALS, both Canadian Association for Laboratory Accreditation certified laboratories located in Burnaby BC for analysis of general parameters, nutrients and dissolved metals. The results were compared to the guidelines listed in Section0 of this current report.

Concentrations of metals were below applicable guideline values in background wells with the exception of lithium and manganese. Within the tailings, concentrations of sulfate, magnesium, cobalt, iron, manganese, and zinc have been detected above the applicable guideline values. However, concentrations are below criteria in downgradient wells with the exception of lithium (RDCK, 2020; SLR, 2020).

### 4.2.2 Groundwater Monitoring Program

#### 4.2.2.1 Groundwater Monitoring Locations

The groundwater sampling locations have been selected to correspond to previous sampling locations to allow for water quality comparisons to be made to pre-construction values. Additional locations have been included to provide further assessment of groundwater along the flow path.

Groundwater sampling locations are shown in Drawing 7 and with Table 4-3 providing sample location descriptions and rationale.

**Table 4-3:**
**Groundwater Sampling Locations and Rationale for Selection**

| Sampling ID | Location Description | Rationale |
|---|---|---|
| MW99-1 (S) and (D) | Approximately 150m downgradient/south of the tailings facility. The shallow well (S) is screened in overburden, and the deep well (D) is screened in bedrock. | Characterize groundwater quality as it flows downgradient from the TMF. |

| Sampling ID | Location Description | Rationale |
|---|---|---|
| MW-01-2004 (S) and (D) | Downgradient/south of the tailings facility, approximately 150 m north of Highway 3. The shallow well (S) is screened in overburden, and the deep well (D) is screened in bedrock. | Characterize groundwater quality as it flows downgradient from the TMF and prior to reaching the property boundary. |
| MW99-2 (S) and (D) | Immediately west of the tailings area and downgradient along the western flow path. Both wells (S) and (D) are screened in bedrock. | Characterize groundwater quality as it flows westward in the northern portion of the Site. |
| E221703/S-MW-2 | Located between Landfill and Tailings, screened in overburden. | Characterize groundwater quality originating from the landfill and flowing towards the TMF. |
| MW-04S-05 | Towards the southern portion of tailing facility, screened in overburden/tailings | Evaluate changes in groundwater quality within the tailings after cover construction. |
| MW-06-01 | Within northern portion of tailing facility, screened in overburden/tailings | Evaluate changes in groundwater quality within the tailings after cover construction. |
| MW-05-01 | Background well is screened in overburden located approximately 200 m east of the current tailings pond. | Characterize background groundwater quality in overburden. |
| MW-02A-01 | Background well is screened in overburden located north of landfill across Sheep Creek | Characterize background groundwater quality in overburden. |
| E221702/S-MW-1 | Background well is screened in bedrock located east of landfill | Characterize background groundwater quality in bedrock. |

Monitoring has also historically been completed at MW-02-2004 (S) and (D); however, due to the proximity of these wells to MW99-1 (S) and (D), these wells are suggested to be removed from the monitoring program post-construction. However, should results suggest groundwater impact downgradient of the tailings facility, monitoring at these locations can be re-instated at that time.

Background water quality is proposed to be collected from wells MW-05-01, located east of the current tailings pond, and MW-02A-01, located north of the landfill at Sheep Creek. Both of these wells are screened in overburden. In addition, background bedrock water quality is proposed to be sourced from well E221702/S-MW-1 located east of the landfill.

Both monitoring wells MW99-2 (S) and (D) located along the western boundary of the TMF are screened in bedrock. Consideration should be given to installing another well at this location and screened with the overburden to assess shallow groundwater flow in this area of the facility. However, it is noted that MW99-2 (D) is reported to be artesian, indicating upwards groundwater gradients at this location.

#### 4.2.2.2 Groundwater Monitoring Frequency

The post closure groundwater sampling program will initially consist of quarterly monitoring in April/May (freshet), July, October, December. The monitoring frequencies will be reviewed as part of the annual report and are expected to be reduced to an annual frequency in the long-term, once it can be demonstrated that the facility is physically and chemically stable.

#### 4.2.2.3 Groundwater Sampling Methodology

Groundwater sampling will be completed by RDCK-contracted environmental technicians. Standardized procedures should be developed and used for groundwater sampling to maintain consistency in data collection and to prevent cross-contamination. Sampling should be carried out in accordance with the procedures described in the "British Columbia Field Sampling Manual, 2013 Edition", or most recent edition, or by procedures accepted by BC ENV.

The following procedure summary is recommended based on generally accepted environmental practices and BC ENV guidance for groundwater monitoring. Scientifically defensible modifications to the procedures outlined below may be acceptable but should be documented and supported by appropriate rationale.

Prior to sampling, the water level in the well should be measured relative to either the top of pipe or ground surface.

The objective of sampling is to obtain groundwater samples that are representative of formation conditions. In order for the sample to be representative, any standing water within the monitoring well casing and surrounding annulus should be purged from the well. There are two basic methods for establishing that well purging has been sufficiently completed. The first method is based on the removal of three to five standing well volumes. The second method is based on the stabilization of specific physical parameters (such as pH, conductivity, and turbidity) that are periodically assessed during purging.

Groundwater samples should be collected using either positive pressure submersible pumps, negative pressure peristaltic pumps, inertial displacement pumps or bailers. Whatever method is selected, it should remain consistent over time where possible. Prior to collecting each sample, field parameters should be measured on separate un-preserved and un-filtered sub-samples. Samples for dissolved metals analysis should be filtered in the field. Samples should be collected in laboratory prepared sample bottles. Preservatives should be added as required. The samples should be labelled and stored in ice filled coolers. The samples along with completed chain of custody forms should be transported to an accredited laboratory for analysis within the acceptable holding times.

#### 4.2.2.4 Groundwater Quality Analyses

After construction is complete, and prior to the initiation of the post-closure groundwater monitoring program, it is recommended that an elevation survey of the monitoring wells be completed to determine both ground surface and top of pipe elevations of all wells to allow for appropriate determination of groundwater flow directions.

The parameters for laboratory and field analyses of water quality samples are summarized in Table 4-4.

In addition to the collection of field parameters of temperature, pH, conductivity, dissolved oxygen (DO) and sulphide, water levels should be collected in all wells prior to sampling. Laboratory analyses should also include both total and dissolved metals. The list of parameters will be reviewed regularly, and changes made, based on analysis and interpretation of monitoring results.

**Table 4-4:**
**Groundwater Samples Analytes**

| | |
|---|---|
| Groundwater Analyses | • pH<br>• Total dissolved solids (TDS)<br>• Sulphate<br>• Total and dissolved metals (by ICP-MS, sufficient to meet BC Aquatic Life criteria)<br>• Nitrate/nitrite<br>• Ammonia<br>• Orthophosphate<br>• Temperature<br>• Conductivity<br>• Dissolved oxygen<br>• Sulfide<br>• Water elevation |

#### 4.2.2.5 Groundwater Quality Evaluation and Reporting

Reporting for the groundwater monitoring will include comprehensive annual reports prepared for submission to EMLI. Reports will include description of sampling activities, locations, summary of methodologies and tabulation of analytical results. A groundwater elevation contour map should also be completed for both high water (spring) and low water (fall) seasons.

The focus of the analytical review should be on exceedances of the applicable standards/guidelines and any trends that might suggest an increase in contaminate loadings to groundwater. If significant negative trends are clearly evident at any time, taking into account seasonal variability, the data should be reviewed by a qualified geochemist. The parameters and plot types used to evaluate temporal variance will be chosen to comply with EMLI Annual Reclamation Report Format Requirements. If a significant increase in contaminants concentrations or in frequency of exceedances is observed, additional investigations will be implemented (e.g. additional environmental sampling and remedial activities).

