2023 Operations and Monitoring Report

New Landfill

Northwin Environmental and the Ministry of Environment and Climate Change Strategy

27 March 2024

→ **The Power of Commitment**

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1. Introduction

GHD has been retained by Northwin Environment Ltd. (Northwin) to prepare this 2023 Annual Operations and Monitoring Report (Annual Report) for the New Landfill located at 7295 Gold River Highway (Site) approximately 7 kilometres (km) west of Campbell River, British Columbia (BC) city centre. A Site location map is provided as Figure 1. The landfill is operating under the Operational Certificate 107689 (OC 107689), which was issued to Upland Excavating Ltd. (Upland) on August 1, 2019, and an amendment received on April 26, 2022. A copy of the OC and the amendment is provided in Appendix A. The Site is owned by Upland. The landfill is operated by Northwin.

The Annual Report provides a summary of the New Landfill operations carried out on Site and the results of the environmental monitoring program (EMP) implemented from January 1 to December 31 of 2023 (Reporting Period). An evaluation of the operational and environmental performance of the landfill are provided with recommendations made for the ongoing development of the landfill and the EMP.

This Annual Report has been written in accordance with the Landfill Criteria for Municipal Solid Waste (MOE, June 2016) and Section 5.4 of the OC.

1.1 Limitations

This report has been prepared by GHD for Northwin Environmental and the Ministry of Environment and Climate Change Strategy and may only be used and relied on by Northwin Environmental and the Ministry of Environment and Climate Change Strategy and the Ministry of Environment and Climate Change Strategy for the purpose agreed between GHD and Northwin Environmental and the Ministry of Environment and Climate Change Strategy as set out in section 1 of this report.

GHD otherwise disclaims responsibility to any person other than Northwin Environmental and the Ministry of Environment and Climate Change Strategy arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited by the information provided by Northwin Environmental.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

1.2 Background

Prior to the issuance of the OC, the Original Landfill operated under Permit PR-10807 (Permit). This Permit was issued for the Original Landfill on June 1, 1992. In accordance with the approved Comox Valley Regional District Solid Waste Management Plan (SWMP), Upland submitted an application in June 2015 to replace the Permit with a new Operational Certificate.

Prior to the issuance of the OC, annual water quality monitoring results were provided to the Ministry of Environment and Climate Change Strategy (the Ministry) in 2017 and 2018 in response to an e-mail request from the Ministry to Upland and GHD dated November 10, 2017.

The OC was issued on August 1, 2019, authorizing waste management at the Original Landfill and the New Landfill. On April 26, 2022, the OC was amended to include the acceptance of soil that is non-hazardous waste (IL+), a treated leachate holding pond or tank, and conditions related to the decommissioning of the Original Landfill and the Original Leachate Management Works.

The Original Landfill and Original Landfill Leachate Management Works, operated under the OC until they were both decommissioned in 2023. Operations ceased at the Original Landfill in September 2022 and waste was removed and placed into the New Landfill from April to June 2023. Decomissioning activities were completed in June 2023. Details regarding the Original Landfill decommissioning is provided in the *Original Landfill and Original Landfill Leachate Management Works Decommissioning Report* (GHD, 2023) which was submitted to the Ministry in June 2023.

1.3 Site Location

The Site is bound to the north by Gold River Highway (Highway 28), to the east by forested and industrial land parcels and to the west by Rico Lake, a construction storage yard, and an undeveloped industrial lot. The southern boundary of the Site is located on the Campbell River city limit. The area to the south is part of the Strathcona Regional District and includes land parcels used by the forestry industry. The legal description of the Site is Lot A, District Lot 85, Plan 30709, Sayward District.

The Site is approximately 48 hectares in size and is accessed from the north via an entrance from Gold River Highway. In 2023, the Site encompasses a large sand and gravel pit (Pit), the New Landfill including Cell 1 East and Cell 1 West and leachate treatment works. A Site Plan is provided on Figure 2.

1.4 Site Security

Signage is erected at the main entrance of the Site. The signage includes all information specified in Section 6.10 of the Landfill Criteria. In addition, there are four signs at property access points that read “Industrial Site, No Trespassing. Property Under Video Surveillance”. The surveillance cameras are monitored 24-hours a day by a security company. An outdoor lighting system also illuminates the Site at night.

2. Operations and Development

2.1 New Landfill

Presently, the New Landfill includes two cells: Cell 1 East and Cell 1 West. Cell 1 West was constructed in 2022. Both cells include a double liner system, leak detection layer, and leachate management works (see Section 3.2), as shown on Figure 3.

Cell 1 East and Cell 1 West are comprised of a primary and secondary base liner. The primary base liner refers to the composite liner system that consists of an HDPE geomembrane liner and geosynthetic clay liner (GCL) which underlies the leachate collection system. The secondary base liner refers to the composite liner system which is comprised from an HDPE geomembrane liner and GCL which underlies the leak detection system.

The Cell 1 East and Ponds Construction Report was submitted to the Ministry on October 19, 2021. The New Landfill was authorized to accept waste 30-days following submission on November 19, 2021. The New Landfill (Cell 1 East) started accepting waste on November 24, 2021.

The New Landfill is authorized to accept C&D waste, landfill clearing waste, Industrial Quality soil (from January 1 to April 23, 2022), IL+ soil (as of April 24, 2022), and sludge from the leachate management works or water management works.

2.2 New Leachate Management Works

The new leachate management works include leachate collection, extraction, storage, treatment, and infiltration. A process schematic of the new leachate management works is provided in Figure 2.1 below.

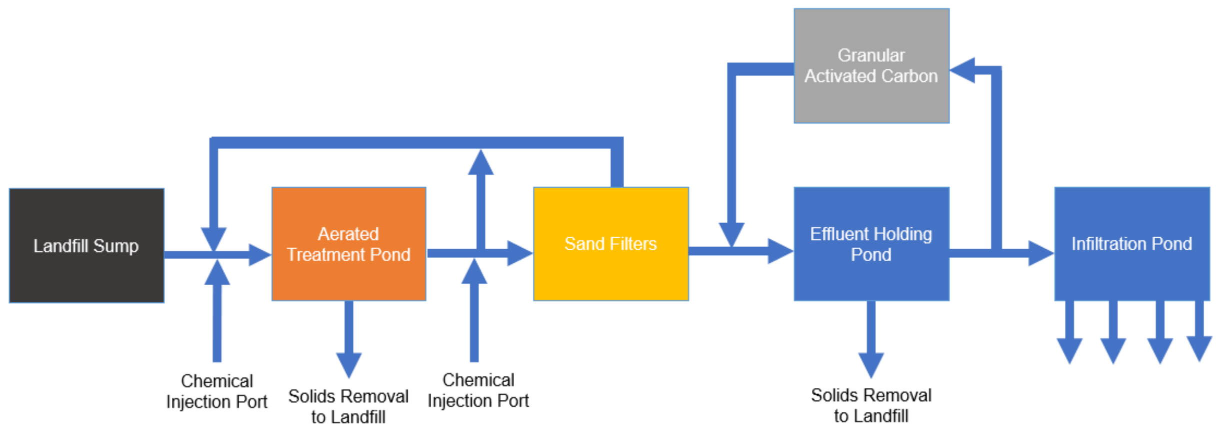

Figure 2.1 New Leachate Management Works Schematic

Leachate is collected within Cell 1 East and Cell 1 Westin a series of perforated pipes installed at the base of the cell and discharges to a sump. Leachate is stored temporarily in the landfill and pumped from the sump to the leachate treatment pond for batch treatment as shown in Figure 2.1, on an as-needed basis. The location of the sump is shown on Figure 4. The leachate treatment pond includes a primary and secondary liner, leak detection layer, and leak collection pipes.

To target operation of a weekly batch at the peak daily leachate generation rate, an average batch size is 625 m^3, with the maximum batch size to be 1,400 m^3. A batch size may vary, requiring operational adjustments to the treatment system.

The process begins with aerated equalization, where the aerated equalization pond is filled, and the aeration system on during the filling process. Following aeration, the leachate is pumped through pipes to the leachate treatment container, where chemicals can be added inline through injection ports. After chemical addition, leachate can be recirculated to the equalization pond or sent through a series of sand filters before entering the effluent holding pond. The effluent batch will be held in the effluent holding pond and sampled with a 3-day turnaround on the laboratory analysis. Following receipt of sample results, the batch will then be pumped to the infiltration pond or recirculated through the Granular Activated Carbon (GAC), if polycyclic aromatic hydrocarbons (PAHs) did not meet discharge criteria. During operations the batches will be tested periodically to confirm discharge criteria are being met. The treatment process will continue until treated effluent concentrations meet the British Columbia Contaminated Sites Regulations (BC CSR) Schedule 3.2 DW standards.

2.3 Summary of DOCP Implementation

GHD prepared an updated Design, Operations, and Closure Plan (DOCP) dated July 8, 2022 for the Site. The DOCP provides additional regulatory frameworks for the Site.

A summary of the DOCP components that were implemented within the Reporting Period, include:

– The DOCP was completed by a QP on behalf of Upland and submitted to the Ministry on July 8, 2021.
– Operations Plan: the New Landfill operated in accordance with the Site Operations section presented in the DOCP.
– Soil Acceptance Plan: soil was received in accordance with the soil acceptance plan presented in the DOCP and OC amendment. A GHD QP certified and submitted to Upland a document outlining at minimum the OC requirements under Section 2.7(b).
– Filling: waste was accepted according to the waste acceptance policy and discharged in Cell 1 East and West, including waste excavated from the Original Landfill.

- Cover Placement: cover was placed over waste as a means of landfill nuisance control on an as-needed basis determined by landfill staff. Intermediate soil cover was placed on areas of the landfill that were not scheduled to receive the placement of additional waste for 30-days or more.
- New Leachate Management Plan: leachate management includes leachate collection, extraction, storage, and treatment. Leachate is extracted from the landfill by active pumping from the Cell 1 East for treatment as described in Section 2.2.
- New Surface Water Management Plan: perimeter berms around the cell prevent run-on of stormwater to the landfill footprint. Existing site ditches promote stormwater infiltration into the ground at the base of the Pit. Contact water is managed as leachate. Swales constructed in 2022 outside of the New Landfill gravity drains stormwater away from the footprint to the pit.
- Environmental Monitoring Plan: the EMP described in Section 4 was implemented in 2023. Results of the EMP are presented in Sections 6 and 8.
- Trigger Level Assessment Plan: leachate in the leak detection system triggered the contingency plan outlined in the DOCP.
- Financial Security Plan: the financial security plan (revision 2) was completed on July 2, 2021, and submitted as part of the DOCP.
- Cell 1 West Construction Report is provided in Appendix B and further described in Section 2.5.
- Cell 1 East, Cell 1 West, and Ponds Commissioning Report is provided in Appendix C and described in Section 2.5.

2.4 2024 Significant Works

The significant works planned for 2024 at the New Landfill include:

- The installation of the proposed monitoring well MW13.

2.5 Construction Reports

Cell 1 West Construction Report

The Cell 1 West Construction Report was prepared in 2023 and is provided in Attachment B. The Cell 1 West Construction Report demonstrates that the Cell 1 West has been constructed in accordance with OC and the most recent DOCP, with the changes noted below and approved by the undersigned during construction. Qualified Professionals (QP) completed inspections before and during construction of Cell 1 West.

Cell 1 East, Cell 1 West, and Ponds Commissioning Report Commissioning Report

The Cell 1 East, Cell 1 West, and Ponds Commissioning Commissioning Report (commissioning report) was prepared in 2023 is provided in Attachment C. The commissioning report demonstrates that Cell 1 East and Ponds have been commissioned in accordance with the OC and the 2021 DOCP. QPs completed inspections before and during commissioning of Cell 1 East and the Ponds. This commissioning report includes the information described in Section 2.6(b) of the OC, and Leachate Treatment Facility (LTF) Commissioning Plan presented in the 2021 DOCP, specifically:

- Summary of commission activities including sampling activities
- Summary of analytical results of influent leachate and effluent sampling
- Copy of all calibration reports and laboratory analytical reports
- Comments on any observed deficiencies in the LTF design or performance, and a plan for addressing any such deficiencies.
- Maintenance and performance monitoring plan

2.6 Waste Tonnage and Volume

In 2023, the New Landfill accepted a total 38,327 tonnes of waste for discharge to the New Landfill:

– 8,205 tonnes of C&D waste
– 25,663 tonnes of non-hazardous waste quality soil
– 4,100 tonnes of asbestos containing material
– 357 tonnes of creosote timbers

No recyclable material was diverted from the landfill in 2023 as the landfill only received residual material.

No hazardous waste, controlled waste, and attractants were received in 2023.

2.7 Airspace Consumption, Remaining Volume, and Remaining Life

As shown in Table 2.1, the design capacity of Cell 1 East and Cell 1 West is 207,784 m^3. The total airspace consumption from January 1 to December 31, 2023 was approximately 29,482 m^3. The remaining airspace capacity of the New Landfill is approximately 482,540 m^3.

Using the maximum allowable discharge rate of 45,000 tonnes per year or 34,615 m^3 per year, the remaining life of the constructed cells is approximately 2-years.

Table 2.1 New Landfill Airspace Consumption, Remaining Volume, and Remaining Life

	Total New Landfill (m^3)
Waste accepted January 1 thru December 31, 2022	34,472
Waste accepted January 1 thru December 31, 2023	29,482
Relocation of Original Landfill	57,167
Total estimated discharged to Cell 1 East and Cell 1 West	121,121
Cell 1 East and Cell 1 West Capacity	207,784
Airspace Remaining	86,663
Remaining Life in Constructed Cells	2.5-years

2.8 Treated Leachate Effluent Quantity and Quality

In 2023, Northwin collected, treated, and discharged approximately 4,050,000 litres of leachate. Treated leachate effluent was sampled by Northwin throughout the year, as summarized in Table 2.2 below. Details regarding treated leachate effluent quality is provided in the Cell 1 East, Cell 1 West, & Ponds Commissioning Report (Appendix C)

Table 2.2 Treated Leachate Effluent Quality Analytical Summary

Sample Date	Lab Report No.	Discharge Criteria Results	Treatment Continued or Discharged
February 2, 2023	VA23A2628	001: No exceedances	Discharged
February 13, 2023	VA23A3351	001: Boron, quinoline	Treatment continued
March 6, 2023	VA23A4848	001: Arsenic, boron, quinoline	Treatment continued
March 30, 2023	VA23A6860	001: No exceedances 002: No exceedances	Discharged

Sample Date	Lab Report No.	Discharge Criteria Results	Treatment Continued or Discharged
April 14, 2023	VA23A8082	001: Boron, sodium	Treatment continued
October 23, 2023	VA23C5387	001: Sulfate, boron, benzo(a)pyrene, quinoline	Treatment continued
November 21, 2023	VA23C7975	001: No exceedances 002: No exceedances	Discharged
December 11, 2023	VA23C0976	001: No exceedances	Discharged
December 18, 2023	VA23D0378	001: Benzo(a)pyrene, quinoline 002: No exceedances	Treatment continued Discharged
Notes: * - All samples were collected by Northwin.			

2.9 Non-Compliance

According to Northwin, the New Landfill was compliant with the conditions of the OC during the Reporting Period. The annual status form is provided in Appendix D.

2.10 Public Complaints

According to Northwin, no public complaints were received during the Reporting Period.

3. Site Physical Setting

The following section summarizes the Site setting with respect to climate, topography, stormwater drainage, geology, and hydrogeology.

3.1 Climate

Climate data was measured at Environment Canada's Campbell River Airport Climate Station (ID 1021261) located approximately 8 km southeast of the Site. Based on the Canadian Climate Normal 1981 – 2010 Station Data, the area received 1489 millimetres (mm) of precipitation per year with much of the rainfall occurring between November and January.

3.2 Topography and Drainage

The Site is located on a terrace that is partially surrounded by mountainous terrain to the south and southwest. The terrace gradually slopes towards the Quinsam River located approximately 3.8 km to the southeast of the east Site boundary. The Quinsam River channel is at an elevation that is greater than 100 m below the Site. There are no natural surface water courses on Site.

Drainage within the New Landfill area is managed according to the stormwater management plan provided in the DOCP, respectively. Perimeter berms have been constructed around the landfill cells to ensure that precipitation that falls on the landfill footprints remains within the footprint and managed as leachate. Precipitation that falls outside of the landfill footprints is considered clean water and infiltrates into the groundwater aquifer below the Site.

3.3 Geologic Setting

Overburden

Based on regional geologic mapping, the area in the vicinity of the landfill underwent several periods of glaciation during the Pleistocene Epoch. Vancouver Island was glaciated with ice thicknesses to 2 km. During the recession of the last glaciation approximately 14,000 years ago, glacial and glacio-fluvial sediments were deposited, and in some cases reworked and redeposited, to make up many of the present surficial deposits of Vancouver Island. These deposits consist of till that was deposited directly by glacial activity[1] and of glacial outwash composed primarily of poorly sorted, coarse-grained sand and gravel sediments deposited by glacial melt water (Greene, Scoates, and Weis, 2005; McCammon, 1977)[2].

Based on investigations completed by GHD and Site operations, the surficial geology underlying the landfill is native interbedded sand and gravel with occasional seams of sand and silty sand. Directly underlying the landfill, this unit is greater than 40 m in thickness.

Bedrock

The Site is underlain by the Karmutsen Formation, which is part of the Wrangellia Terrane. The Karmutsen Formation consists mostly of submarine flood basalts up to 6 km in thickness.

Based on Site investigations completed by GHD, the bedrock underlying the landfill is competent igneous basalt. The surface of the bedrock is greater than 50 m below the ground surface in the Original Landfill area.

A bedrock ridge is present between Rico Lake and the Pit along the western limit of the Site. The presence of the ridge creates a surface water and groundwater flow divide. The approximate location of the watershed and groundwater flow divide is illustrated on Figures 5 and 6.

3.4 Hydrogeologic Setting

In general, the geologic units identified in the previous section may be grouped into the following three hydrogeologic units:

1. Sand and gravel aquifer
2. Shallow aquifer
3. Bedrock aquifer

An unconfined aquifer exists within sand and gravel overlying bedrock at the Site. In 2023, the water table was present approximately 13 – 18 meters (m) below top of riser (btor) in the vicinity of the New Landfill. Groundwater flow is interpreted to be from northwest to southeast, towards the Quinsam River. The head waters of the aquifer are from McIvor Lake in the vicinity of the Site.

A relatively thin, discontinuous shallow aquifer is present within the northern portion and in the southwest corner of the

Site. Groundwater flow in this area is largely controlled by bedrock surface topography.

This sand and gravel aquifer is a major aquifer in the region and is identified in the BC Water Resource Atlas (2017) as aquifer 975 IIA (10). This aquifer is interpreted to be the principal groundwater flow zone at the Site. In the context of the landfill, this aquifer represents the only receptor to landfill-related groundwater quality impairments.

GHD completed single well response tests (SWRT) at nine wells screened within the sand and gravel aquifer. The results of the SWRTs show that hydraulic conductivity of the sand and gravel aquifer is approximately 1.8 x 10^{-2} cm/sec. Borehole logs of monitoring wells shown on Figure 2 are provided in Appendix E. Details regarding the Site's

[1] This till consists of larger clasts supported in a matrix of fine-grained sediment.
[2] Greene, A.R., J.S. Scoates and D. Weis, 2005. Wrangellia Terrane on Vancouver Island, British Columbia: Distribution of Flood Basalts with Implications for Potential Ni Cu PGE Mineralization in Southwestern British Columbia.

geological and hydrological setting are provided in the Hydrogeology and Hydrology Characterization Report (HHCR), dated May 27, 2016 and last amended May 4, 2021.

4. 2023 Environmental Monitoring Plan

This section presents the 2023 environmental monitoring plan (EMP), sampling methodology, laboratory program, quality assurance/quality control (QA/QC) program, and specification developed for the New Landfill. The quarterly EMP for the New Landfill began in 2023. Monitoring locations are presented in Figure 4.

4.1 Monitoring Locations

The EMP was developed for the Site to assess and identify potential landfill derived impacts to the underlying aquifers, to monitor groundwater and surface water levels, and to evaluate Site regulatory compliance (Section 3.5 of the OC).

The EMP consists of the following:

– Quarterly hydraulic monitoring at 18 groundwater locations
– Quarterly field parameter and sample collection at 11 groundwater locations
– Quarterly hydraulic monitoring at 2 surface water locations
– Annual field parameters and sample collection at 2 surface water locations
– Quarterly monitoring, field parameter and sample collection at 3 leachate locations
– Quarterly hydraulic monitoring at 4 leak detection monitoring locations
– Quarterly field parameters and sample collection at 1 leak detection monitoring locations

The objective of each component of the EMP's is provided below.

Groundwater

The objective of the groundwater monitoring plan is to detect the extent and magnitude of potential landfill-derived impacts to the underlying overburden aquifer and to monitor the groundwater flow direction across both landfills.

For the new landfill, groundwater quality is monitored at five upgradient (MW6-17, MW9-17, MW1-14, MW4A-15, and MW4B-15), two cross-gradient (MW2-14 and MW2A-16) and four downgradient wells (MW10-17, MW12-22, MW11-19, and MW3-14). A proposed well, MW13 (Figure 4), will be part of the monitoring program once installed. Monitoring wells MW4A-15 and MW4B-15 were buried in 2022 during construction activities and inaccessible during the EMP. MW4A-15 and MW4B-15 are protected by a cover and are recommended to be dug up.

Surface Water

Water levels in Rico Lake and McIvor Lake are monitored to assess the hydraulic relationship between these surface water bodies and the underlying aquifers. The water level surface elevation at Rico Lake is measured from a surface water gauge installed in the lake. The hydrometric surface of McIvor Lake is monitored by BC Hydro. GHD records the water level surface elevation from the publicly available BC Hydro Data Records.

Leachate

The objective of the leachate monitoring program is to characterize leachate quality generated within the lined cell of the New Landfill. At the New Landfill, leachate is sampled from a sump located in Cell 1 East (S06-21).

Treated leachate is also sampled from the Infiltration Pond if Northwin is discharging treated leachate during the EMP event. The sample collection point (TLIP) is located at the end of the treated leachate discharge pipe/hose.

An additional leachate monitoring location will be added to the EMP to characterize quality from the Leachate Sump in Cell 1 West in 2024.

Leak Detection Layer

Leak detection layers are present in the New Landfill. Design variations exist across the leak detection systems; however, the systems are conceptually the same.

The objective of monitoring the leak detection layer is to assess leakage of the primary liner. Water in the leak detection layer is monitored at the leak detection access pipe (LDS) on the north side of the landfill.

Four leak detection monitoring ports (LDMP) monitor leakage at the primer liner of the landfill as part of the Trigger Level Response Plan. Two LDMP are located on the north side of the landfill (LDMP 1-2) and two are located on the on the east side of the landfill (LDMP 3-4).

Landfill Gas in Soil

The objective of monitoring landfill gas in soil is to assess its migration from the New Landfill towards the nearest receptors (i.e., workers) who are working in the buildings near the front entrance of the site. Landfill gas in soil is monitored at two probes (LFG1-22 and LFG2-22).

4.2 EMP Specifications

The EMP Specification is presented in Appendix F. The specification includes monitoring locations, frequency, and analytical parameters for each sample type. The EMP is updated following a field event or during each year's review of Site operations and environmental data as part of the Annual Report.

4.3 Leachate Indicator Parameters

The leachate indicator parameters selected for the Site, presented in Table 4.1, were based on parameters that are typically elevated in construction and demolition landfill leachate as well as IL+ soils. Further details on the selection of leachate indicator parameter concentrations for assessing potential landfill-derived water quality alteration is provided in the HHCR.

Table 4.1 Leachate Indicator Parameters selected for the Site

Parameter	Description
Alkalinity	Alkalinity typically increases down-gradient of landfills primarily due to elevated levels of dissolved carbon dioxide in affected water (produced by the biological breakdown of organic material) causing the dissolution of carbonate from natural geologic materials within the aquifer.
Ammonia	High concentrations of ammonia are observed when the landfill enters its anaerobic stage. In the anaerobic stage, anaerobic decomposition dominates, resulting in more ammonia than nitrate or nitrite.
Boron	Boron is a useful leachate indicator parameter as it is not subject to retardation processes and is therefore a conservative tracer.
Chloride	Chloride is generally abundant in municipal solid waste, however, is often found at lower concentrations in construction and demolition waste (Townsend, 2000). Chloride is formed in part by the degradation of various wastes and can be a very useful leachate indicator parameter because it is not subject to retardation processes and is therefore a conservative tracer.
Conductivity	Electrical or specific conductivity increases in leachate-affected groundwater due to the increased conductive capacity of water as a result of increased dissolved ions.
Hardness	Caused by the increased concentrations of calcium and magnesium ions due to the waste materials and more acidic pH breaking down the native lime-rich soils.

Parameter	Description
Hydrogen Sulphide	Under anaerobic conditions, sulphide (as H_2S) is observed through the reduction of sulphur species. The reducing conditions resulting from the presence of buried waste favor the development of sulphide in leachate.
Iron and Manganese	Concentrations typically increase in landfill-affected groundwater due to the alteration of redox conditions within the groundwater. The breakdown of dissolved organic matter within leachate consumes dissolved oxygen and related oxygen sources in groundwater and creates reducing conditions. Where conditions are reducing, naturally-occurring iron and manganese oxides within the geologic material are reduced to more soluble forms.
Petroleum hydrocarbons (including PAHs)	Waste in the form of creosote timbers and IL+ soil can contain petroleum hydrocarbons including polycyclic aromatic hydrocarbons (PAHs), which is a useful indicator parameter since petroleum hydrocarbons are not naturally present in groundwater on-site.
Sulphate	Construction and demolition waste landfills often generate elevated concentrations of sulphate in leachate due to the abundance of sulphate available from gypsum in drywall and other building materials in the waste stream.
TDS	A measure of the quantity of dissolved ions in solution. TDS increases with the dissolution of waste materials and salts.

4.4 Applicable Water Quality Standards

The groundwater and surface water analytical results have been assessed to the BC CSR Drinking Water (CSR DW) standards as specified in Section 3.5 of the OC.

The CSR DW standards are appropriate for evaluating water quality at permitted landfills as stated in the BC MOE Landfill Criteria for Municipal Solid Waste (Second Edition, June 2016) and based on the following rationale.

Rationale

Protocol 21 states that both current and future drinking water use must be considered when determining whether CSR DW standards apply to a site. Future land use in the vicinity of the Site may include potable water supply, therefore the drinking water exposure pathway is applicable for the Site and DW standards apply.

Protocol 21 also states that CSR freshwater aquatic life (FWAL) standards apply to sites located within 500 m of an aquatic receiving environment (i.e., a surface water body containing aquatic life) unless it can be demonstrated that the groundwater discharges into a different surface water body (located greater than 500 m from the site) or that groundwater does not migrate to within 500 m of a surface water body that contains aquatic life. The results of the aquatic life assessment completed down-gradient of the Site as part of the HHCR revealed that no surface water bodies are present within 500 m east of the Site. The assessment identified two watercourses within 500 m of the southeast Site boundary; however, the watercourses are located cross-gradient of the New Landfill and at an elevation well above (at least 24 m) groundwater leaving the Site. In addition, Rico Lake and McIvor Lake are located upgradient based on Site flow patterns (Figures 5 and 6) and are therefore also not considered aquatic receiving environments. Based on these results, the CSR FWAL standards do not apply to groundwater quality at the Site.

Per CSR Schedule 3.2 footnotes, iron and manganese standards only apply to select CSR Schedule 2 activities including specific waste disposal and recycling operations activities (biomedical waste disposal, organic or petroleum material landspreading [landfarming], on-site industrial woodwaste disposal at specific industry sites and municipal or provincial road snow removal dumping). The Site’s activities do not trigger the applicability of these standards.

4.5 Sampling Methodology

Sampling was conducted in accordance with the BC Field Sampling Manual for Continuous Monitoring and the Collection of Air, Air Emission, Water, Wastewater, Soil, Sediment and Biological Samples (British Columbia, Ministry of Environment, 2013) (BC Field Sampling Manual) and GHD's standard operating procedures.

4.6 Laboratory Program

Analytical services were provided by Bureau Veritas Laboratories (BV) of Burnaby, BC. BV is an accredited by the Canadian Association for Laboratory Accreditation (CALA) to perform the analytical tests required as part of the EMP. Laboratory reports and respective field sample keys (FSK) for each monitoring event are provided in Appendix G.

4.7 Data Quality Assessment and Verification

A qualified GHD chemist completed data verification to assess laboratory and field QA/QC measures. The QA/QC results presented in the annual data verification report in Appendix H indicate that data exhibits acceptable levels of accuracy and precision with the qualifications noted. All data collected for the 2023 EMP has been determined to be acceptable for use in this Annual Report.

5. Water Level Monitoring Results

Water levels were measured from the monitoring wells on-Site in March, July, September, and November. After the March event, the full groundwater monitoring network was added to the hydraulic monitoring program of the EMP.

Water level monitoring data is presented in the attached Table 1. Borehole logs of monitoring wells shown on Figure 2 are provided in Appendix E. Groundwater contours for June and November are presented on Figures 5 and 6.

The inferred groundwater flow direction within the sand and gravel aquifer is directed from the northwest towards the southeast (i.e., from McIvor Lake towards the southeast corner of the Site). McIvor Lake is the headwaters for the sand and gravel aquifer underlying the Site. This groundwater flow direction occurred during each quarterly monitoring event and is consistent with historical results.

6. EMP Results and Water Quality Assessment

This section presents the EMP results and an assessment of leachate, groundwater, leak detection layer water, and surface water quality. Groundwater and surface water quality were assessed through an evaluation of the spatial distribution and temporal trends of typical leachate indicator parameters compared to leachate and background quality as well as baseline results. Baseline results were established prior to landfilling as part of the HHCR. Groundwater concentration versus time plots for leachate indicator parameters are presented in Appendix I.

6.1 Leachate Quality

Characterization of leachate generated within the New Landfill was completed via sample collection from leachate sump S06-21. Samples were collected in March, July, and November. Sample collection was not possible during the September event as the sump riser pipe was dry. Treated leachate is sampled from the Treated Leachate Infiltration Pond (TLIP) if discharging to assess treatment performance and determine if changes to the treatment process are required. Discharge did not occur during the EMP events.

Leachate samples were analyzed for general chemistry, biological oxygen demand (BOD), nutrients, sulphide, total metals, dissolved hardness, PAHs, light extractable petroleum hydrocarbons (LEPH), heavy extractable petroleum hydrocarbons (HEPH), extractable petroleum hydrocarbons (EPH), benzene, toluene, ethylbenzene and xylene (BTEX), volatile petroleum hydrocarbons (VPH) and phenols. The analytical leachate results are provided in Table 2.

A summary of the indicator parameters concentrations from leachate samples and the 2022 leak detection system is presented in Table 6.1 below.

Based on the leachate analytical results, leachate can be characterized as:

– Characteristic of C&D waste and IL+ soil, containing:
  - High concentrations of select metals, bicarbonate, sulphate, total dissolved solids (TDS), and conductivity
  - Low concentrations of BOD, COD, ammonia, nitrate, and nitrite
– Variable oxidation reduction potential ranging (60 to -376 mV)
– Containing low extractable petroleum hydrocarbons (i.e., $EPH_{C10-C19}$ and LEPH)
– Containing low PAH concentrations with no exceedances above BC CSR DW Standards.

Table 6.1 2023 Leachate Water Quality Summary of Indicator Parameters – New Landfill (March-November)

Leachate Indicator Parameter	Leak Detection System Range[1] (LDS)	2023 Leachate Concentration Range (S06-21)
ORP (millivolts)	(-85) - 197	(-376) – 60
TDS (lab)	360 - 3800	2,300 – 3,700
Dissolved Hardness	78.8 – 85.3	1,010 – 1,560
Conductivity (lab) (µS/cm)	3800 - 4000	3,200 – 4,400
Bicarbonate	1300 - 1600	31 – 1,000
Alkalinity (total)	1200 - 1500	26 – 840
Chloride	28 - 37	190 – 310
Sulphate	730 - 840	720 – 2,000
Hydrogen Sulphide (total)	0.012 - 0.024	0.020 – 13
Boron (µg/L)	0.652 – 1.28	1,240 – 12,200
Iron (µg/L)	1.2 – 14.8	1,970 – 26,500
Manganese (µg/L)	0.289 – 0.702	923 – 4,790
Sulphur (µg/L)	240,000 – 273,000	235,000 – 648,000
Total PAHs (µg/L)	--	4.0 – 4.2

Notes:

Units are in mg/L unless otherwise noted; --: data not available; Boron, iron, manganese, and sulphur are total for the leak detection system and leachate.

The leak detection system was dry during all monitoring events in 2023 and the range includes data from 2022, the only year with LDS data.

6.2 Landfill Leak Detection System Water Quality

Leachate is also monitored quarterly from the primary liner of the landfill as part of the Trigger Level Response Plan at the Leak Detection Sump (LDS). Samples are collected to assess the water quality and potential for leachate leakage through the primary liner of Cell 1 East. Leak detection samples are analyzed for general chemistry, BOD, nutrients, total metals, dissolved hardness, LEPH, HEPH, EPH, PAH, BTEX, VPH and Phenols. Water was not present in the leak detection system during any of the monitoring events and no samples were collected in 2023.

The LDS reporting dry for all monitoring events in 2023 is an indication that the primary liner and secondary base liner are functioning.

A summary of the indicator parameter concentrations reported in the water sampled from the LDS in 2022 are presented in Table 6.1 above for comparison with leachate quality.

6.3 Groundwater Quality

Water quality results have been assessed for evidence of leachate derived alterations. Upgradient and cross-gradient groundwater samples were analyzed for general chemistry parameters, nutrients, and dissolved metals. Downgradient groundwater samples were analyzed for general chemistry, nutrients, dissolved metals, EPH, LEPH, HEPH, and PAHs. The 2023 analytical results are presented in Table 3.