## 4.3 Tailings Porewater Monitoring Program

Clause C.5 of Permit No. M-128 requires the development of a Tailings Geochemistry Monitoring and Assessment program, with a report provided to the Chief Inspector by March 31, 2024. The purpose of this assessment is to evaluate potential effects of the tailings cover placement and lowering of the spillway invert elevation and subsequent potential lowering of the groundwater table on the tailings geochemistry.

### 4.3.1 Porewater Monitoring Locations

Three porewater sampling locations have been selected near the former tailings pond that are predicted to be most affected by the lowering of the spillway and cover placement. The monitoring locations are shown in Drawing 7 and listed in Table 4-5. The three locations were selected as they are close to the pre-construction water table, near the spillway and north of the tailings pond backfill area to make post-construction sample collection easier.

**Table 4-5:**
**Porewater Sampling Locations**

| Sampling ID | Northing (m) | Easting (m) | Location Description |
|---|---|---|---|
| PW-1 | 5,442,150 | 481,780 | Approximately 60m upstream of the spillway immediate to the north of the Main Tailings Surface Drainage Channel. |
| PW-2 | 5,442,115 | 481,700 | Approximately 150 m upstream of the spillway near the center of the tailings impoundment north of the former tailings pond. |
| PW-3 | 5,442,190 | 481,945 | Approximately 30 m east of the South Spur Channel Inlet. |

### 4.3.2 Porewater Monitoring Frequency

Pre-construction samples were collected on June 6 and 10, 2021 and submitted to the laboratory for analysis. Post-construction samples are to be collected during June 2023, or once water levels in the tailings impoundment have lowered in response to the construction activities. Cores or test pits are to be excavated at each sample location to determine the depth to the saturated tailings to determine if laboratory testing is required.

### 4.3.3 Porewater Sampling Methodology

Tailings porewater samples are to be collected by SRK. A 2-inch soil corer is to be used to core down through the tailings and collect samples at 0.3 m intervals. For the post-construction samples, the holes will be dug through the till cover prior to advancing the soil corer. If the tailings are dry, multiple cores are to be advanced to obtained sufficient porewater for laboratory testing. If the samples are unable to be retained within the soil corer, hand-dug samples are to be collected.

Each hole is to be logged to indicate the following:

- Changes in water content (dry, moist, wet)
- Changes in colour (orange, yellow, brown, grey)
- Texture (loose, cemented, platy, etc.)

Each sample is to be labelled and sealed in a manner to be air-tight with as little air as possible within the container (either the soil core tube, or zip-lock bag). All samples are to be stored in a cooler and kept cool or frozen.

Particular care is to be made to prevent contamination between samples. All collection devices (shovel, soil corer, etc.) are to be cleaned and rinsed with distilled water between locations.

All samples are to be sent to a laboratory equipped with a Porewater Piston Squeezer that will be used to extract the tailings porewater from each sample.

### 4.3.4 Porewater Laboratory Analyses

Following porewater extraction, laboratory analyses are to be completed for the parameters listed in Table 4-6.

**Table 4-6:**
**Tailings Samples Analytes**

| | |
|---|---|
| Porewater Analyses | • pH<br>• Conductivity<br>• Alkalinity<br>• Sulphate<br>• Dissolved metals by ICP-MS<br>• Nitrate/nitrite<br>• Phosphate |
| Tailings Solid Analyses | • Total Sulphate<br>• Sulfide<br>• Total Carbonate<br>• Modified acid base accounting, neutralization potential<br>• Trace elements by aqua regia |

### 4.3.5 Porewater Quality Evaluation and Reporting

Following receipt of the post-construction laboratory test results, an evaluation will be completed to compare the pre-construction and post-construction tailings porewater and solid-phase compositions. The results will also be compared to the SRK (2017) document "Prediction of Geochemical Performance of HB Tailings Under Proposed Remediation Conditions and, and if required, an update of the geochemical model (SRK 2017) will be prepared along with an updated assessment of the long-term geochemical stability of the tailings. The report will also include recommendations for additional tailings geochemistry monitoring if required.

# 5.0 QUALITY ASSURANCE/ QUALITY CONTROL

A quality assurance and quality control (QA/QC) program should be followed to confirm that the sampling and analytical data are meaningful and reproducible. Two stages of QA/QC should be completed, with one stage completed by the laboratory and one stage completed as part of the field procedures.

In situ meters and water quality probe should be calibrated as per manufacture instructions. At minimum, calibrations should be completed daily and documented in field notes.

All monitoring equipment should be clean, in good working order, and maintained as per manufacture instructions. All equipment should be cleaned between each sample collection to prevent cross-contamination.

Samples should be submitted for analyses to laboratories accredited by the Standards Council of Canada in cooperation with the Canadian Association for Laboratory Accreditation Inc. (CALA). As an internal quality control, these laboratories routinely report the results of laboratory spikes and duplicate analyses and report the results of the laboratory QA/QC in the laboratory certificates. The laboratory QA/QC results should be reviewed and flags followed up on.

To verify the reproducibility of the laboratory analyses and to demonstrate that the field sampling techniques utilized by field personnel are capable of yielding reproducible results, blind field duplicate (BFD) samples of surface water and groundwater should be collected at a frequency of approximately one in ten samples and submit to the laboratory for analyses. The relative per cent difference (RPD) between the original sample and its duplicate should be calculated for each parameter. RPD is defined as the difference of the absolute between the two results (original sample and duplicate) divided by the average of the two results expressed as a percentage. Analytical error increases near the method detection limit; therefore, the RPDs should not be calculated if results of the original sample and/or its duplicate are greater than five times the method detection limit. The RPDs should be compared to recommended alert limits to evaluate the sample result variability. The recommended alert limits for field duplicate RPDs are based on a factor of 1.5x the RPD for laboratory duplicate samples.

The RPDs for laboratory duplicate samples are provided in the BC Environmental Laboratory Manual.

# 6.0 STATEMENT OF LIMITATIONS

This report has been prepared and the work referred to in this report has been undertaken by SLR Consulting (Canada) Ltd. (SLR) for the Regional District of Central Kootenay, hereafter referred to as the "Client". It is intended for the sole and exclusive use of the Regional District of Central Kootenay. Other than by the Client and as set out herein, copying or distribution of this report or use of or reliance on the information contained herein, in whole or in part, is not permitted unless payment for the work has been made in full and express written permission has been obtained from SLR.

This report has been prepared for specific application to this site and site conditions existing at the time work for the report was completed. Any conclusions or recommendations made in this report reflect SLR's professional opinion based on limited investigations including: visual observation of the site, surface and subsurface investigation at discrete locations and depths, and laboratory analysis of specific chemical parameters. The results cannot be extended to previous or future site conditions, portions of the site that were unavailable for direct investigation, subsurface locations which were not investigated directly, or chemical parameters and materials that were not addressed. Substances other than those addressed by the investigation may exist within the site; and substances addressed by the investigation may exist in areas of the site not investigated in concentrations that differ from those reported. SLR does not warranty information from third party sources used in the development of investigations and subsequent reporting.

Nothing in this report is intended to constitute or provide a legal opinion. SLR expresses no warranty to the accuracy of laboratory methodologies and analytical results. SLR makes no representation as to the requirements of compliance with environmental laws, rules, regulations or policies established by federal, provincial or local government bodies. Revisions to the regulatory standards referred to in this report may be expected over time. As a result, modifications to the findings, conclusions and recommendations in this report may be necessary.