A summary of the leachate indicator parameter concentrations reported in the upgradient wells, cross-gradient wells, and downgradient wells are summarized ted in Table 6.2 below.

Upgradient Groundwater Monitoring Wells

Water quality at the upgradient monitoring wells (MW1-14, MW4A-15, and MW4B-15, MW6-17, MW9-17) is similar in quality to the cross-gradient wells and is characterized as relatively fresh water with low concentrations of general chemistry, hardness (soft), nutrients, and metals. Monitoring wells MW4A-15 and MW4B-15 were buried and sample collection was not possible in 2023.

Little variation was observed between the 2017 to 2023 monitoring events at the upgradient groundwater monitoring wells, and concentrations of leachate indicator parameters do not appear to be increasing over time.

The 2023 dataset was compared to historical concentrations (Appendix I) and the following observations in regard to water quality at the upgradient groundwater monitoring wells were noted:

– Groundwater from MW9-17 is slightly different in quality based on lower concentrations of the major ions and cations.
– No petroleum hydrocarbons are present in upgradient groundwater.
– Hydrogen sulphide concentrations at monitoring well MW6-17 increased from 0.0025 mg/L to 0.034 mg/L in March. Concentrations have since been low at around 0.001 mg/L indicating that this spike was likely an outlier.

No exceedances of the CSR DW standards occurred in the 2023 monitoring events with the following exception and noted qualifier:

– Benzo(a)pyrene: MW6-17(J+)

The above qualifier (J+) indicates that the result is qualified as estimated due to analytical interference identified by the laboratory which impacted accurate determination of the analyte concentration. This result has been flagged as "tentatively identified" only with a suspected high bias (Appendix H).

Cross-gradient Groundwater Monitoring Wells

Water quality at the cross-gradient monitoring wells (MW2-14 and MW2A-16) can be characterized as relatively fresh water with low concentrations of general chemistry, hardness (soft), nutrients, and metals. No petroleum hydrocarbons are present in cross-gradient groundwater.

Groundwater quality at the cross-gradient monitoring wells in 2023 is within historical concentration ranges and leachate indicator parameters are not increasing. No exceedances of the CSR DW standards occurred in 2023.

Downgradient Groundwater Monitoring Wells

The water quality at the downgradient wells (MW10-17, MW12-22, MW11-19 and MW3-14) is characterized as unimpacted water with low concentrations of alkalinity, hardness (moderately hard), chloride, nutrients, and dissolved metals. Seasonal variation in analyte concentrations are present. No exceedances of the CSR DW standards occurred in the 2023 monitoring events.

The water quality at downgradient well MW10-17 indicated alteration potentially from site activities in 2022 with elevated chloride, conductivity, sulphate, hardness concentrations. In response to the groundwater impacts at MW10-17, potential sources of alteration were being investigated. Concentrations at MW10-17 returned to historical ranges in 2023.

Table 6.2 Groundwater Quality Summary of Indicator Parameters –March-November

Leachate Indicator Parameter	Upgradient Concentration Range	Cross-Gradient Concentration Range	Downgradient Concentration Range
ORP (millivolts)	94 – 284	105 – 382	134 – 288
TDS (lab)	36 – 370	44 – 120	80 – 240
Dissolved Hardness	24.6 – 175	32.5 – 85.9	44.7 – 145
Conductivity (lab) (µS/cm)	53 – 530	73 – 200	130 – 340
Bicarbonate	28 – 150	40 – 94	53 – 170
Alkalinity (total)	23 – 120	32 – 77	43 – 140
Chloride	ND (1.0) – 86	ND (1.0) – 6.3	ND (1.0) – 16
Sulphate	2.2 – 6.4	2.4 – 8.4	3.8 – 48
Hydrogen Sulphide	ND (0.0050) – 0.017	ND (0.0050)	ND (0.0050)
Boron (µg/L)	ND (50)	ND (50)	ND (50) – 171
Iron (µg/L)	ND (5.0) – 7.3	ND (5.0) – 10.7	ND (5.0) – 7.5
Manganese (µg/L)	ND (1.0) – 28.1	ND (1.0)	ND (1.0) – 9.6
Sulphur (µg/L)	ND (3,000)	ND (3,000) – 3,000	ND (3,000) – 16,400
Total PAHs (µg/L)	ND (0.10) – 0.28	ND (0.10)	ND (0.10)
Notes: Units are in mg/L unless otherwise noted; Boron, iron, manganese, and sulphur are dissolved for groundwater.			

6.4 Stormwater

The perimeter stormwater ditches will be established and included in the EMP once final cover is placed. While the landfill is active, landfill operational berms separate clean stormwater and contact water. Contact water remains within the lined cell and separate from the clean stormwater runoff. Clean stormwater continues to be directed away from the landfill for infiltration into the groundwater aquifer below the Site. The east and west surface water ditches will be removed from the specification in 2024.

6.5 Surface Water

Surface water quality is monitored at McIvor Lake and Rico Lake annually in November. Samples were analyzed for general chemistry parameters, nutrients, total metals, and dissolved hardness. The 2023 analytical results are presented in Table 4.

A summary of the leachate indicator parameter concentrations reported in McIvor are summarized in Table 6.3.

Table 6.3 Surface Water Quality Summary of Indicator Parameters (November)

Leachate Indicator Parameter	Upgradient GW Concentration Range	Surface Water Concentration Range (McIvor Lake)	Surface Water Concentration Range (Rico Lake)
ORP (millivolts)	94 – 284	197	207
TDS (lab)	36 – 370	34	38
Dissolved Hardness	24.6 – 175	22.6	17.5
Conductivity (lab) (µS/cm)	53 – 530	55	65

Leachate Indicator Parameter	Upgradient GW Concentration Range	Surface Water Concentration Range (McIvor Lake)	Surface Water Concentration Range (Rico Lake)
Bicarbonate	28 – 150	27	22
Alkalinity (total)	23 – 120	22	18
Chloride	ND (1.0) – 86	ND (1.0)	5.5
Sulphate	2.2 – 6.4	2.6	1.0
Hydrogen Sulphide	ND (0.0050) – 0.017	ND (0.0050)	ND (0.0050)
Boron (µg/L)	ND (50)	351	167
Iron (µg/L)	ND (5.0) – 7.3	ND (10)	225
Manganese (µg/L)	ND (1.0) – 28.1	1.8	11.8
Sulphur (µg/L)	ND (3,000)	ND (3000)	ND (3000)
Notes: Units are in mg/L unless otherwise noted; -- data not available; Boron, iron, manganese, and sulphur are dissolved for groundwater and total for surface water.			

Surface water quality in McIvor and Rico Lakes is similar to that observed in the sand and gravel aquifer and is characterized as being low in alkalinity, hardness, conductivity, and TDS and with low concentrations of nutrients and major ions.

McIvor and Rico Lakes are not interpreted to be receptors of groundwater flow under the area of the New Landfill based on the documented flow direction (Figure 5 and 6). However, as Rico Lake discharges into McIvor Lake and McIvor Lake recharges the sand and gravel aquifer, analytical results from McIvor and Rico Lakes are useful in characterizing water quality upgradient of the Site. Details on the Site's drainage patterns, and surface water divide located right of Rico lake is discussed in the HHCR.

Historically, seasonal variation was evident in water quality at Rico Lake, with higher concentrations evident during the fall monitoring event. Minimal seasonal variation in water quality between the monitoring events was evident at McIvor Lake, which is also consistent with historical results.

6.6 Landfill Gas in Soil Quality

Monitoring of landfill gas in soil began following the installation of LFG1-22 and LFG2-22 on July 27, 2022. In November, concentrations of methane were outside of the explosive range of methane (5 – 15 % v/v), which is the compliance criteria per the Landfill Criteria. The landfill gas results are presented in Table 5.

7. Conclusions

Based on the results of this Annual Report, the operational and water quality conclusions presented below can be made.

Operational Conclusions

– No complaints were received in 2023. According to Northwin, the New Landfill was compliant with the conditions of the OC during the Reporting Period. The annual status form is provided in Appendix D.

– Waste filling began in Cell 1 West. No other significant works occurred in 2023.

– An estimated total of 8,205 tonnes of C&D waste, 25,663 tonnes of non-hazardous waste quality soil, 4,100 tonnes of asbestos containing material, and 357 tonnes of creosote timbers were discharged to the New Landfill.
– The total airspace consumption from January 1 to December 31, 2023, was approximately 29,482 m^3. The remaining airspace for the constructed cells is approximately 86,663 m^3.
– In 2023, the quantity of leachate collected, treated, and discharged from the New Landfill was approximately 4,050,000 litres of leachate from the New Landfill.
– The leak detection system continues to show no leaks in the primary liner system.

Water Quality Conclusions

– Water level monitoring results show that groundwater flow direction is in a general southeasterly direction.
– Groundwater quality at the upgradient and cross-gradient monitoring wells is consistent with previous water quality monitoring results.
– Downgradient groundwater concentrations were well below the applicable CSR DW standards.
– Leachate was characterized by high concentrations of select metals, bicarbonate, sulphate, TDS, and conductivity.
– Surface water quality in McIvor and Rico Lakes is similar to that observed in the sand and gravel aquifer and is characterized as being low in alkalinity, hardness, conductivity, and TDS and with low concentrations of nutrients and major ions.
– McIvor and Rico Lakes are not interpreted to be receptors of groundwater flow under the area of the New Landfill based on the documented flow direction.

8. Recommendations

Based on the conclusions presented in this Annual Report, the following operational and water quality recommendations can be made:

Operational Recommendations

– Complete a survey of Cell 1 East and Cell 1 West and compare the results to the interim design contours to assess the remaining capacity in Cell 1 East and Cell 1 West.

Water Quality Recommendations

– Install downgradient well MW13 in 2024
– Complete the 2024 New Landfill proposed environmental monitoring plan as outlined in Appendix J. Updates include:
  - The addition of Cell 1 West Sump to the quarterly leachate monitoring program following waste discharge (S07).
  - Removal of the east and west ditches. These locations will be constructed and monitored following the placement of final cover.
– Recover MW4A-15 and MW4B-15 which were buried during construction activities.

All of Which is Respectfully Submitted,

GHD

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Tables

Table 1

Hydraulic Monitoring Results
2023 Operations and Monitoring Report
New Landfill
Campbell River, British Columbia

Monitoring Location	Depth to Bottom (m BGS)	Reference Elevation TOR (m AMSL)	Depth to Water (m BTOR)				Water Elevation (m AMSL)				Screened Unit (Aquifer)
		Date	March 28 - 29, 2023	July 17 - 19, 2023	September 6 - 8, 2023	November 28, 2023	March 28, 2023	July 17 - 19, 2023	September 6 - 8, 2023	November 28, 2023	Primary Constituent
MW1-14	11.0	172.9	8.4	8.1	8.8	9.3	164.5	164.9	164.1	163.7	Sand/gravel (S&G Aquifer)
MW2-14	21.6	173.8	17.5	17.1	17.4	18.1	156.4	156.7	156.4	155.8	Sand/gravel (S&G Aquifer)
MW2A-16	45.4	173.9	17.4	17.1	17.4	18.0	156.5	156.8	156.5	155.8	Sand (S&G Aquifer)
MW3-14	18.6	168.6	13.48	15.0	15.3	16.0	155.1	153.6	153.3	152.6	Sand/gravel (S&G Aquifer)
MW4A-15	21.3	169.3	-[2]	-[2]	-[2]	-[2]	-[2]	-[2]	-[2]	-[2]	Bedrock (Bedrock)
MW4B-15	18.3	169.3	-[2]	-[2]	-[2]	-[2]	-[2]	-[2]	-[2]	-[2]	Sand (S&G Aquifer)
MW5A-15	10.7	191.9	-	8.8	9.0	8.4	-	183.1	182.9	183.5	Bedrock (Bedrock)
MW5B-15	8.2	192.0	-	8.5	8.8	7.1	-	183.5	183.2	185.0	Sand/Silt with clay (Shallow Aquifer)
MW6-17	11.3	*185.4*	8.1	8.7	9.2	8.5	177.3	176.6	176.2	176.9	Sand (S&G Aquifer)
MW7-17	4.3	*187.5*	-	4.0	4.2	3.2	-	183.5	183.3	184.3	Gravel (Shallow Aquifer)
MW8-17	18.8	*192.5*	-	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Gravel (S&G Aquifer)
MW9-17	33.5	*191.7*	24.6	24.4	25.3	25.7	167.1	167.3	166.4	166.0	Sand/gravel (S&G Aquifer)
MW10-17	46.3	*189.1*	42.0	41.6	41.7	42.5	147.0	147.4	147.4	146.6	Sand (S&G Aquifer)
MW15A-18	15.2	183.1	-	7.2	7.9	7.5	-	175.9	175.2	175.6	Bedrock (Bedrock)
MW15B-18	9.0	183.2	-	7.9	8.6	8.4	-	175.3	174.6	174.8	Silty/Clayey Sand (S&G Aquifer)
MW11-19	54.9	194.8	48.1	47.8	47.9	48.6	146.7	-	146.9	146.2	Sand (S&G Aquifer)
MW12-22[3]	45.1	-	40.5	40.4	40.6	41.5	-	-	-	-	Sand (S&G Aquifer)
PZ1-19	20.4	192.1	-	20.2	20.2	19.7	-	172.0	171.9	172.4	Sand/Silty Gravel (Shallow Aquifer)
McIvor Lake*	N/A	N/A	-	-	-	-	177.4	177.1	176.7	177.2	N/A
SW15-02 [Rico Lake]**	N/A	180.3	1.9	2.9	-[1]	3.1	178.5	177.4	-[1]	177.2	N/A
East Surface Water Ditch	N/A	N/A	Dry	-[4]	-	-	Dry	-	-	-	N/A
West Surface Water Ditch	N/A	N/A	Dry	-[4]	-	-	Dry	-	-	-	N/A
S06-213	N/A	N/A	N/A[5]	N/A[5]	N/A[5]	N/A[5]	N/A[5]	N/A[5]	N/A[5]	N/A[5]	N/A
LDS3	N/A	N/A	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	N/A
LDMP-1	N/A	N/A	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	N/A
LDMP-2	N/A	N/A	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	N/A
LDMP-3	N/A	N/A	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	N/A
LDMP-4	N/A	N/A	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	N/A

Notes:

191.88	Surveys completed by McElhanney on April 6, 2016 and March 16 and 31, 2017.
185.4	Survey completed by Upland Excavating Ltd. on January 29th, 2015, March 8, 2016 and April 6th, 2016. Elevations measured with respect to AMSL.
*	McIvor Lake elevations are based on BC Hydro record of water elevations at Ladore Dam recorded every three hours.
**	Surface water gauge reference elevation refers to the bottom of the gauge (0 m on gauge = 180.33 m amsl).
m BGS	metres below ground surface.
m AMSL	metres above mean sea level (WGS1984).
TOR	top of riser.
S&G	sand and gravel.
N/A	not applicable.
MW	monitoring well.
LDS	leak detection sump
LDMP	leak detection monitoring pipe.
-	Not included in the EMP event.
1	Water level below gauge.
2	Well was burried during construction activities and is inaccessible.
3	Will be surveyed in 2024.
4	East and West Ditch removed from EMP in July 2023 until final cover is placed.
5	Leachate is pumped and depth to water mesurement is not possible, sample collection is completed via tap from riser pipe.