The Client may submit this report to the BC ENV and/or related BC environmental regulatory authorities or persons for review and comment purposes.

CT/BF/MV/ kw

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# 7.0 REFERENCES


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# TABLES

## Water Quality Management and Monitoring Plan – 2022 Update

Regional District of Central Kootenay

HB TAILINGS MANAGEMENT FACILITY

SALMO, BC

SLR Project No: 204.03242.00008

## TABLE 1: ANNUAL DOCUMENT REVIEW TRACKER

| Report Section | Issue ID or Explanation for Addition | Description of Revision |
|---|---|---|
| 1.0 - Introduction | Introduction only described the first WQMP prepared in May 2021. | Introduction edited to indicate the current document is the 2022 update of the WQMP. |
| 1.0 - Introduction | Introduction did not include porewater as an environmental media considered in the WQMP | Introduction edited to include porewater. |
| 1.0 - Introduction | 2021 site works not included in summary. | 2021 site construction works summary and 2022 proposed site works added to the document. |
| 1.0 - Introduction | Introduction did not include an annual document review tracker. | Section 1.2 Annual Document Review Tracker added to the document. |
| 2.1 - Topography and Surface Drainage Features | 2021 ditch works not included in site drainage description. | 2021 ditch system upgrades completed by Teck added to section of report. |
| 2.4 Site Components | Current site components required updates. | This section was updated to include current site components and 2021/2022 site closure works. |
| 2.4 Closure Measure | The closure measures did not included the work done in 2021. | 2021 closure work added to document. |
| 3.1 Permit No. M-218 Requirements | This section did not include requirements pertaining to porewater. | Section 3.1 updated to include Permit M-218 porewater requirements and most recent permit date. |
| 5.1.2- BC *Environmental Management Act* (EMA) and Contaminated Sites Regulation (CSR) | Revisions to BC Contaminated Site Regulation (CSR) occurred in 2021. | Section of report replaced to include CSR updates through March 11, 2021. |
| 3.3 - Guidelines and Standards | This section did not include porewater regulatory details. | Porewater regulatory details added to section. |
| 4.0 - Water Monitoring | This section did not include porewater. | Porewater added to section. |
| 4.1.1.1- Pre-construction Water Quality Conditions | 2021 data not included in previous document. | A summary of 2021 baseline assessment and Waste discharge Authorization #110450 added to document. |
| 4.1.1.2 - Summary of Current Water Quality Conditions | 2021 data not included in previous document. | A summary of 2021 water quality added to documents. |
| 4.1.3.1 - Surface Water Sampling Locations | Additional surface water and post closure details not included. | Rational for sampling SW5-19 as well post closure details added to document. |
| 4.3 - Tailings Porewater | Tailings porewater not included in 2021 document. | Tailings porewater section 4.3 added to document. |
| 7.0 - References | Reference section requires updates. | Reference section updated in 2022 document. |
| ATTACHMENTS | | |
| Tables | Annual document review tracker not included in report. | Addition of Table 1: Annual document review tracker. |
| Drawings | | No change. |

# DRAWINGS

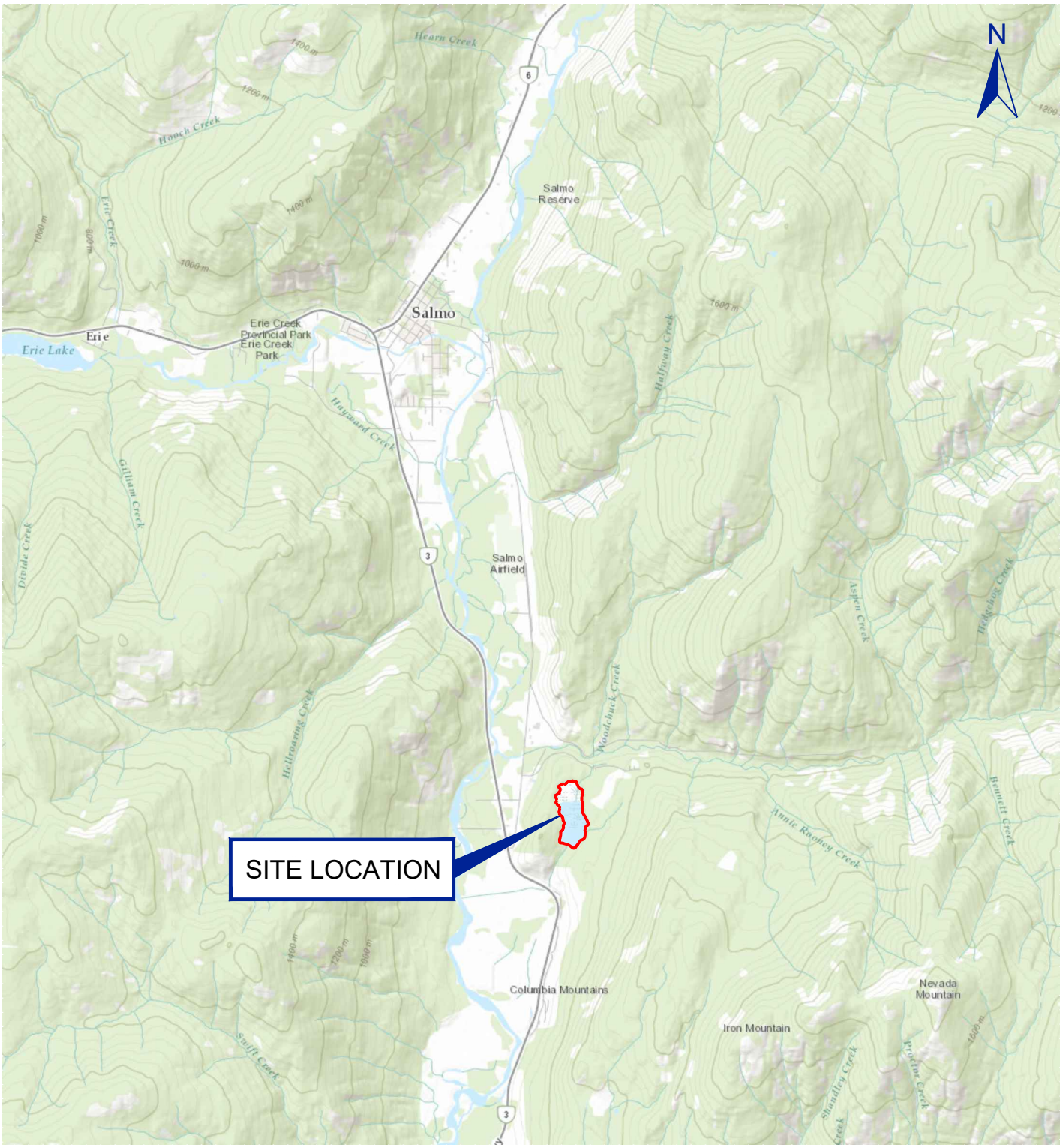
## Water Quality Management and Monitoring Plan – 2022 Update

Regional District of Central Kootenay

HB TAILINGS MANAGEMENT FACILITY

SALMO, BC

SLR Project No: 204.03242.00008




Basemap sources: Esri, DeLorme, HERE, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, and the GIS User Community

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SCALE 1:75,000
WHEN PLOTTED CORRECTLY ON A 11 x 17 PAGE LAYOUT
NAD 1983 UTM Zone 11U

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REGIONAL DISTRICT OF CENTRAL KOOTENAY
HB TAILINGS MAINTENANCE FACILITY
SALMO, BC

WATER QUALITY MANAGEMENT PLAN

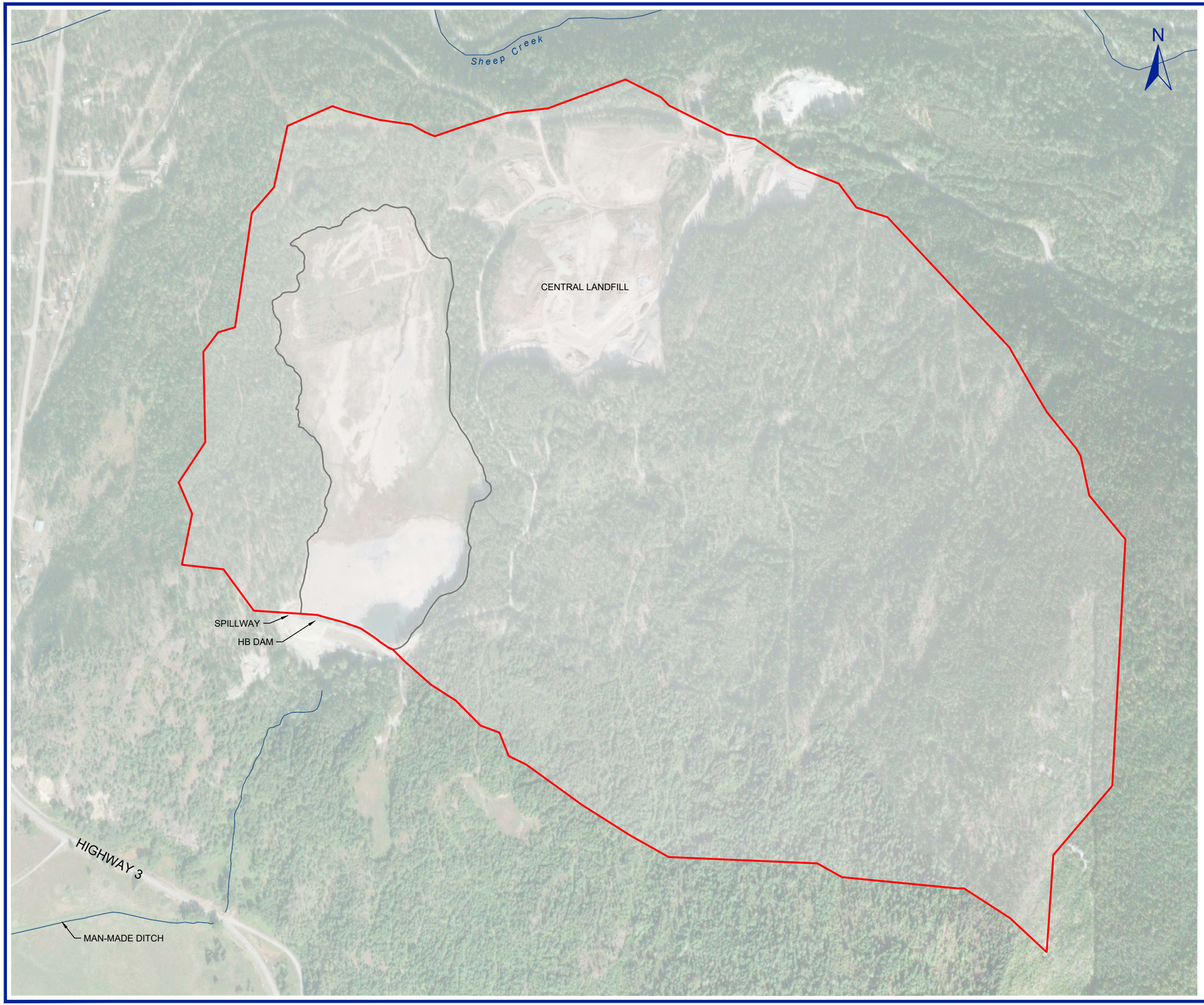
**SITE LOCATION**

Date: May 12, 2022

Project No. 204.03242.00008

Drawing No. 1

Cadfile name: S_204-03242-00008-A1.dwg

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REFERENCED FROM SRK FILE: *FIG01_SURFACEDRAINAGE.PPTX* (APRIL, 2019).
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LEGEND:

- CATCHMENT AREA
- TAILINGS DEPOSITION AREA

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SCALE 1:7,500
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HB TAILINGS MAINTENANCE FACILITY
SALMO, BC

WATER QUALITY MANAGEMENT PLAN

**CATCHMENT AREA REPORTING TO THE TMF**

| | |
|---|---|
| Date: May 12, 2022 | Drawing No. 2 |
| Project No. 204.03242.00008 | |

SLR

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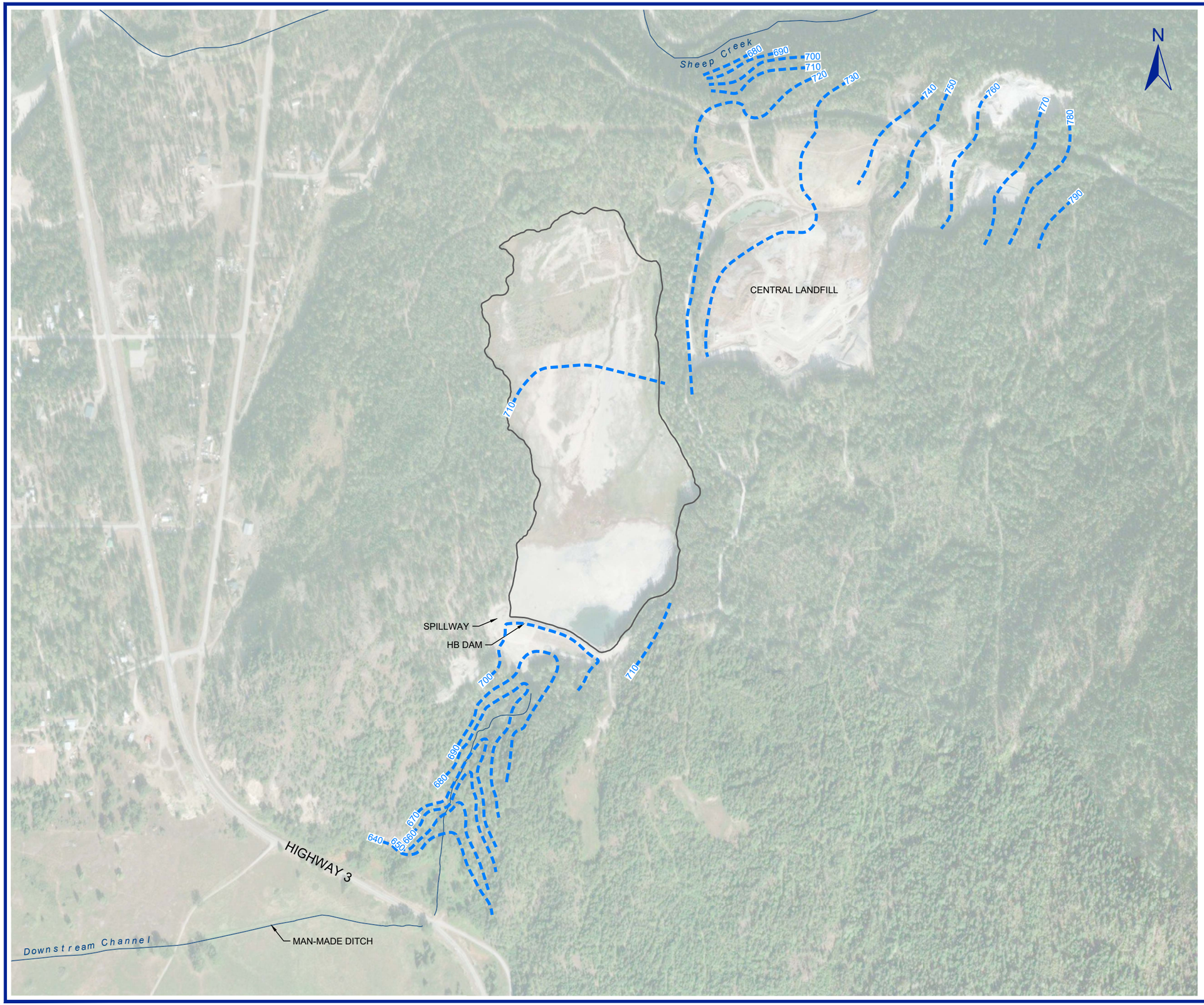