Table 2

Leachate Analytical Results
2023 Operations and Monitoring Report
New Landfill
Campbell River, British Columbia

Sample Location:			S06-21				
Sample ID:			WL-11222680-280323-KH-01	WL-11222680-280323-KH-02	WL-11222680-180723-KH-01	WL-11222680-180723-KH-02	WL-11222680-281123-KH-01
Sample Date:		BC CSR[1]	03/28/2023	03/28/2023	07/18/2023	07/18/2023	11/28/2023
		DW		Duplicate		Duplicate	
Parameters	**Units**	**a**					
Field Parameters							
Conductivity, field	µS/cm	--	3730	3730	4150	4150	3.35
Dissolved oxygen (DO), field	mg/L	--	8.59	8.59	9.08	9.08	10.47
Oxidation reduction potential (ORP), field	millivolts	--	-376	-376	-2	-2	60
pH, field	s.u.	--	7.67	7.67	6.32	6.32	6.53
Temperature, field	Deg C	--	16.53	16.53	24.04	24.04	9.61
Total dissolved solids, field (TDS)	mg/L	--	2100	2100	-	-	-
Turbidity, field	NTU	--	30.3	30.3	282	282	9
General Chemistry							
Alkalinity (as CaCO3 pH=8.3)	mg/L	--	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
Alkalinity, total (as CaCO3)	mg/L	--	840	830	26	30	690
Biochemical oxygen demand (BOD)	mg/L	--	26	27	8.4	8.3	5.2
Chemical oxygen demand (COD)	mg/L	--	370	392	208	210	311
Chloride (dissolved)	mg/L	250	190	190	**310[a]**	**310[a]**	**290[a]**
Conductivity	µS/cm	--	3200	3200	4400	4400	3600
Fluoride (dissolved)	mg/L	--	-	-	-	-	0.19
Hardness	mg/L	--	-	-	1290	1350	934
Hardness (dissolved)	mg/L	--	1010	1040	1530	1560	1090
Hydroxide (as CaCO3)	mg/L	--	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
Orthophosphate	mg/L	--	0.18	0.19	ND (0.0030)	ND (0.0030)	0.013
pH	s.u.	--	-	-	5.82 J	5.96 J	7.35 J
Sulphate (Dissolved)	mg/L	500	**730[a]**	**720[a]**	**2000[a]**	**2000[a]**	**720[a]**
Un-ionized Sulphide as H2S	mg/L	0.05	**2.4[a]**	ND (0.0050)	**0.29[a]**	**0.26[a]**	0.021
Total Sulfide as H2S	mg/L	--	-	-	0.37	0.34	0.027
Total Sulfide as H2S (calculated)	mg/L	--	13	13	0.28	0.25	0.020
Total Sulfide as S	mg/L	--	12	12	0.35 J-	0.32 J-	0.025
Total dissolved solids (TDS)	mg/L	--	2300	2300	3700	3600	2400
Total suspended solids (TSS)	mg/L	--	38	59	140 J	180 J	4.8
Nutrients							
Ammonia-N	mg/L	--	61	62	55	55	30
Bicarbonate (as CaCO3)	mg/L	--	1000	1000	31	36	850
Carbonate (as CaCO3)	mg/L	--	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
Nitrate (as N)	mg/L	10	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)	7.37
Nitrite (as N)	mg/L	1	ND (0.0050)	0.0053	ND (0.0050)	ND (0.0050)	0.0414
Nitrite/Nitrate	mg/L	10	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)	7.41
Dissolved Metals							
Calcium (dissolved)	µg/L	--	339000	354000	486000	500000	348000
Magnesium (dissolved)	µg/L	--	38500	38500	76700	76900	54800
Total Metals							
Aluminum	µg/L	9500	488	482	1250	1170	313
Antimony	µg/L	6	ND (5.0)	ND (5.0)	ND (2.5)	ND (2.5)	3.21
Arsenic	µg/L	10	**19.3[a]**	**19.1[a]**	3.06	3.18	4.86
Barium	µg/L	1000	124	120	59.8	62.0	116
Beryllium	µg/L	8	ND (1.0)	ND (1.0)	ND (0.50)	ND (0.50)	ND (0.10)
Bismuth	µg/L	--	ND (10)	ND (10)	ND (5.0)	ND (5.0)	ND (1.0)
Boron	µg/L	5000	**12200[a]**	**11600[a]**	1240	1280	**11500[a]**
Cadmium	µg/L	5	ND (0.10)	ND (0.10)	0.282	0.297	0.111
Calcium	µg/L	--	366000	357000	409000	426000	295000
Chromium	µg/L	50	19	20	10.4	10.2	7.8
Cobalt	µg/L	1	**2.9[a]**	**2.6[a]**	**13.9[a]**	**14.5[a]**	**4.38[a]**
Copper	µg/L	1500	7.5	7.2	32.0	31.7	66.0
Iron	µg/L	6500	2290	2160	**26300[a]**	**26500[a]**	1970
Lead	µg/L	10	ND (2.0)	ND (2.0)	ND (1.0)	ND (1.0)	0.29
Lithium	µg/L	8	**ND (20)[a]**	**ND (20)[a]**	**11[a]**	**12[a]**	5.0
Magnesium	µg/L	--	41900	41100	66600	69400	47700
Manganese	µg/L	1500	957	923	**4600[a]**	**4790[a]**	**1530[a]**
Mercury	µg/L	1	ND (0.038)	ND (0.038)	0.0041	0.0041	ND (0.0019)
Molybdenum	µg/L	250	ND (10)	ND (10)	ND (5.0)	ND (5.0)	7.7
Nickel	µg/L	80	18	27	20.3	18.8	11.5
Phosphorus	µg/L	--	572	558	123	106	164
Potassium	µg/L	--	50000	48900	48200	51000	39200
Selenium	µg/L	10	ND (1.0)	ND (1.0)	ND (0.50)	ND (0.50)	0.50
Silicon	µg/L	--	15000	14600	18400	19100	14500
Silver	µg/L	20	ND (0.20)	ND (0.20)	ND (0.10)	ND (0.10)	ND (0.020)
Sodium	µg/L	200000	**240000[a]**	**235000[a]**	**304000[a]**	**319000[a]**	**276000[a]**
Strontium	µg/L	2500	2370	2300	**2720[a]**	**2890[a]**	1890
Sulphur	µg/L	--	248000	241000	593000	648000	235000
Thallium	µg/L	--	ND (0.10)	ND (0.10)	ND (0.050)	ND (0.050)	ND (0.010)
Tin	µg/L	2500	ND (50)	ND (50)	ND (25)	ND (25)	ND (5.0)
Titanium	µg/L	--	ND (50)	ND (50)	34	26	16.7
Uranium	µg/L	20	ND (1.0)	ND (1.0)	ND (0.50)	ND (0.50)	1.72
Vanadium	µg/L	20	**ND (50)[a]**	**ND (50)[a]**	**ND (25)[a]**	**ND (25)[a]**	6.0
Zinc	µg/L	3000	51	ND (50)	131	132	67.0
Zirconium	µg/L	--	1.5	1.4	0.56	0.55	1.55
PHCs							
Extractable Petroleum Hydrocarbons (C10-C19)	µg/L	5000	420	430	ND (200)	ND (200)	210
Extractable Petroleum Hydrocarbons (C19-C32)	µg/L	--	230	220	ND (200)	ND (200)	ND (200)
HEPH (C19-C32 less PAH)	µg/L	--	230	220	ND (200)	ND (200)	ND (200)
LEPH (C10-C19 less PAH)	µg/L	--	420	430	ND (200)	ND (200)	210
Total Petroleum Hydrocarbons VPH (C6-C10)LessBTEX	µg/L	--	-	-	-	-	ND (300)
Total Petroleum Hydrocarbons VH (C6-C10)	µg/L	15000	-	-	-	-	ND (300)
VOCs							
Benzene	µg/L	5	-	-	-	-	ND (0.40)
Ethylbenzene	µg/L	140	-	-	-	-	ND (0.40)
m&p-Xylenes	µg/L	--	-	-	-	-	0.63
Methyl tert butyl ether (MTBE)	µg/L	95	-	-	-	-	ND (4.0)
o-Xylene	µg/L	--	-	-	-	-	0.65
Styrene	µg/L	800	-	-	-	-	ND (0.40)
Toluene	µg/L	60	-	-	-	-	ND (0.40)
Xylenes (total)	µg/L	90	-	-	-	-	1.3
PAHs							
1-Methylnaphthalene	µg/L	5.5	0.19	0.19	-	-	-
2-Methylnaphthalene	µg/L	15	0.27	0.28	-	-	-
Acenaphthene	µg/L	250	0.23	0.23	0.094	0.094	0.48
Acenaphthylene	µg/L	--	ND (0.050)	ND (0.050)	-	-	-
Acridine	µg/L	--	0.093	0.096	ND (0.050)	ND (0.050)	0.078
Anthracene	µg/L	1000	0.025	0.026	0.018	0.019	0.098
Benzo(a)anthracene	µg/L	0.07	ND (0.010)	ND (0.010)	ND (0.010)	ND (0.010)	0.031
Benzo(a)pyrene	µg/L	0.01	ND (0.0050)	ND (0.0050)	ND (0.0050)	ND (0.0050)	ND (0.0050)
Benzo(b)fluoranthene/Benzo(j)fluoranthene	µg/L	0.07	ND (0.030)	ND (0.030)	-	-	-
Benzo(b)pyridine (Quinoline)	µg/L	0.05	ND (0.037)	ND (0.039)	-	-	-
Benzo(g,h,i)perylene	µg/L	--	ND (0.050)	ND (0.050)	-	-	-
Benzo(k)fluoranthene	µg/L	--	ND (0.050)	ND (0.050)	-	-	-
Chrysene	µg/L	7	ND (0.020)	ND (0.020)	-	-	-
Dibenz(a,h)anthracene	µg/L	0.01	ND (0.0030)	ND (0.0030)	-	-	-
Fluoranthene	µg/L	150	0.034	0.035	0.021	ND (0.020)	0.25
Fluorene	µg/L	150	0.10	0.11	ND (0.050)	ND (0.050)	0.37
Indeno(1,2,3-cd)pyrene	µg/L	--	ND (0.050)	ND (0.050)	-	-	-
Naphthalene	µg/L	80	3.0	3.1	0.78	0.82	1.6
PAH high molecular weight	µg/L	--	0.064	0.066	-	-	-
PAH low molecular weight	µg/L	--	4.0	4.2	-	-	-
Phenanthrene	µg/L	--	0.10	0.10	ND (0.050)	ND (0.050)	0.47
Pyrene	µg/L	100	0.030	0.031	ND (0.020)	ND (0.020)	0.26
Total PAH	µg/L	--	4.0	4.2	-	-	-
Phenols							
2,3,4,5-Tetrachlorophenol	µg/L	--	-	-	-	-	ND (0.10)
2,3,4,6-Tetrachlorophenol	µg/L	100	-	-	-	-	ND (0.10)
2,3,4-Trichlorophenol	µg/L	--	-	-	-	-	ND (0.10)
2,3,5,6-Tetrachlorophenol	µg/L	--	-	-	-	-	ND (0.10)
2,3,5-Trichlorophenol	µg/L	--	-	-	-	-	ND (0.10)
2,3,6-Trichlorophenol	µg/L	--	-	-	-	-	ND (0.10)
2,3-Dichlorophenol	µg/L	--	-	-	-	-	ND (0.10)
2,4,5-Trichlorophenol	µg/L	400	-	-	-	-	ND (0.10)
2,4,6-Trichlorophenol	µg/L	5	-	-	-	-	0.16
2,4/2,5-Dichlorophenol	µg/L	--	-	-	-	-	ND (0.10)
2,4-Dimethylphenol	µg/L	80	-	-	-	-	ND (0.50)
2,4-Dinitrophenol	µg/L	8	-	-	-	-	ND (0.50)
2,6-Dichlorophenol	µg/L	--	-	-	-	-	ND (0.10)
2,6-Dimethylphenol	µg/L	2.5	-	-	-	-	ND (0.50)
2-Chlorophenol	µg/L	45	-	-	-	-	ND (0.080)
2-Methylphenol	µg/L	200	-	-	-	-	ND (0.50)
2-Nitrophenol	µg/L	--	-	-	-	-	ND (0.50)
3&4-Methylphenol	µg/L	--	-	-	-	-	ND (0.50)
3,4,5-Trichlorophenol	µg/L	--	-	-	-	-	ND (0.10)
3,4-Dichlorophenol	µg/L	--	-	-	-	-	ND (0.10)
3,4-Dimethylphenol	µg/L	4	-	-	-	-	ND (0.50)
3,5-Dichlorophenol	µg/L	--	-	-	-	-	ND (0.10)
3/4-Chlorophenol	µg/L	--	-	-	-	-	ND (0.080)
4,6-Dinitro-2-methylphenol	µg/L	1	-	-	-	-	ND (0.50)
4-Chloro-3-methylphenol	µg/L	400	-	-	-	-	ND (1.0)
4-Nitrophenol	µg/L	--	-	-	-	-	ND (0.50)
Catechol	µg/L	--	-	-	-	-	ND (10)
Chlorophenols	µg/L	--	-	-	-	-	ND (0.080)
Chlorophenols (total)	µg/L	--	-	-	-	-	0.52
Dichlorophenols	µg/L	--	-	-	-	-	ND (0.10)
Hydroquinone	µg/L	2.5	-	-	-	-	ND (1.0)
Pentachlorophenol	µg/L	60	-	-	-	-	0.37
Phenol	µg/L	1000	-	-	-	-	ND (0.50)
Phenolics (total)	µg/L	--	-	-	-	-	ND (10)
Resorcinol	µg/L	4500	-	-	-	-	ND (10)
Tetrachlorophenol	µg/L	--	-	-	-	-	ND (0.10)
Total unchlorinated phenols-OC	µg/L	--	-	-	-	-	ND (10)
Trichlorophenol (DOT)	µg/L	--	-	-	-	-	0.16

Table 3

Groundwater Analytical Results
2023 Operations and Monitoring Report
New Landfill
Campbell River, British Columbia

Sample Location:			MW1-14				MW2-14					MW2A-16			
Sample ID:			WG-11222680-280323-KH-03	WG-11222680-180723-KH-06	WG-11222680-070923-CXW-07	WG-11222680-271123-KH-05	WG-11222680-280323-KH-02	WG-11222680-180723-KH-07	WG-11222680-070923-CXW-05	WG-11222680-070923-CXW-06	WG-11222680-281123-KH-07	WG-11222680-280323-KH-01	WG-11222680-180723-KH-08	WG-11222680-070923-CXW-04	WG-11222680-281123-KH-08
Sample Date:		BC CSR[1] DW a	03/28/2023	07/18/2023	09/07/2023	11/27/2023	03/28/2023	07/18/2023	09/07/2023	09/07/2023 Duplicate	11/28/2023	03/28/2023	07/18/2023	09/07/2023	11/28/2023
Parameters	**Units**														
Field Parameters															
Conductivity, field	µS/cm	--	199	132	86	102	110	191	165	165	164	62	66	83	78
Dissolved oxygen (DO), field	mg/L	--	8.96	10.30	10.67	9.77	-	11.94	7.92	7.92	11.37	-	10.12	3.50	10.82
Oxidation reduction potential (ORP), field	millivolts	--	105	148	103	284	382	195	105	105	219	318	118	150	201
pH, field	s.u.	--	7.58	7.65	7.32	7.54	6.80	6.99	6.74	6.74	7.73	7.65	8.59	8.20	8.38
Temperature, field	Deg C	--	13.87	16.90	12.36	13.12	9.9	14.96	11.84	11.84	10.55	12.12	15.95	10.56	10.97
Total dissolved solids, field (TDS)	mg/L	--	129	-	56	-	70	-	107	107	-	40	-	54	-
Turbidity, field	NTU	--	24	9.1	4.4	37.1	2.8	8.5	4.1	4.1	1.2	3.5	4.3	5.0	2.0
General Chemistry															
Alkalinity (as CaCO3 pH=8.3)	mg/L	--	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
Alkalinity, total (as CaCO3)	mg/L	--	52	41	35	41	50	77	67	67	72	34	32	39	36
Chloride (dissolved)	mg/L	250	14	12	3.3	3.3	3.3	6.3	4.5	4.7	4.1	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
Conductivity	µS/cm	--	170	130	88	100	130	200	170	170	180	74	73	87	84
Fluoride (dissolved)	mg/L	--	-	-	-	-	-	-	-	-	ND (0.050)	-	-	-	ND (0.050)
Hardness (dissolved)	mg/L	--	78.4	30.7	33.2	41.7	55.2	85.9	69.2	68.8	78.1	33.8	32.5	36.2	37.4
Hydroxide (as CaCO3)	mg/L	--	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
Orthophosphate	mg/L	--	0.0057	0.0040 J	0.0047	0.0042	0.0051	0.0035	0.0033	ND (0.0030)	ND (0.0030)	0.030	0.026	0.021	0.022
pH	s.u.	--	-	7.15 J	-	-	-	7.54 J	-	-	7.32 J	-	7.61 J	-	7.25 J
Sulfate (dissolved)	mg/L	500	2.8	3.1	3.0	2.9	7.0	8.4	7.3	7.4	7.1	2.4	2.7	2.8	2.6
Un-ionized Sulphide as H2S	mg/L	0.05	ND (0.0050)	ND (0.0050)	ND (0.0050)	ND (0.0050)	ND (0.0050)	ND (0.0050)	ND (0.0050)	ND (0.0050)	ND (0.0050)	ND (0.0050)	ND (0.0050)	ND (0.0050)	ND (0.0050)
Total Sulfide as H2S	mg/L	--	ND (0.0020)	ND (0.0020)	ND (0.0020)	ND (0.0020)	ND (0.0020)	ND (0.0020)	ND (0.0020)	ND (0.0020)	ND (0.0020)	ND (0.0020)	ND (0.0020)	ND (0.0020)	ND (0.0020)
Total Sulfide as H2S (calculated)	mg/L	--	-	ND (0.0050)	ND (0.0050)	ND (0.0050)	-	ND (0.0050)	ND (0.0050)	ND (0.0050)	ND (0.0050)		ND (0.0050)	ND (0.0050)	ND (0.0050)
Total Sulfide as S	mg/L	--	ND (0.0018)	ND (0.0018) J	ND (0.0018)	ND (0.0018)	ND (0.0018)	ND (0.0018) J	ND (0.0018)	ND (0.0018)	ND (0.0018)	ND (0.0018)	ND (0.0018) J	ND (0.0018)	ND (0.0018)
Total dissolved solids (TDS)	mg/L	--	94	54	54	78	92	120	96	100	88	64	56	60	44
Nutrients															
Ammonia-N	mg/L	--	ND (0.015)	ND (0.015)	ND (0.015)	ND (0.015)	ND (0.015)	ND (0.015)	ND (0.015)	ND (0.015)	ND (0.015)	ND (0.015)	ND (0.015)	ND (0.015)	ND (0.015)
Bicarbonate (as CaCO3)	mg/L	--	63	50	43	50	62	94	81	82	87	41	40	48	44
Carbonate (as CaCO3)	mg/L	--	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
Nitrate (as N)	mg/L	10	1.68	0.190 J	0.127	0.416	0.245	0.720	0.325	0.326	0.237	0.037	0.082	0.062	0.043
Nitrite (as N)	mg/L	1	0.0171	0.0055 J	ND (0.0050)	ND (0.0050)	ND (0.0050)	ND (0.0050)	ND (0.0050)	ND (0.0050)	ND (0.0050)	ND (0.0050)	ND (0.0050)	ND (0.0050)	ND (0.0050)
Nitrite/Nitrate	mg/L	10	1.70	0.195 J	0.127	0.416	0.245	0.720	0.325	0.326	0.237	0.037	0.082	0.062	0.043
Dissolved Metals															
Aluminum (dissolved)	µg/L	9500	ND (3.0)	3.6	ND (3.0)	ND (3.0)	ND (3.0)	41.3	ND (3.0)	ND (3.0)	ND (3.0)	9.2	4.1	ND (3.0)	3.9
Antimony (dissolved)	µg/L	6	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)
Arsenic (dissolved)	µg/L	10	ND (0.10)	ND (0.10)	ND (0.10)	0.13	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	0.96	0.83	0.72	0.85
Barium (dissolved)	µg/L	1000	1.5	ND (1.0)	ND (1.0)	1.2	1.4	2.4	2.0	1.9	2.2	2.0	1.8	2.0	1.9
Beryllium (dissolved)	µg/L	8	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)
Bismuth (dissolved)	µg/L	--	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
Boron (dissolved)	µg/L	5000	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)
Cadmium (dissolved)	µg/L	5	ND (0.010)	ND (0.010)	ND (0.010)	ND (0.010)	ND (0.010)	ND (0.010)	ND (0.010)	ND (0.010)	ND (0.010)	ND (0.010)	ND (0.010)	ND (0.010)	ND (0.010)
Calcium (dissolved)	µg/L	--	26100	10100	11000	13800	17300	26900	21900	21500	24700	11000	10500	11800	12100
Chromium (dissolved)	µg/L	50	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
Cobalt (dissolved)	µg/L	1	ND (0.20)	ND (0.20)	ND (0.20)	ND (0.20)	ND (0.20)	ND (0.20)	ND (0.20)	ND (0.20)	ND (0.20)	ND (0.20)	ND (0.20)	ND (0.20)	ND (0.20)
Copper (dissolved)	µg/L	1500	ND (0.20)	ND (0.20)	ND (0.20)	1.30	0.26	0.37	ND (0.20)	ND (0.20)	0.26	ND (0.20)	ND (0.20)	ND (0.20)	ND (0.20)
Iron (dissolved)	µg/L	6500	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	10.7	ND (5.0)	ND (5.0)	ND (5.0)
Lead (dissolved)	µg/L	10	ND (0.20)	ND (0.20)	ND (0.20)	ND (0.20)	ND (0.20)	ND (0.20)	ND (0.20)	ND (0.20)	ND (0.20)	ND (0.20)	ND (0.20)	ND (0.20)	ND (0.20)
Lithium (dissolved)	µg/L	8	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)
Magnesium (dissolved)	µg/L	--	3230	1350	1360	1740	2910	4540	3540	3650	4000	1500	1550	1650	1730
Manganese (dissolved)	µg/L	1500	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
Mercury (dissolved)	µg/L	1	ND (0.0019)	ND (0.0019)	ND (0.0019)	ND (0.0019)	ND (0.0019)	ND (0.0019)	ND (0.0019)	ND (0.0019)	ND (0.0019)	ND (0.0019)	ND (0.0019)	ND (0.0019)	ND (0.0019)
Molybdenum (dissolved)	µg/L	250	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
Nickel (dissolved)	µg/L	80	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
Phosphorus (dissolved)	µg/L	--	11	ND (10)	ND (10)	ND (10)	ND (10)	ND (10)	ND (10)	ND (10)	ND (10)	34	29	25	29
Potassium (dissolved)	µg/L	--	264	139	124	176	201	271	225	238	254	177	174	165	178
Selenium (dissolved)	µg/L	10	0.14	ND (0.10)	ND (0.10)	0.12	0.18	0.14	0.14	0.11	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)
Silicon (dissolved)	µg/L	--	5860	3810	3430	4990	5590	6480	5960	5750	6950	4210	3880	3380	4250
Silver (dissolved)	µg/L	20	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)
Sodium (dissolved)	µg/L	200000	4670	2070	1210	1860	3160	4010	3570	3610	3840	1020	990	932	1050
Strontium (dissolved)	µg/L	2500	41.9	16.1	16.1	21.0	28.0	44.5	36.9	37.3	40.2	13.7	13.2	15.5	15.2
Sulfur (dissolved)	µg/L	--	ND (3000)	ND (3000)	ND (3000)	ND (3000)	ND (3000)	3000	ND (3000)	ND (3000)	ND (3000)	ND (3000)	ND (3000)	ND (3000)	ND (3000)
Thallium (dissolved)	µg/L	--	ND (0.010)	ND (0.010)	ND (0.010)	ND (0.010)	ND (0.010)	ND (0.010)	ND (0.010)	ND (0.010)	ND (0.010)	ND (0.010)	ND (0.010)	ND (0.010)	ND (0.010)
Tin (dissolved)	µg/L	2500	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)
Titanium (dissolved)	µg/L	--	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)
Uranium (dissolved)	µg/L	20	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)
Vanadium (dissolved)	µg/L	20	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	7.5	6.8	5.9	7.2
Zinc (dissolved)	µg/L	3000	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)
Zirconium (dissolved)	µg/L	--	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)
PHCs															
EPHw10-19	µg/L	5000	ND (200)	ND (200)	ND (200)	ND (200)	ND (200)	ND (200)	ND (200)	ND (200)	ND (200)	ND (200)	ND (200)	ND (200)	ND (200)
EPHw19-32	µg/L	--	ND (200)	ND (200)	ND (200)	ND (200)	ND (200)	ND (200)	ND (200)	ND (200)	ND (200)	ND (200)	ND (200)	ND (200)	ND (200)
HEPHw	µg/L	--	ND (200)	ND (200)	ND (200)	ND (200)	ND (200)	ND (200)	ND (200)	ND (200)	ND (200)	ND (200)	ND (200)	ND (200)	ND (200)
LEPHw	µg/L	--	ND (200)	ND (200)	ND (200)	ND (200)	ND (200)	ND (200)	ND (200)	ND (200)	ND (200)	ND (200)	ND (200)	ND (200)	ND (200)
PAHs															
1-Methylnaphthalene	µg/L	5.5	ND (0.050)	-	ND (0.050)	ND (0.050)	ND (0.050)	-	ND (0.050)	ND (0.050)	-	ND (0.050)	-	ND (0.050)	-
2-Methylnaphthalene	µg/L	15	ND (0.10)	-	ND (0.10)	ND (0.10)	ND (0.10)	-	ND (0.10)	ND (0.10)	-	ND (0.10)	-	ND (0.10)	-
Acenaphthene	µg/L	250	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)
Acenaphthylene	µg/L	--	ND (0.050)	-	ND (0.050)	ND (0.050)	ND (0.050)	-	ND (0.050)	ND (0.050)	-	ND (0.050)	-	ND (0.050)	-
Acridine	µg/L	--	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)
Anthracene	µg/L	1000	ND (0.010)	ND (0.010)	ND (0.010)	ND (0.010)	ND (0.010)	ND (0.010)	ND (0.010)	ND (0.010)	ND (0.010)	ND (0.010)	ND (0.010)	ND (0.010)	ND (0.010)
Benzo(a)anthracene	µg/L	0.07	ND (0.010)	ND (0.010)	ND (0.010)	ND (0.010)	ND (0.010)	ND (0.010)	ND (0.010)	ND (0.010)	ND (0.010)	ND (0.010)	ND (0.010)	ND (0.010)	ND (0.010)
Benzo(a)pyrene	µg/L	0.01	ND (0.0050)	ND (0.0050)	ND (0.0050)	ND (0.0050)	ND (0.0050)	ND (0.0050)	ND (0.0050)	ND (0.0050)	ND (0.0050)	ND (0.0050)	ND (0.0050)	ND (0.0050)	ND (0.0050)
Benzo(b)fluoranthene/Benzo(j)fluoranthene	µg/L	0.07	ND (0.030)	-	ND (0.030)	ND (0.030)	ND (0.030)	-	ND (0.030)	ND (0.030)	-	ND (0.030)	-	ND (0.030)	-
Benzo(b)pyridine (Quinoline)	µg/L	0.05	ND (0.020)	-	ND (0.020)	ND (0.020)	ND (0.020)	-	ND (0.020)	ND (0.020)	-	ND (0.020)	-	ND (0.020)	-
Benzo(g,h,i)perylene	µg/L	--	ND (0.050)	-	ND (0.050)	ND (0.050)	ND (0.050)	-	ND (0.050)	ND (0.050)	-	ND (0.050)	-	ND (0.050)	-
Benzo(k)fluoranthene	µg/L	--	ND (0.050)	-	ND (0.050)	ND (0.050)	ND (0.050)	-	ND (0.050)	ND (0.050)	-	ND (0.050)	-	ND (0.050)	-
Chrysene	µg/L	7	ND (0.020)	-	ND (0.020)	ND (0.020)	ND (0.020)	-	ND (0.020)	ND (0.020)	-	ND (0.020)	-	ND (0.020)	-
Dibenz(a,h)anthracene	µg/L	0.01	ND (0.0030)	-	ND (0.0030)	ND (0.0030)	ND (0.0030)	-	ND (0.0030)	ND (0.0030)	-	ND (0.0030)	-	ND (0.0030)	-
Fluoranthene	µg/L	150	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)
Fluorene	µg/L	150	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)
Indeno(1,2,3-cd)pyrene	µg/L	--	ND (0.050)	-	ND (0.050)	ND (0.050)	ND (0.050)	-	ND (0.050)	ND (0.050)	-	ND (0.050)	-	ND (0.050)	-
Naphthalene	µg/L	80	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)
PAH high molecular weight	µg/L	--	ND (0.050)	-	ND (0.050)	ND (0.050)	ND (0.050)	-	ND (0.050)	ND (0.050)	-	ND (0.050)	-	ND (0.050)	-
PAH low molecular weight	µg/L	--	ND (0.10)	-	ND (0.10)	ND (0.10)	ND (0.10)	-	ND (0.10)	ND (0.10)	-	ND (0.10)	-	ND (0.10)	-
Phenanthrene	µg/L	--	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)
Pyrene	µg/L	100	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)
Total PAH	µg/L	--	ND (0.10)	-	ND (0.10)	ND (0.10)	ND (0.10)	-	ND (0.10)	ND (0.10)	-	ND (0.10)	-	ND (0.10)	-

Table 3

Groundwater Analytical Results
2023 Operations and Monitoring Report
New Landfill
Campbell River, British Columbia