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REFERENCED FROM SRK FILE: *1CR012.006 - GW CONTOURS.DWG* (JANUARY, 2020). IMAGERY © 2021 ESRI, DIGITALGLOBE, GEOEYE, I-CUBED, USDA FSA, USGS, AEX, GETMAPPING, AEROGRID, IGN, IGP, SWISSTOPO, AND THE GIS USER COMMUNITY. IMAGE DATE: 2016.

LEGEND:

- TAILINGS DEPOSITION AREA
- 690 GROUNDWATER CONTOUR (INTERVAL10m)

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REGIONAL DISTRICT OF CENTRAL KOOTENAY
HB TAILINGS MAINTENANCE FACILITY
SALMO, BC

WATER QUALITY MANAGEMENT PLAN

**CENTRAL LANDFILL AND TAILINGS AREAS GROUNDWATER ELEVATION CONTOURS**

Date: May 12, 2022
Project No. 204.03242.00008
Drawing No. 3

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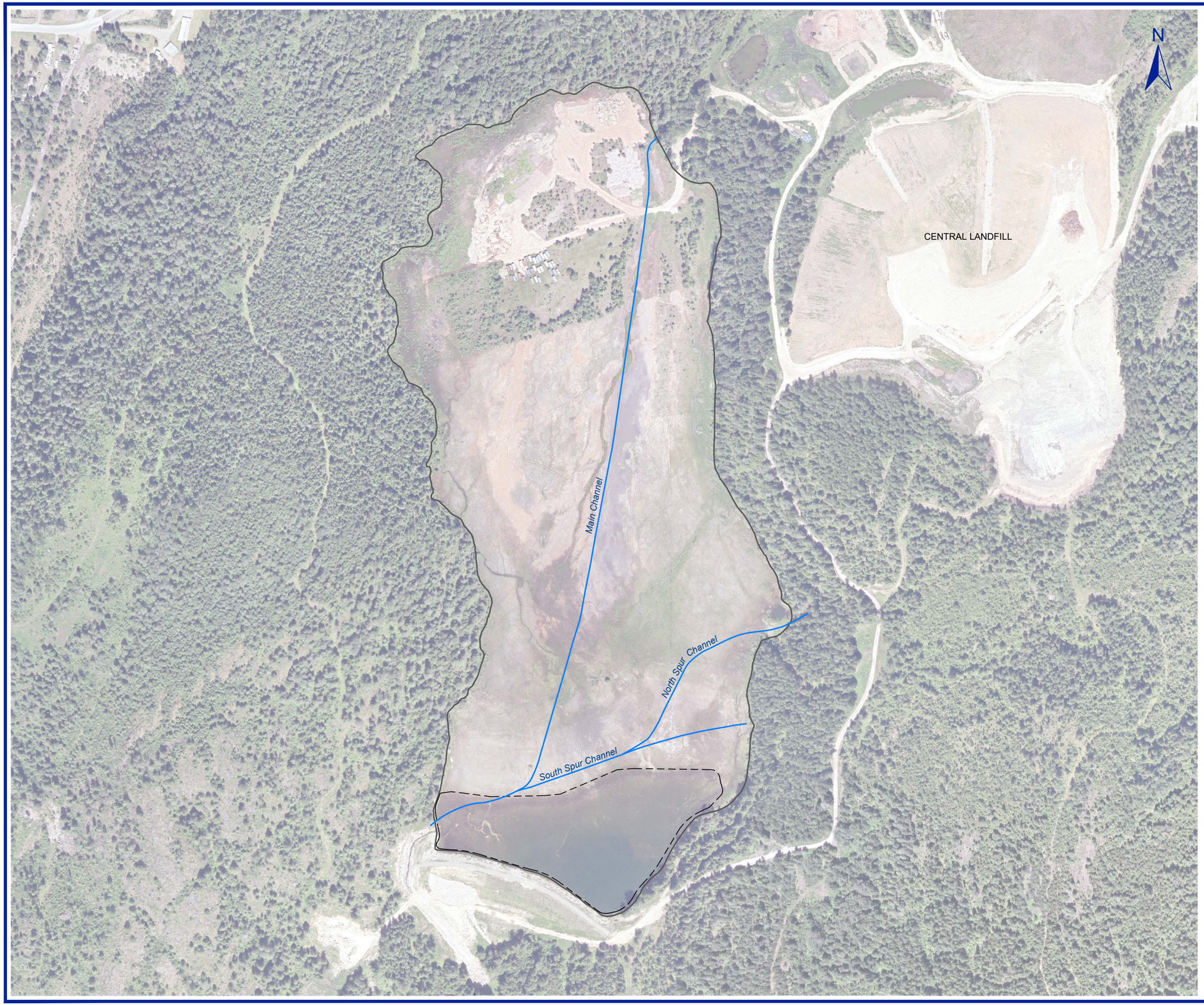


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LEGEND:

- TAILINGS DEPOSITION AREA
- TAILINGS POND
- SURFICIAL CHANNEL

0 25 50 100 150 200 250 m

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REGIONAL DISTRICT OF CENTRAL KOOTENAY
HB TAILINGS MAINTENANCE FACILITY
SALMO, BC