Sample Location:			MW3-14			MW6-17				MW9-17				
Sample ID:			WG-11222680-180723-KH-09	WG-11222680-070923-CXW-03	WG-11222680-291123-KH-10	WG-11222680-290323-KH-10	WG-11222680-180723-KH-10	WG-11222680-070923-CXW-08	WG-11222680-281123-KH-09	WG-11222680-280323-KH-04	WG-11222680-170723-KH-03	WG-11222680-170723-KH-04	WG-11222680-070923-CXW-10	WG-11222680-271123-KH-01
Sample Date:		BC CSR[1] DW a	07/18/2023	09/07/2023	11/29/2023	03/29/2023	07/19/2023	09/07/2023	11/28/2023	03/28/2023	07/17/2023	07/17/2023 Duplicate	09/07/2023	11/27/2023
Parameters	**Units**													
Field Parameters														
Conductivity, field	µS/cm	--	117	131	135	432	484	428	420	45	57	57	74	70
Dissolved oxygen (DO), field	mg/L	--	12.09	8.14	7.26	-	3.33	1.56	11.53	10.82	12.4	12.4	4.46	9.13
Oxidation reduction potential (ORP), field	millivolts	--	160	258	249	171	152	129	210	150	189	189	94	252
pH, field	s.u.	--	7.37	6.61	6.50	7.09	6.99	6.74	7.19	7.51	7.84	7.84	7.73	7.63
Temperature, field	Deg C	--	15.26	11.02	9.54	10.58	14.59	18.24	9.64	7.41	19.42	19.42	12.35	17.08
Total dissolved solids, field (TDS)	mg/L	--	-	85	-	2810	-	279	-	29	-	-	48	-
Turbidity, field	NTU	--	3.1	4.5	1.5	800	300	122	37.8	3.3	3.0	3.0	0.1	3.9
General Chemistry														
Alkalinity (as CaCO3 pH=8.3)	mg/L	--	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
Alkalinity, total (as CaCO3)	mg/L	--	44	45	43	120	94	78	78	23	25	26	34	29
Chloride (dissolved)	mg/L	250	1.9	2.2	2.6	84	86	85	85	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
Conductivity	µS/cm	--	130	140	130	530	500	450	490	53	60	60	76	68
Fluoride (dissolved)	mg/L	--	-	-	ND (0.050)	-	-	-	ND (0.050)	-	-	-	-	-
Hardness (dissolved)	mg/L	--	49.2	47.7	44.7	175	155	134	145	24.6	26.4	26.0	32.0	32.0
Hydroxide (as CaCO3)	mg/L	--	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
Orthophosphate	mg/L	--	0.0047	0.0048	0.0039	0.0069	0.0075	0.0045	0.0052	0.0037	ND (0.0030)	ND (0.0030)	0.0055	ND (0.0030)
pH	s.u.	--	7.14 J	-	6.91 J	-	7.49 J	-	7.12 J	-	-	-	-	-
Sulfate (dissolved)	mg/L	500	8.6	8.4	6.7	5.1	6.4	5.8	5.3	2.4	2.2	2.2	2.9	2.9
Un-ionized Sulphide as H2S	mg/L	0.05	ND (0.0050)	ND (0.0050)	ND (0.0050)	0.018	ND (0.0050)	ND (0.0050)	ND (0.0050)	ND (0.0050)	ND (0.0050)	ND (0.0050)	ND (0.0050)	ND (0.0050)
Total Sulfide as H2S	mg/L	--	ND (0.0020)	ND (0.0020)	ND (0.0020)	0.034	ND (0.0020)	ND (0.0020)	ND (0.0020)	ND (0.0020)	ND (0.0020)	ND (0.0020)	ND (0.0020)	ND (0.0020)
Total Sulfide as H2S (calculated)	mg/L	--	ND (0.0050)	ND (0.0050)	ND (0.0050)	0.017	ND (0.0050)	ND (0.0050)	ND (0.0050)	-	ND (0.0050)	ND (0.0050)	ND (0.0050)	ND (0.0050)
Total Sulfide as S	mg/L	--	ND (0.0018) J	ND (0.0018)	ND (0.0018)	0.032	ND (0.0018) J	ND (0.0018)	ND (0.0018)	ND (0.0018)	ND (0.0018)	ND (0.0018)	ND (0.0018)	ND (0.0018)
Total dissolved solids (TDS)	mg/L	--	100	84	80	340	370	300	280	46	42	46	36	56
Nutrients														
Ammonia-N	mg/L	--	ND (0.015)	ND (0.015)	ND (0.015)	ND (0.015)	ND (0.015)	ND (0.015)	ND (0.015)	ND (0.015)	ND (0.015)	0.020	ND (0.015)	ND (0.015)
Bicarbonate (as CaCO3)	mg/L	--	54	55	53	150	110	95	96	28	31	32	42	36
Carbonate (as CaCO3)	mg/L	--	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
Nitrate (as N)	mg/L	10	2.66	2.33	1.52	0.680	0.901	0.740	0.610	0.027	0.046	0.045	0.079	0.044
Nitrite (as N)	mg/L	1	ND (0.0050)	ND (0.0050)	ND (0.0050)	ND (0.0050)	ND (0.0050)	ND (0.0050)	ND (0.0050)	ND (0.0050)	ND (0.0050)	ND (0.0050)	ND (0.0050)	ND (0.0050)
Nitrite/Nitrate	mg/L	10	2.66	2.33	1.52	0.680	0.901	0.740	0.610	0.027	0.046	0.045	0.079	0.044
Dissolved Metals														
Aluminum (dissolved)	µg/L	9500	ND (3.0)	ND (3.0)	ND (3.0)	13.4	6.9	ND (3.0)	ND (3.0)	ND (3.0)	8.8 J	ND (3.0) J	ND (3.0)	ND (3.0)
Antimony (dissolved)	µg/L	6	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)
Arsenic (dissolved)	µg/L	10	ND (0.10)	ND (0.10)	ND (0.10)	0.25	0.20	0.12	0.14	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)
Barium (dissolved)	µg/L	1000	1.1	1.1	ND (1.0)	18.1	18.0	11.4	13.2	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	1.3
Beryllium (dissolved)	µg/L	8	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)
Bismuth (dissolved)	µg/L	--	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
Boron (dissolved)	µg/L	5000	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)
Cadmium (dissolved)	µg/L	5	ND (0.010)	ND (0.010)	ND (0.010)	0.077 J-	0.015	0.011	0.012	ND (0.010)	ND (0.010)	ND (0.010)	ND (0.010)	ND (0.010)
Calcium (dissolved)	µg/L	--	14200	13800	12800	46300	39300	33800	35700	8300	8750	8640	10800	10700
Chromium (dissolved)	µg/L	50	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
Cobalt (dissolved)	µg/L	1	ND (0.20)	ND (0.20)	ND (0.20)	ND (0.20)	ND (0.20)	ND (0.20)	ND (0.20)	ND (0.20)	ND (0.20)	ND (0.20)	ND (0.20)	ND (0.20)
Copper (dissolved)	µg/L	1500	0.23	ND (0.20)	ND (0.20)	1.66	0.35	ND (0.20)	0.45	ND (0.20)	ND (0.20)	ND (0.20)	ND (0.20)	ND (0.20)
Iron (dissolved)	µg/L	6500	7.5	ND (5.0)	ND (5.0)	ND (16.5)	7.3	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)
Lead (dissolved)	µg/L	10	ND (0.20)	ND (0.20)	ND (0.20)	ND (0.20)	ND (0.20)	ND (0.20)	ND (0.20)	ND (0.20)	ND (0.20)	ND (0.20)	ND (0.20)	ND (0.20)
Lithium (dissolved)	µg/L	8	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)
Magnesium (dissolved)	µg/L	--	3370	3230	3070	14400	13900	12200	13500	940	1110	1070	1240	1300
Manganese (dissolved)	µg/L	1500	ND (1.0)	ND (1.0)	ND (1.0)	28.1	19.0	13.8	15.7	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
Mercury (dissolved)	µg/L	1	ND (0.0019)	ND (0.0019)	ND (0.0019)	ND (0.0019)	ND (0.0019)	ND (0.0019)	ND (0.0019)	ND (0.0019)	ND (0.0019)	ND (0.0019)	ND (0.0019)	ND (0.0019)
Molybdenum (dissolved)	µg/L	250	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
Nickel (dissolved)	µg/L	80	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
Phosphorus (dissolved)	µg/L	--	ND (10)	ND (10)	ND (10)	23	23	ND (10)	ND (10)	ND (10)	ND (10)	ND (10)	ND (10)	ND (10)
Potassium (dissolved)	µg/L	--	223	190	175	1050	1190	976	1040	112	115	111	135	208
Selenium (dissolved)	µg/L	10	0.17	0.23	0.13	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)
Silicon (dissolved)	µg/L	--	7370	6650	7420	13600	12800	13300	14500	2610	2570	2580	2930	4550
Silver (dissolved)	µg/L	20	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)
Sodium (dissolved)	µg/L	200000	5910	6270	6770	26300	26500	22900	26900	653	688	698	765	1100
Strontium (dissolved)	µg/L	2500	29.0	29.5	24.8	107	102	96.6	98.7	10.6	11.5	11.5	14.8	15.5
Sulfur (dissolved)	µg/L	--	ND (3000)	ND (3000)	ND (3000)	ND (3000)	ND (3000)	ND (3000)	ND (3000)	ND (3000)	ND (3000)	ND (3000)	ND (3000)	ND (3000)
Thallium (dissolved)	µg/L	--	ND (0.010)	ND (0.010)	ND (0.010)	0.018	ND (0.010)	ND (0.010)	ND (0.010)	ND (0.010)	ND (0.010)	ND (0.010)	ND (0.010)	ND (0.010)
Tin (dissolved)	µg/L	2500	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)
Titanium (dissolved)	µg/L	--	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)
Uranium (dissolved)	µg/L	20	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)
Vanadium (dissolved)	µg/L	20	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)
Zinc (dissolved)	µg/L	3000	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	8.0	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)
Zirconium (dissolved)	µg/L	--	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)
PHCs														
EPHw10-19	µg/L	5000	ND (200)	ND (200)	ND (200)	ND (200)	ND (200)	ND (200)	ND (200)	ND (200)	ND (200)	ND (200)	ND (200)	ND (200)
EPHw19-32	µg/L	--	ND (200)	ND (200)	ND (200)	ND (200)	290	ND (200)	ND (200)	ND (200)	ND (200)	ND (200)	ND (200)	ND (200)
HEPHw	µg/L	--	ND (200)	ND (200)	ND (200)	ND (200)	290	ND (200)	ND (200)	ND (200)	ND (200)	ND (200)	ND (200)	ND (200)
LEPHw	µg/L	--	ND (200)	ND (200)	ND (200)	ND (200)	ND (200)	ND (200)	ND (200)	ND (200)	ND (200)	ND (200)	ND (200)	ND (200)
PAHs														
1-Methylnaphthalene	µg/L	5.5	-	ND (0.050)	-	ND (0.050)	-	ND (0.050)	-	ND (0.050)	-	-	ND (0.050)	ND (0.050)
2-Methylnaphthalene	µg/L	15	-	ND (0.10)	-	0.11	-	ND (0.10)	-	ND (0.10)	-	-	ND (0.10)	ND (0.10)
Acenaphthene	µg/L	250	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)
Acenaphthylene	µg/L	--	-	ND (0.050)	-	ND (0.050)	-	ND (0.050)	-	ND (0.050)	-	-	ND (0.050)	ND (0.050)
Acridine	µg/L	--	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)
Anthracene	µg/L	1000	ND (0.010)	ND (0.010)	ND (0.010)	ND (0.010)	ND (0.010)	ND (0.010)	ND (0.010)	ND (0.010)	ND (0.010)	ND (0.010)	ND (0.010)	ND (0.010)
Benzo(a)anthracene	µg/L	0.07	ND (0.010)	ND (0.010)	ND (0.010)	ND (0.010)	ND (0.010)	ND (0.010)	ND (0.010)	ND (0.010)	ND (0.010)	ND (0.010)	ND (0.010)	ND (0.010)
Benzo(a)pyrene	µg/L	0.01	ND (0.0050)	ND (0.0050)	ND (0.0050)	0.0062	**0.013 J+[a]**	ND (0.0050)	ND (0.0050)	ND (0.0050)	ND (0.0050)	ND (0.0050)	ND (0.0050)	ND (0.0050)
Benzo(b)fluoranthene/Benzo(j)fluoranthene	µg/L	0.07	-	ND (0.030)	-	ND (0.030)	-	ND (0.030)	-	ND (0.030)	-	-	ND (0.030)	ND (0.030)
Benzo(b)pyridine (Quinoline)	µg/L	0.05	-	ND (0.020)	-	ND (0.020)	-	ND (0.020)	-	ND (0.020)	-	-	ND (0.020)	ND (0.020)
Benzo(g,h,i)perylene	µg/L	--	-	ND (0.050)	-	ND (0.050)	-	ND (0.050)	-	ND (0.050)	-	-	ND (0.050)	ND (0.050)
Benzo(k)fluoranthene	µg/L	--	-	ND (0.050)	-	ND (0.050)	-	ND (0.050)	-	ND (0.050)	-	-	ND (0.050)	ND (0.050)
Chrysene	µg/L	7	-	ND (0.020)	-	ND (0.020)	-	ND (0.020)	-	ND (0.020)	-	-	ND (0.020)	ND (0.020)
Dibenz(a,h)anthracene	µg/L	0.01	-	ND (0.0030)	-	ND (0.0030)	-	ND (0.0030)	-	ND (0.0030)	-	-	ND (0.0030)	ND (0.0030)
Fluoranthene	µg/L	150	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)
Fluorene	µg/L	150	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)
Indeno(1,2,3-cd)pyrene	µg/L	--	-	ND (0.050)	-	ND (0.050)	-	ND (0.050)	-	ND (0.050)	-	-	ND (0.050)	ND (0.050)
Naphthalene	µg/L	80	ND (0.10)	ND (0.10)	ND (0.10)	0.15	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)
PAH high molecular weight	µg/L	--	-	ND (0.050)	-	ND (0.050)	-	ND (0.050)	-	ND (0.050)	-	-	ND (0.050)	ND (0.050)
PAH low molecular weight	µg/L	--	-	ND (0.10)	-	0.26	-	ND (0.10)	-	ND (0.10)	-	-	ND (0.10)	ND (0.10)
Phenanthrene	µg/L	--	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)
Pyrene	µg/L	100	ND (0.020)	ND (0.020)	ND (0.020)	0.021	0.030	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)
Total PAH	µg/L	--	-	ND (0.10)	-	0.28	-	ND (0.10)	-	ND (0.10)	-	-	ND (0.10)	ND (0.10)

Table 3

Groundwater Analytical Results
2023 Operations and Monitoring Report
New Landfill
Campbell River, British Columbia