WATER QUALITY MANAGEMENT PLAN

**TMF DRAINAGE CHANNELS**

Date: May 12, 2022
Project No. 204.03242.00008

Drawing No. 4

SLR

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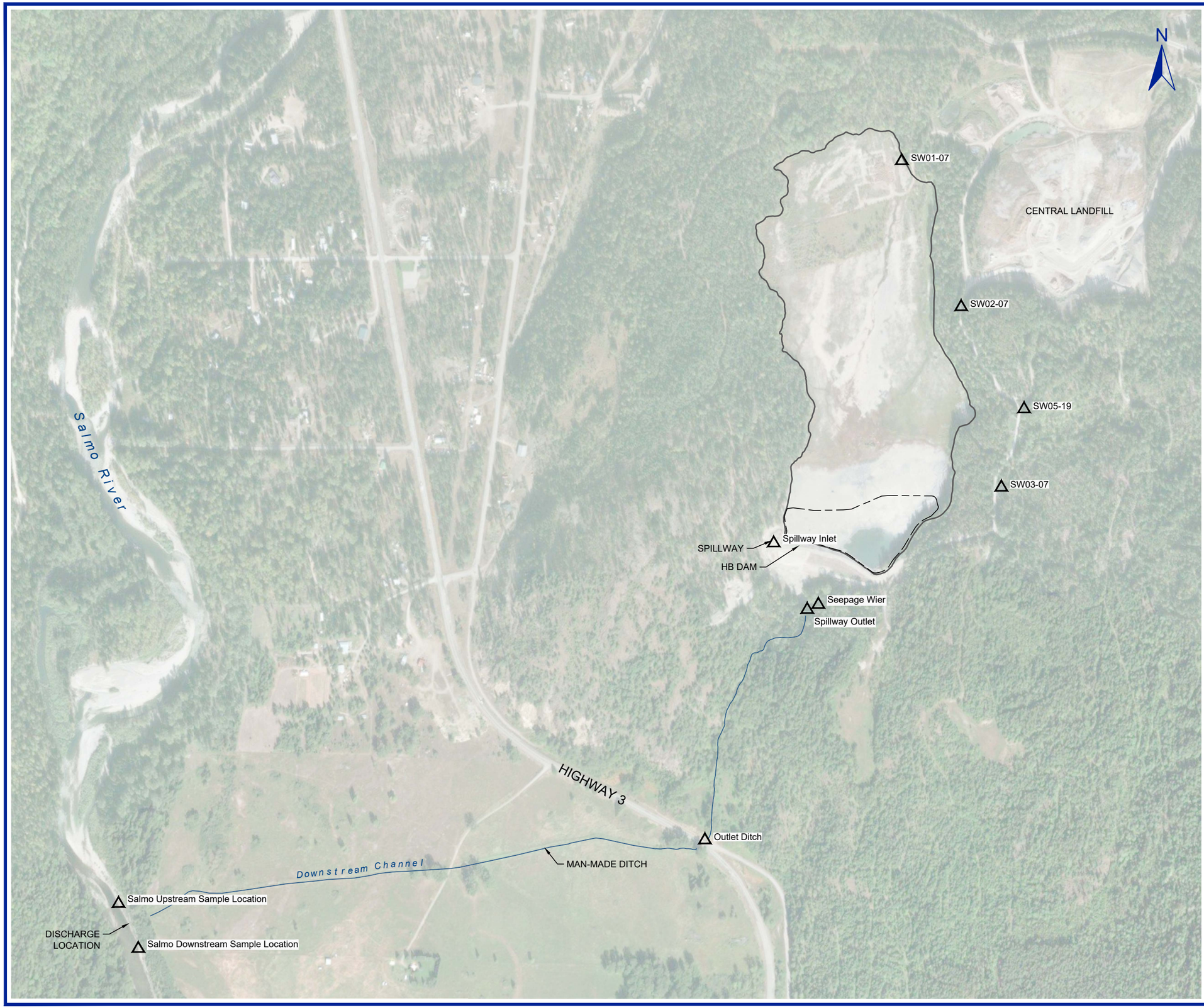


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LEGEND:

- TAILINGS DEPOSITION AREA
- TAILINGS POND
- SURFACE WATER SAMPLE

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NAD 1983 UTM Zone 11U

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WATER QUALITY MANAGEMENT PLAN

**PRE-REMEDIATION AND CLOSURE SURFACE WATER SAMPLING LOCATIONS**

| | |
|---|---|
| Date: May 12, 2022 | Drawing No. 5 |
| Project No. 204.03242.00008 | |

SLR

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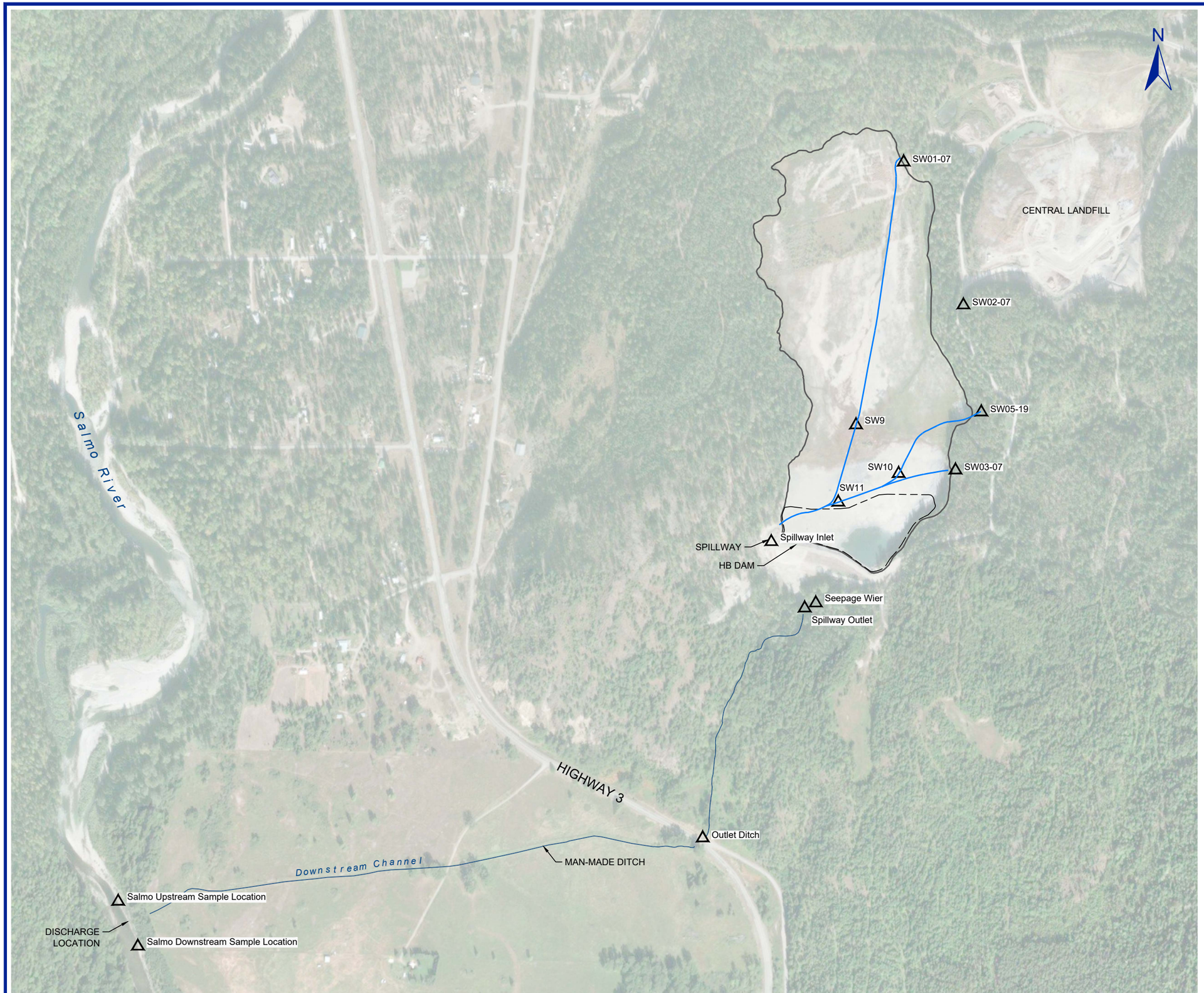


NOTES:
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LEGEND:

- TAILINGS DEPOSITION AREA
- TAILINGS POND
- SURFICIAL CHANNEL
- SURFACE WATER SAMPLE

0 50 100 200 300 400 m

SCALE 1:7,500
WHEN PLOTTED CORRECTLY ON A 11 x 17 PAGE LAYOUT
NAD 1983 UTM Zone 11U

THIS DRAWING IS FOR CONCEPTUAL PURPOSES ONLY. ACTUAL LOCATIONS MAY VARY AND NOT ALL STRUCTURES ARE SHOWN.

REGIONAL DISTRICT OF CENTRAL KOOTENAY
HB TAILINGS MAINTENANCE FACILITY
SALMO, BC

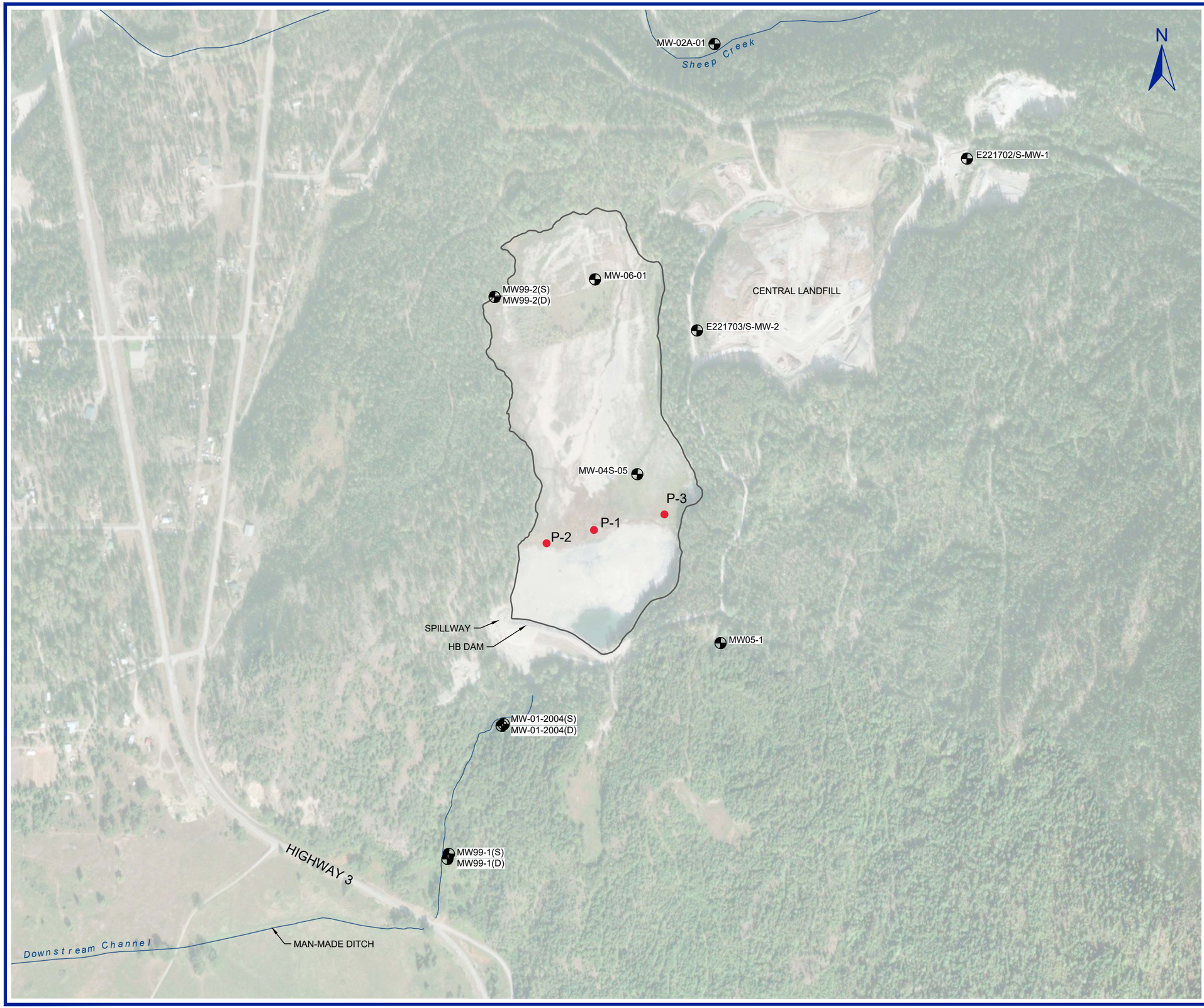
WATER QUALITY MANAGEMENT PLAN

**POST-REMEDIATION AND CLOSURE**
**SURFACE WATER SAMPLING LOCATIONS**

Date: May 12, 2022
Project No. 204.03242.00008
Drawing No. 6

SLR

Cadfile name: N:\Vancouver\CAD\Project Drawings\204\204.03242\204.03242.00008\S_204-03242-00008-A1.dwg




NOTES:
IMAGERY © 2021 ESRI, DIGITALGLOBE, GEOEYE, I-CUBED, USDA FSA, USGS, AEX, GETMAPPING, AEROGRID, IGN, IGP, SWISSTOPO, AND THE GIS USER COMMUNITY. IMAGE DATE: 2016.

LEGEND:

- TAILINGS DEPOSITION AREA
- BOREHOLE COMPLETED AS A MONITORING WELL
- Porewater sample Locations

0 50 100 200 300 400 m

SCALE 1:7,500
WHEN PLOTTED CORRECTLY ON A 11 x 17 PAGE LAYOUT
NAD 1983 UTM Zone 11U

THIS DRAWING IS FOR CONCEPTUAL PURPOSES ONLY. ACTUAL LOCATIONS MAY VARY AND NOT ALL STRUCTURES ARE SHOWN.

REGIONAL DISTRICT OF CENTRAL KOOTENAY
HB TAILINGS MAINTENANCE FACILITY
SALMO, BC

WATER QUALITY MANAGEMENT PLAN

**POST-REMEDIATION AND CLOSURE GROUNDWATER SAMPLING LOCATIONS**

Date: May 12, 2022
Project No. 204.03242.00008
Drawing No. 7

SLR

Cadfile name: N:\Vancouver\CAD\Project Drawings\204\204.03242\204.03242.00008\S_204-03242-00008-A1.dwg

# Environmental Monitoring Program

## Nakusp Landfill

| Field Designation | EMS Number | Matrix | Well Depth (m bgs) | Purpose | Location | Q1 | Q2 | Q3 | Q4 |
|---|---|---|---|---|---|---|---|---|---|
| MW1-95 | E225548 | groundwater | 34.6 | compliance | Adjacent to southern property | A | | A & B | |
| MW2-95 | E225549 | groundwater | 36.71 | background | Adjacent to southern property | A | | A | |
| MW3-95 | E225550 | groundwater | 39.68 | background | Adjacent to southern property | A | | A | |
| MW4-06 | E265109 | groundwater | 35.63 | source concentration | Located centrally on landfill | A | | A & B | |
| MW5-06 | E265110 | groundwater | 37 | background | Located in northeast quadrant of property | A | | A | |
| MW17-7 | | groundwater | ~40 | background | within adjacent southern property | A | | A & B | |

Note: Water depth is measured and recorded at each well during each sampling event.
Gases in monitoring well headspace to be measured with a landfill gas meter (e.g. Gem 3000) prior to water level measurement.