Sample Location:			MW10-17				MW11-19				MW12-22					
Sample ID:			WG-11222680-290323-KH-09	WG-11222680-170723-KH-02	WG-11222680-060923-CXW-01	WG-11222680-271123-KH-02	WG-11222680-290323-KH-07	WG-11222680-180723-KH-05	WG-11222680-070923-CXW-09	WG-11222680-281123-KH-06	WG-11222680-290323-KH-05	WG-11222680-290323-KH-06	WG-11222680-170723-KH-01	WG-11222680-060923-CXW-02	WG-11222680-271123-KH-03	WG-11222680-271123-KH-04
Sample Date:		BC CSR[1] DW a	03/29/2023	07/17/2023	09/06/2023	11/27/2023	03/29/2023	07/18/2023	09/07/2023	11/28/2023	03/29/2023	03/29/2023 Duplicate	07/17/2023	09/06/2023	11/27/2023	11/27/2023 Duplicate
Parameters	**Units**															
Field Parameters																
Conductivity, field	µS/cm	--	159	148	169	350	171	191	250	286	124	124	149	189	323	323
Dissolved oxygen (DO), field	mg/L	--	-	11.40	7.66	10.20	-	6.39	3.63	5.81	11.53	11.53	8.93	11.64	6.63	6.63
Oxidation reduction potential (ORP), field	millivolts	--	140	202	178	256	150	139	134	251	173	173	196	194	288	288
pH, field	s.u.	--	7.65	7.75	7.89	7.98	7.67	7.70	6.74	7.37	7.56	7.56	7.24	7.37	7.25	7.25
Temperature, field	Deg C	--	12.33	13.68	12.57	10.84	16.54	16.92	18.72	10.72	10.37	10.37	16.19	10.61	9.48	9.48
Total dissolved solids, field (TDS)	mg/L	--	103	-	109	-	111	-	163	-	80	80	-	124	-	-
Turbidity, field	NTU	--	2.5	2.7	62.0	3.4	18	45.9	73.7	5.6	0.5	0.5	3.8	22.4	2.6	2.6
General Chemistry																
Alkalinity (as CaCO3 pH=8.3)	mg/L	--	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
Alkalinity, total (as CaCO3)	mg/L	--	77	63	72	110	90	74	100	140	66	65	73	85	90	89
Chloride (dissolved)	mg/L	250	6.0	3.4	4.2	14	6.2	16	8.6	4.7	2.3	2.3	ND (1.0)	1.9	8.2	8.3
Conductivity	µS/cm	--	200	150	180	360	210	220	250	320	150	150	160	200	340	340
Fluoride (dissolved)	mg/L	--	-	-	-	-	-	-	-	ND (0.050)	-	-	-	-	-	-
Hardness (dissolved)	mg/L	--	85.8	59.1	70.5	156	95.1	87.7	103	145	65.3	65.3	65.3	81.5	143	144
Hydroxide (as CaCO3)	mg/L	--	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
Orthophosphate	mg/L	--	0.010	0.010	0.012	0.0069	0.011	0.0099	0.025	0.0081	0.0049	0.0054	0.0048	0.0048	0.0032	0.0031
pH	s.u.	--	-	-	-	-	-	7.76 J	-	7.40 J	-	-	-	-	-	-
Sulfate (dissolved)	mg/L	500	7.2	7.0	9.4	40	6.3	6.6	7.3	7.7	4.4	4.4	3.8	9.2	48	47
Un-ionized Sulphide as H2S	mg/L	0.05	ND (0.0050)	ND (0.0050)	ND (0.0050)	ND (0.0050)	ND (0.0050)	ND (0.0050)	ND (0.0050)	ND (0.0050)	ND (0.0050)	ND (0.0050)	ND (0.0050)	ND (0.0050)	ND (0.0050)	ND (0.0050)
Total Sulfide as H2S	mg/L	--	ND (0.0020)	ND (0.0020)	ND (0.0020)	ND (0.0020)	0.0023	ND (0.0020)	ND (0.0020)	ND (0.0020)	ND (0.0020)	ND (0.0020)	ND (0.0020)	ND (0.0020)	ND (0.0020)	ND (0.0020)
Total Sulfide as H2S (calculated)	mg/L	--	ND (0.0050)	ND (0.0050)	ND (0.0050)	ND (0.0050)	ND (0.0050)	ND (0.0050)	ND (0.0050)	ND (0.0050)	ND (0.0050)	ND (0.0050)	ND (0.0050)	ND (0.0050)	ND (0.0050)	ND (0.0050)
Total Sulfide as S	mg/L	--	ND (0.0018)	ND (0.0018)	ND (0.0018)	ND (0.0018)	0.0022	ND (0.0018) J	ND (0.0018)	ND (0.0018)	ND (0.0018)	ND (0.0018)	ND (0.0018)	ND (0.0018)	ND (0.0018)	ND (0.0018)
Total dissolved solids (TDS)	mg/L	--	100	38	110	220	140	130	140	180	130	100	92	120	220	240
Nutrients																
Ammonia-N	mg/L	--	ND (0.015)	ND (0.015)	ND (0.015)	ND (0.015)	ND (0.015)	ND (0.015)	ND (0.015)	ND (0.015)	ND (0.015)	ND (0.015)	ND (0.015)	ND (0.015)	ND (0.015)	ND (0.015)
Bicarbonate (as CaCO3)	mg/L	--	94	77	87	140	110	90	130	170	80	80	89	100	110	110
Carbonate (as CaCO3)	mg/L	--	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
Nitrate (as N)	mg/L	10	1.17	0.298	0.637	0.804	0.408	0.365	0.521	0.719	0.700	0.699	0.653	1.06	3.51	3.49
Nitrite (as N)	mg/L	1	0.0166	ND (0.0050)	ND (0.0050)	ND (0.0050)	ND (0.0050)	ND (0.0050)	ND (0.0050)	ND (0.0050)	ND (0.0050)	ND (0.0050)	ND (0.0050)	ND (0.0050)	ND (0.0050)	ND (0.0050)
Nitrite/Nitrate	mg/L	10	1.19	0.298	0.637	0.804	0.408	0.365	0.521	0.719	0.700	0.699	0.653	1.06	3.51	3.49
Dissolved Metals																
Aluminum (dissolved)	µg/L	9500	3.7	ND (3.0)	ND (3.0)	ND (3.0)	ND (3.0)	ND (3.0)	ND (3.0)	ND (3.0)	11.4 J	ND (3.0) J	ND (3.0)	ND (3.0)	ND (3.0)	ND (3.0)
Antimony (dissolved)	µg/L	6	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)
Arsenic (dissolved)	µg/L	10	0.40	0.39	0.32	0.34	0.25	0.23	0.17	0.21	0.24 J	ND (0.10) J	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)
Barium (dissolved)	µg/L	1000	3.7	2.7	3.3	6.8	5.7	5.3	7.0	9.2	3.5	3.1	2.4	3.1	4.4	4.4
Beryllium (dissolved)	µg/L	8	0.15	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	0.19	0.12	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)
Bismuth (dissolved)	µg/L	--	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
Boron (dissolved)	µg/L	5000	490	92	52	742	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	171	167
Cadmium (dissolved)	µg/L	5	ND (0.034)	ND (0.010)	ND (0.010)	0.012	ND (0.010)	ND (0.010)	ND (0.010)	ND (0.010)	0.167 J	ND (0.010) J	ND (0.010)	ND (0.010)	ND (0.010)	0.010
Calcium (dissolved)	µg/L	--	27500	18700	22800	49800	30200	27800	32600	46000	20400	20300	20000	24800	43200	43700
Chromium (dissolved)	µg/L	50	1.6	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	1.0	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
Cobalt (dissolved)	µg/L	1	ND (0.20)	ND (0.20)	ND (0.20)	ND (0.20)	ND (0.20)	ND (0.20)	ND (0.20)	ND (0.20)	ND (0.20)	ND (0.20)	ND (0.20)	ND (0.20)	ND (0.20)	ND (0.20)
Copper (dissolved)	µg/L	1500	2.34	0.70	0.79	1.92	0.53	ND (0.20)	ND (0.20)	ND (0.20)	2.17 J	ND (0.20) J	ND (0.20)	ND (0.20)	0.68	0.66
Iron (dissolved)	µg/L	6500	ND (11.9)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (24.1)	ND (11.5)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)
Lead (dissolved)	µg/L	10	ND (0.20)	ND (0.20)	ND (0.20)	ND (0.20)	ND (0.20)	ND (0.20)	ND (0.20)	ND (0.20)	ND (0.20)	ND (0.20)	ND (0.20)	ND (0.20)	ND (0.20)	ND (0.20)
Lithium (dissolved)	µg/L	8	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)
Magnesium (dissolved)	µg/L	--	4160	3020	3320	7590	4770	4450	5130	7350	3470	3530	3700	4730	8540	8520
Manganese (dissolved)	µg/L	1500	1.0	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	2.8	ND (1.0)	9.6	5.8	2.5	2.4	1.8	1.9
Mercury (dissolved)	µg/L	1	ND (0.0019)	ND (0.0019)	0.0019	0.0055	ND (0.0019)	ND (0.0019)	ND (0.0019)	ND (0.0019)	ND (0.0019)	ND (0.0019)	ND (0.0019)	ND (0.0019)	ND (0.0019)	ND (0.0019)
Molybdenum (dissolved)	µg/L	250	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
Nickel (dissolved)	µg/L	80	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
Phosphorus (dissolved)	µg/L	--	20	14	14	13	15	13	26	14	31 J	ND (10) J	ND (10)	ND (10)	ND (10)	ND (10)
Potassium (dissolved)	µg/L	--	365	338	361	529	392	405	476	467	326	275	278	315	404	402
Selenium (dissolved)	µg/L	10	ND (0.23)	ND (0.10)	ND (0.10)	0.14	ND (0.20)	0.19	0.16	0.13	ND (0.28)	ND (0.18)	0.11	ND (0.10)	0.23	0.22
Silicon (dissolved)	µg/L	--	6950	6410	6490	7400	8900	8440	9540	13000	7630	7690	7520	7250	8240	8280
Silver (dissolved)	µg/L	20	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)
Sodium (dissolved)	µg/L	200000	5790	6210	6890	10200	5670	6100	4940	5880	5220	5030	5180	5940	8670	8670
Strontium (dissolved)	µg/L	2500	37.6	27.7	33.5	74.8	45.2	42.3	53.2	74.7	32.4	27.5	28.2	38.7	76.2	76.1
Sulfur (dissolved)	µg/L	--	ND (3000)	ND (3000)	ND (3000)	13400	ND (3000)	ND (3000)	ND (3000)	ND (3000)	ND (3000)	ND (3000)	ND (3000)	ND (3000)	16400	16400
Thallium (dissolved)	µg/L	--	ND (0.010)	ND (0.010)	ND (0.010)	ND (0.010)	ND (0.010)	ND (0.010)	ND (0.010)	ND (0.010)	0.032 J	ND (0.010) J	ND (0.010)	ND (0.010)	ND (0.010)	ND (0.010)
Tin (dissolved)	µg/L	2500	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)
Titanium (dissolved)	µg/L	--	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)
Uranium (dissolved)	µg/L	20	ND (0.10)	ND (0.10)	ND (0.10)	0.17	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	0.16	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)
Vanadium (dissolved)	µg/L	20	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)
Zinc (dissolved)	µg/L	3000	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)
Zirconium (dissolved)	µg/L	--	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)
PHCs																
EPHw10-19	µg/L	5000	ND (200)	ND (200)	ND (200)	ND (200)	ND (200)	ND (200)	ND (200)	ND (200)	ND (200)	ND (200)	ND (200)	ND (200)	ND (200)	ND (200)
EPHw19-32	µg/L	--	ND (200)	ND (200)	ND (200)	ND (200)	ND (200)	ND (200)	ND (200)	ND (200)	ND (200)	ND (200)	ND (200)	ND (200)	ND (200)	ND (200)
HEPHw	µg/L	--	ND (200)	ND (200)	ND (200)	ND (200)	ND (200)	ND (200)	ND (200)	ND (200)	ND (200)	ND (200)	ND (200)	ND (200)	ND (200)	ND (200)
LEPHw	µg/L	--	ND (200)	ND (200)	ND (200)	ND (200)	ND (200)	ND (200)	ND (200)	ND (200)	ND (200)	ND (200)	ND (200)	ND (200)	ND (200)	ND (200)
PAHs																
1-Methylnaphthalene	µg/L	5.5	ND (0.050)	-	ND (0.050)	ND (0.050)	ND (0.050)	-	ND (0.050)	-	ND (0.050)	ND (0.050)	-	ND (0.050)	ND (0.050)	ND (0.050)
2-Methylnaphthalene	µg/L	15	ND (0.10)	-	ND (0.10)	ND (0.10)	ND (0.10)	-	ND (0.10)	-	ND (0.10)	ND (0.10)	-	ND (0.10)	ND (0.10)	ND (0.10)
Acenaphthene	µg/L	250	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)
Acenaphthylene	µg/L	--	ND (0.050)	-	ND (0.050)	ND (0.050)	ND (0.050)	-	ND (0.050)	-	ND (0.050)	ND (0.050)	-	ND (0.050)	ND (0.050)	ND (0.050)
Acridine	µg/L	--	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)
Anthracene	µg/L	1000	ND (0.010)	ND (0.010)	ND (0.010)	ND (0.010)	ND (0.010)	ND (0.010)	ND (0.010)	ND (0.010)	ND (0.010)	ND (0.010)	ND (0.010)	ND (0.010)	ND (0.010)	ND (0.010)
Benzo(a)anthracene	µg/L	0.07	ND (0.010)	ND (0.010)	ND (0.010)	ND (0.010)	ND (0.010)	ND (0.010)	ND (0.010)	ND (0.010)	ND (0.010)	ND (0.010)	ND (0.010)	ND (0.010)	ND (0.010)	ND (0.010)
Benzo(a)pyrene	µg/L	0.01	ND (0.0050)	ND (0.0050)	ND (0.0050)	ND (0.0050)	ND (0.0050)	ND (0.0050)	ND (0.0050)	ND (0.0050)	ND (0.0050)	ND (0.0050)	ND (0.0050)	ND (0.0050)	ND (0.0050)	ND (0.0050)
Benzo(b)fluoranthene/Benzo(j)fluoranthene	µg/L	0.07	ND (0.030)	-	ND (0.030)	ND (0.030)	ND (0.030)	-	ND (0.030)	-	ND (0.030)	ND (0.030)	-	ND (0.030)	ND (0.030)	ND (0.030)
Benzo(b)pyridine (Quinoline)	µg/L	0.05	ND (0.020)	-	ND (0.020)	ND (0.020)	ND (0.020)	-	ND (0.020)	-	ND (0.020)	ND (0.020)	-	ND (0.020)	ND (0.020)	ND (0.020)
Benzo(g,h,i)perylene	µg/L	--	ND (0.050)	-	ND (0.050)	ND (0.050)	ND (0.050)	-	ND (0.050)	-	ND (0.050)	ND (0.050)	-	ND (0.050)	ND (0.050)	ND (0.050)
Benzo(k)fluoranthene	µg/L	--	ND (0.050)	-	ND (0.050)	ND (0.050)	ND (0.050)	-	ND (0.050)	-	ND (0.050)	ND (0.050)	-	ND (0.050)	ND (0.050)	ND (0.050)
Chrysene	µg/L	7	ND (0.020)	-	ND (0.020)	ND (0.020)	ND (0.020)	-	ND (0.020)	-	ND (0.020)	ND (0.020)	-	ND (0.020)	ND (0.020)	ND (0.020)
Dibenz(a,h)anthracene	µg/L	0.01	ND (0.0030)	-	ND (0.0030)	ND (0.0030)	ND (0.0030)	-	ND (0.0030)	-	ND (0.0030)	ND (0.0030)	-	ND (0.0030)	ND (0.0030)	ND (0.0030)
Fluoranthene	µg/L	150	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)
Fluorene	µg/L	150	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)
Indeno(1,2,3-cd)pyrene	µg/L	--	ND (0.050)	-	ND (0.050)	ND (0.050)	ND (0.050)	-	ND (0.050)	-	ND (0.050)	ND (0.050)	-	ND (0.050)	ND (0.050)	ND (0.050)
Naphthalene	µg/L	80	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)
PAH high molecular weight	µg/L	--	ND (0.050)	-	ND (0.050)	ND (0.050)	ND (0.050)	-	ND (0.050)	-	ND (0.050)	ND (0.050)	-	ND (0.050)	ND (0.050)	ND (0.050)
PAH low molecular weight	µg/L	--	ND (0.10)	-	ND (0.10)	ND (0.10)	ND (0.10)	-	ND (0.10)	-	ND (0.10)	ND (0.10)	-	ND (0.10)	ND (0.10)	ND (0.10)
Phenanthrene	µg/L	--	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)
Pyrene	µg/L	100	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)
Total PAH	µg/L	--	ND (0.10)	-	ND (0.10)	ND (0.10)	ND (0.10)	-	ND (0.10)	-	ND (0.10)	ND (0.10)	-	ND (0.10)	ND (0.10)	ND (0.10)

Table 4

Surface Water Analytical Results
2023 Operations and Monitoring Report
New Landfill
Campbell River, British Columbia

Sample Location:			SW15-01 [McIvor Lake]	SW15-02 [Rico Lake]
Sample ID:			WS-11222680-281123-KH-01	WS-11222680-281123-KH-02
Sample Date:		BC CSR[1] DW a	11/28/2023	11/28/2023
Parameters	**Units**			
Field Parameters				
Dissolved Oxygen, Field	mg/L	--	7.12	6.99
ORP, Field	millivolts	--	197	207
pH, Field	s.u.	--	8.12	7.57
Specific Conductance, Field	µS/cm	--	58	62
Temperature, Field	Deg C	--	8.26	6.33
Turbidity, Field	NTU	--	0	2.0
General Chemistry				
Alkalinity (as CaCO3 pH=8.3)	mg/L	--	ND (1.0)	ND (1.0)
Alkalinity, total (as CaCO3)	mg/L	--	22	18
Chloride (dissolved)	mg/L	250	ND (1.0)	5.5
Conductivity	µS/cm	--	55	65
Fluoride (dissolved)	mg/L	--	ND (0.050)	ND (0.050)
Hardness	mg/L	--	19.8	16.0
Hardness (dissolved)	mg/L	--	22.6	17.5
Hydroxide (as CaCO3)	mg/L	--	ND (1.0)	ND (1.0)
Orthophosphate	mg/L	--	ND (0.0030)	ND (0.0030)
pH	s.u.	--	6.85 J	6.47 J
Sulphate (Dissolved)	mg/L	500	2.6	1.0
Un-ionized Sulphide as H2S	mg/L	0.05	ND (0.0050)	ND (0.0050)
Total Sulfide as H2S	mg/L	--	ND (0.0020)	ND (0.0020)
Total Sulfide as H2S (calculated)	mg/L	--	ND (0.0050)	ND (0.0050)
Total Sulfide as S	mg/L	--	ND (0.0018)	ND (0.0018)
Total dissolved solids (TDS)	mg/L	--	34	38
Total suspended solids (TSS)	mg/L	--	ND (1.1)	2.3
Nutrients				
Ammonia-N	mg/L	--	ND (0.015)	0.063
Bicarbonate (as CaCO3)	mg/L	--	27	22
Carbonate (as CaCO3)	mg/L	--	ND (1.0)	ND (1.0)
Nitrate (as N)	mg/L	10	ND (0.020)	0.357
Nitrite (as N)	mg/L	1	ND (0.0050)	ND (0.0050)
Nitrite/Nitrate	mg/L	10	ND (0.020)	0.357
Dissolved Metals				
Calcium (dissolved)	µg/L	--	7720	5050
Magnesium (dissolved)	µg/L	--	800	1190
Total Metals				
Aluminum	µg/L	9500	5.8	19.9
Antimony	µg/L	6	ND (0.50)	ND (0.50)
Arsenic	µg/L	10	ND (0.10)	ND (0.10)
Barium	µg/L	1000	2.3	2.4
Beryllium	µg/L	8	ND (0.10)	ND (0.10)
Bismuth	µg/L	--	ND (1.0)	ND (1.0)
Boron	µg/L	5000	351	167
Cadmium	µg/L	5	ND (0.010)	ND (0.010)
Calcium	µg/L	--	6780	4560
Chromium	µg/L	50	ND (1.0)	ND (1.0)
Cobalt	µg/L	1	ND (0.20)	ND (0.20)
Copper	µg/L	1500	ND (0.50)	0.51
Iron	µg/L	6500	ND (10)	225
Lead	µg/L	10	ND (0.20)	ND (0.20)
Lithium	µg/L	8	ND (2.0)	ND (2.0)
Magnesium	µg/L	--	696	1110
Manganese	µg/L	1500	1.8	11.8
Mercury	µg/L	1	ND (0.0019)	ND (0.0019)
Molybdenum	µg/L	250	ND (1.0)	ND (1.0)
Nickel	µg/L	80	ND (1.0)	ND (1.0)
Phosphorus	µg/L	--	ND (10)	ND (10)
Potassium	µg/L	--	69	130
Selenium	µg/L	10	ND (0.10)	ND (0.10)
Silicon	µg/L	--	1590	956
Silver	µg/L	20	ND (0.020)	ND (0.020)
Sodium	µg/L	200000	699	3770
Strontium	µg/L	2500	9.4	13.9
Sulphur	µg/L	--	ND (3000)	ND (3000)
Thallium	µg/L	--	ND (0.010)	ND (0.010)
Tin	µg/L	2500	ND (5.0)	ND (5.0)
Titanium	µg/L	--	ND (5.0)	ND (5.0)
Uranium	µg/L	20	ND (0.10)	ND (0.10)
Vanadium	µg/L	20	ND (5.0)	ND (5.0)
Zinc	µg/L	3000	ND (5.0)	ND (5.0)
Zirconium	µg/L	--	ND (0.10)	ND (0.10)

Table 5

Landfill Gas in Soil Analytical Results
2023 Operations and Monitoring Report
New Landfill
Campbell River, British Columbia

Time Purged (min)	Monometer (kPa) (+/-)	Balance (% v/v)	CH_4 (% v/v)	CO_2 (% v/v)	O_2 (% v/v)	H_2S (ppm)	CO (ppm)
LFG1-22							
Initial	-0.00 +0.00	79.4	0.0	0.0	20.6	0.0	0.0
1st Purge	-0.00 +0.00	79.3	0.0	0.0	20.7	0.0	0.0
2nd Purge	-0.00 +0.00	79.2	0.0	0.0	20.8	0.0	0.0
3rd Purge	-0.00 +0.00	79.2	0.0	0.0	20.8	0.0	0.0
LFG2-22							
Initial	-0.00 +0.00	79.2	0.0	0.1	20.8	0.0	0.0
1st Purge	-0.00 +0.00	79.1	0.0	0.0	20.9	0.0	0.0
2nd Purge	-0.00 +0.00	79.0	0.0	0.0	20.8	0.0	0.0
3rd Purge	-0.00 +0.00	79.1	0.0	0.0	20.9	0.0	0.0

Table 6

Analytical Tables Notes
2023 Operations and Monitoring Report
New Landfill
Campbell River, British Columbia

1 - British Columbia Approved Water Quality Guidelines, 2018 Edition or Canadian Drinking Guidelines unless otherwise stated.	
ND - Not detected at the associated reporting limit.	
J - Estimated concentration.	
+	- Bias high
-	- Bias low
ND (50)[a]	- Laboratory detection limit exceeds guideline
2890[a]	- Concentration exceeds standard.
--	- Currently no standard.
LDS	- Leak Detection Sump
-	- Not analyzed.
µS/cm	- Microsiemens per centimetre
mg/L	- Milligrams per litre
s.u.	- Standard units
Deg C	- Degrees Celcius
NTU	- Nephelometric turbidity units
ppm	- parts per million
%v/v	- Percent volume.
[2]	- The volume of the well was used to calculate purge volume.