### Schedule A

***Field Parameters***
pH
Specific Conductance
Reduction-Oxidation Potential (ORP)
Temperature
Total Dissolved Solids
Turbidity

***General Chemistry***
Alkalinity
Chloride
Sulphate
Hardness (Dissolved)
pH
Specific Conductance
Total Organic Carbon (TOC)
Total Inorganic Carbon (TIC)
Chemical Oxygen Demand (COD)

***Nutrients***
Ammonia
Nitrate
Nitrite
Phosphorus (Total)

***Metals (Dissolved)***
Aluminum
Antimony
Arsenic
Barium
Beryllium
Boron
Cadmium
Calcium
Chromium
Cobalt
Copper
Iron
Lead
Magnesium
Manganese
Molybdenum
Nickel
Potassium
Selenium
Silver
Sodium
Thallium
Vanadium
Zinc

**QA/QC**
Ion Balance

### Schedule B

***Volatile Organic Compounds (VOCs)***
1,1,1-Trichloroethane
1,1,2,2-Tetrachloroethane
1,1,2-Trichloroethane
1,1-Dichloroethane
1,1-Dichloroethene
1,2-Dichlorobenzene
1,2-Dichloroethane
1,2-Dichloropropane
1,3-Dichlorobenzene
1,4-Dichlorobenzene
2-Chloroethyl vinyl ether
Bromodichloromethane
Bromoform
Bromomethane (Methyl Bromide)
Carbon tetrachloride
Chlorobenzene
Chloroethane
Chloroform (Trichloromethane)
Chloromethane (Methyl Chloride)
cis-1,2-Dichloroethene
cis-1,3-Dichloropropene
Dibromochloromethane
Methylene chloride
Tetrachloroethene
trans-1,2-Dichloroethene
trans-1,3-Dichloropropene
Trichloroethene
Trichlorofluoromethane (CFC-11)
Vinyl chloride

***Volatile Organic Compounds (BTEX)***
Benzene
Ethylbenzene
Toluene
Xylene (total)

**Table E.2: Amec Foster Wheeler Proposed 2017 Sampling Schedule**

| Ootischenia Landfill | | | | | | |
|---|---|---|---|---|---|---|
| **Field Designation** | **EMS Number** | **Matrix** | **Well Depth** | **Purpose** | **April or May** | **October or November** |
| MW1-95 | E232086 | Groundwater | 67.1 | Background | A | A, B |
| MW06-05 | None | Groundwater | 63.1 | Downgradient monitoring | A | A, B |
| MW07-05 | None | Groundwater | 63.1 | Leachate monitoring | A | A, B |
| MW14-01 | None | Groundwater | 71.6 | Downgradient monitoring | A | A, B |
| MW14-02 | None | Groundwater | 59.4 | Downgradient monitoring | A | A, B |
| MW17-01 | None | Groundwater | 51.5 | Downgradient monitoring | A | A, B |
| MW17-02 | None | Groundwater | 49.1 | Downgradient monitoring | A | A, B |
| MW17-03 | None | Groundwater | TBD | Downgradient monitoring | A | A, B |
| SW-1 | None | Surface Water | n/a | Surface water monitoring | A | A, B |
| SW-2 | None | Surface Water | n/a | Surface water monitoring | A | A, B |

| **Summary of Analytical Program** | **Spring** | **Fall** |
|---|---|---|
| Total Number of Locations Sampled | 10 | 10 |
| Duplicates (1 duplicate for every 10 samples) | 1 | 1 |
| Total Number of Analyses | 11 | 11 |

**Schedule A**

***Field Parameters***
pH
Specific Conductance
Reduction-Oxidation Potential (ORP)
Temperature
Total Dissolved Solids
Turbidity

***General Chemistry***
Alkalinity
Chloride
Sulphate
Hardness (Dissolved)
pH
Specific Conductance
Total Organic Carbon (TOC)
Total Inorganic Carbon (TIC)
Chemical Oxygen Demand (COD)

***Nutrients***
Ammonia
Nitrate
Nitrite
Phosphorus (Total)

***Metals (Dissolved)***
Aluminum
Antimony
Arsenic
Barium
Beryllium
Boron
Cadmium
Calcium
Chromium
Cobalt
Copper
Iron
Lead
Magnesium
Manganese
Molybdenum
Nickel
Potassium
Selenium
Silver
Sodium
Thallium
Vanadium
Zinc

**QA/QC**
Ion Balance

**Schedule B**

***Volatile Organic Compounds (VOCs)***
1,1,1-Trichloroethane
1,1,2,2-Tetrachloroethane
1,1,2-Trichloroethane
1,1-Dichloroethane
1,1-Dichloroethene
1,2-Dichlorobenzene
1,2-Dichloroethane
1,2-Dichloropropane
1,3-Dichlorobenzene
1,4-Dichlorobenzene
2-Chloroethyl vinyl ether
Bromodichloromethane
Bromoform
Bromomethane (Methyl Bromide)
Carbon tetrachloride
Chlorobenzene
Chloroethane
Chloroform (Trichloromethane)
Chloromethane (Methyl Chloride)
cis-1,2-Dichloroethene
cis-1,3-Dichloropropene
Dibromochloromethane
Methylene chloride
Tetrachloroethene
trans-1,2-Dichloroethene
trans-1,3-Dichloropropene
Trichloroethene
Trichlorofluoromethane (CFC-11)
Vinyl chloride

***Volatile Organic Compounds (BTEX)***
Benzene
Ethylbenzene
Toluene
Xylene (total)

Note: BTEX is normally included within VOC analysis

# SLOCAN TS
# Environmental Monitoring Program

| Slocan Closed Landfill | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Field Designation** | **EMS Number** | **Matrix** | **Purpose** | **Location** | **Q1** | **Q2** | **Q3** | **Q4** |
| MW-1 | | groundwater | | northernmost | | A & B | | A |
| MW-2 | | groundwater | background | southernmost | | A & B | | A |
| MW-3 | | groundwater | | | | A & B | | A |
| MW-4 | | groundwater | | westernmost | | A & B | | A |

## Schedule A

**Field Parameters**
pH, Field
Temperature

**General Chemistry**
Chemical Oxygen Demand (COD)
Organic Carbon (Total) (TOC)
pH, Lab
Specific Conductance, Lab
Alkalinity, Bicarbonate
Alkalinity, Carbonate
Alkalinity, Hydroxide
Alkalinity, Total (as $CaCO_3$)
Chloride (Dissolved)
Sulphate
Hardness as $CaCO_3$
Ionic Balance

**Nutrients**
Ammonia-N
Nitrate (as N) Dissolved
Nitrite (as N) Dissolved
Phosphorous (Total)

**Dissolved Metals (Semi-Trace)**
Calcium
Magnesium

## Schedule B

***Volatile Organic Compounds***
1,1,1-Trichloroethane
1,1,2,2-Tetrachloroethane
1,1,2-Trichloroethane
1,1-Dichloroethane
1,1-Dichloroethene
1,2-Dichlorobenzene
1,2-Dichloroethane
1,2-Dichloropropane
1,3-Dichlorobenzene
1,4-Dichlorobenzene
2-Chloroethyl vinyl ether
Bromodichloromethane
Bromoform
Bromomethane (Methyl Bromide)
Carbon tetrachloride
Chlorobenzene
Chloroethane
Chloroform (Trichloromethane)
Chloromethane (Methyl Chloride)
cis-1,2-Dichloroethene
cis-1,3-Dichloropropene
Dibromochloromethane
Methylene chloride
Tetrachloroethene
trans-1,2-Dichloroethene
trans-1,3-Dichloropropene

Potassium
Sodium
Sulphur

**Dissolved Metals (Trace)**
Aluminum
Antimony
Arsenic
Barium
Beryllium
Bismuth
Boron
Cadmium
Chromium
Cobalt
Copper
Iron
Lead
Lithium
Manganese
Mercury
Molybdenum
Nickel
Phosphorous
Selenium
Silicon
Silver
Strontium
Thallium
Tin
Titanium
Uranium
Vanadium
Zinc
Zirconium

Trichloroethene
Trichlorofluoromethane (CFC-11)
Vinyl chloride

***Volatile Organic Compounds (BTEX)***
Benzene
Ethylbenzene
Toluene
Xylene (total)