Figures

UPLAND EXCAVATING PROPERTY
2023 ANNUAL OPERATIONS AND MONITORING REPORT
NEW LANDFILL

SITE LOCATION MAP

Project No. **11222680**
Revision No. **-**
Date **Feb 21, 2024**

FIGURE 1

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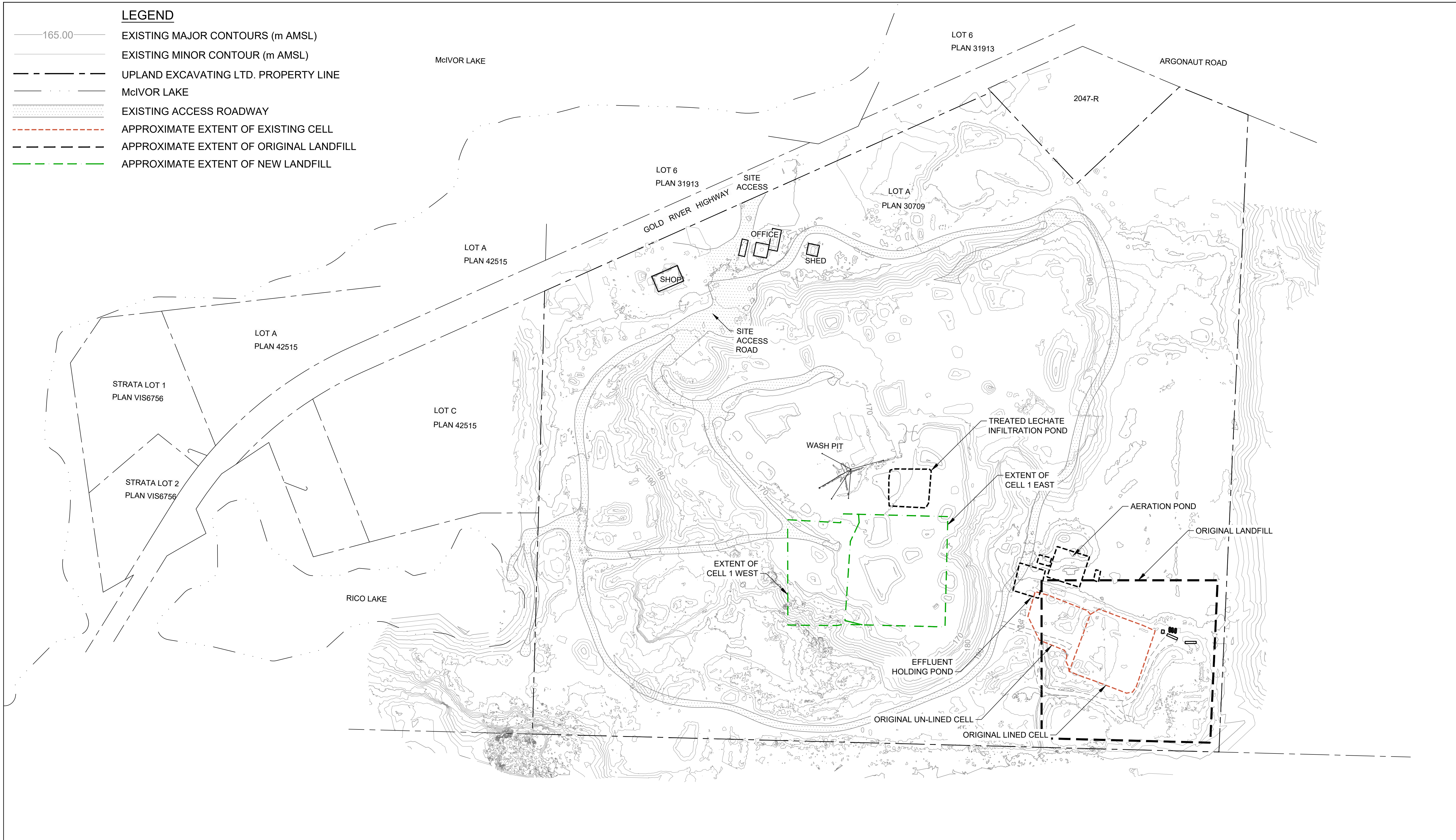
Print date: 21 Feb 2024 - 14:08

Data source: ESRI Topographic Basemap, Accessed 2024; ESRI Data & Maps 2008 Data Distribution Application (DDA); GHD.



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1:4000

Coordinate System:
UTM ZONE 10

N

GHD

UPLAND EXCAVATING PROPERTY
NEW LANDFILL
2023 ANNUAL OPERATIONS AND MONITORING REPORT

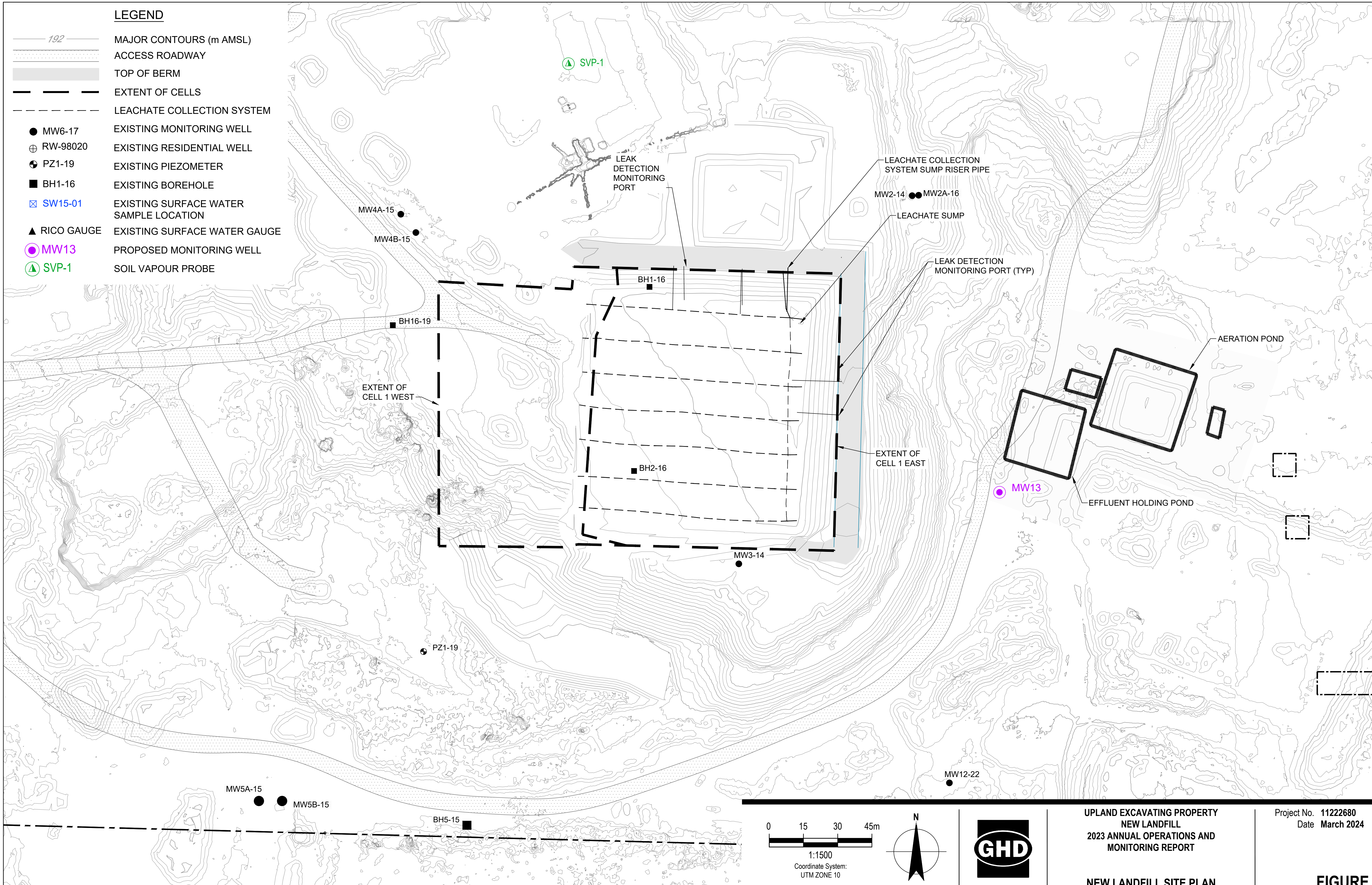
SITE PLAN

Project No. **11222680**
Date **February 2024**

FIGURE 2

Filename: N:\CA\Vancouver\Projects\663\11222680\Digital_Design\ACAD\Figures\RPT006\11222680-GHD-00-00-RPT-EN-D101_SC-006.dwg
Plot Date: 22 February 2024 1:04 PM

Data Source: TOPOGRAPHICAL SURVEY MARCH 2, 2020



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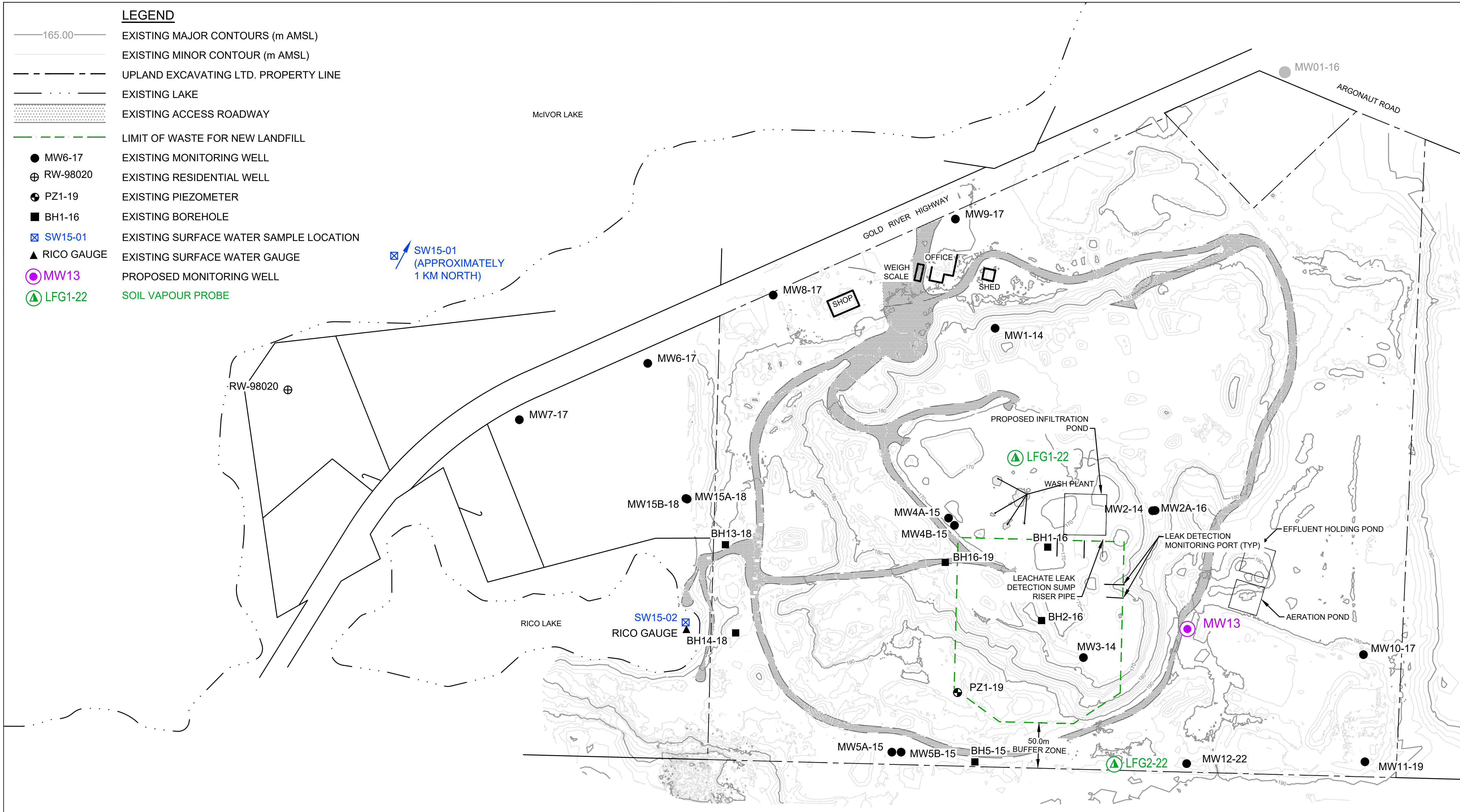
Data Source: TOPOGRAPHICAL SURVEY MARCH 2, 2020 AND SEPTEMBER 2020. AS-BUILT SURVEY OCTOBER 19, 2021



SOURCE: TOPOGRAPHICAL SURVEY CONDUCTED BY McELHANNEY ASSOCIATES LAND SURVEYING LTD., NOVEMBER 21, 2016.

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Coordinate System: UTM ZONE 10

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UPLAND EXCAVATING PROPERTY
NEW LANDFILL
2023 ANNUAL OPERATIONS AND MONITORING REPORT

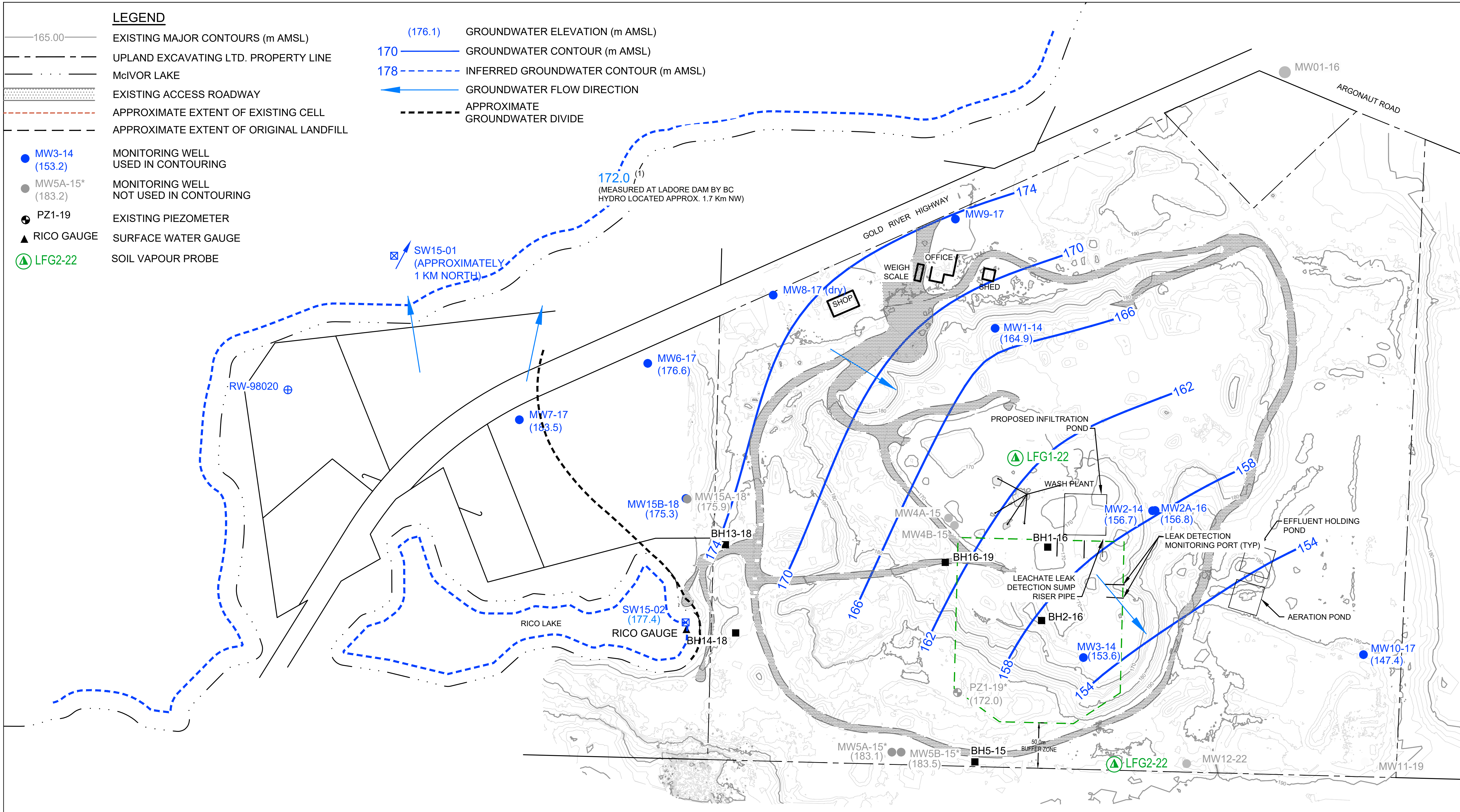
MONITORING LOCATIONS

Project No. 88877
Date March 2024

FIGURE 4

Filename: N:\CA\Vancouver\Projects\663\11222680\Digital_Design\ACAD\Figures\RPT006\88877-11(014)GN-WA007.DWG
Plot Date: 22 March 2024 10:13 AM

Data Source: TOPOGRAPHICAL SURVEY MARCH 2, 2020



SOURCE: TOPOGRAPHICAL SURVEY CONDUCTED BY McELHANNEY ASSOCIATES LAND SURVEYING LTD., NOVEMBER 21, 2016.

NOTE:
1. BASED ON BC HYDRO RECORD OF WATER ELEVATIONS AT LADORE DAM RECORDED EVERY 3 HOURS. (https://www.bchydro.com/energy-in-bc/our_system/transmission_reservoir_data/previous_reservoir_elevations/vancouver_island/ladore_ldr.html)

0 40 80 120m
1:4000
Coordinate System: UTM ZONE 10

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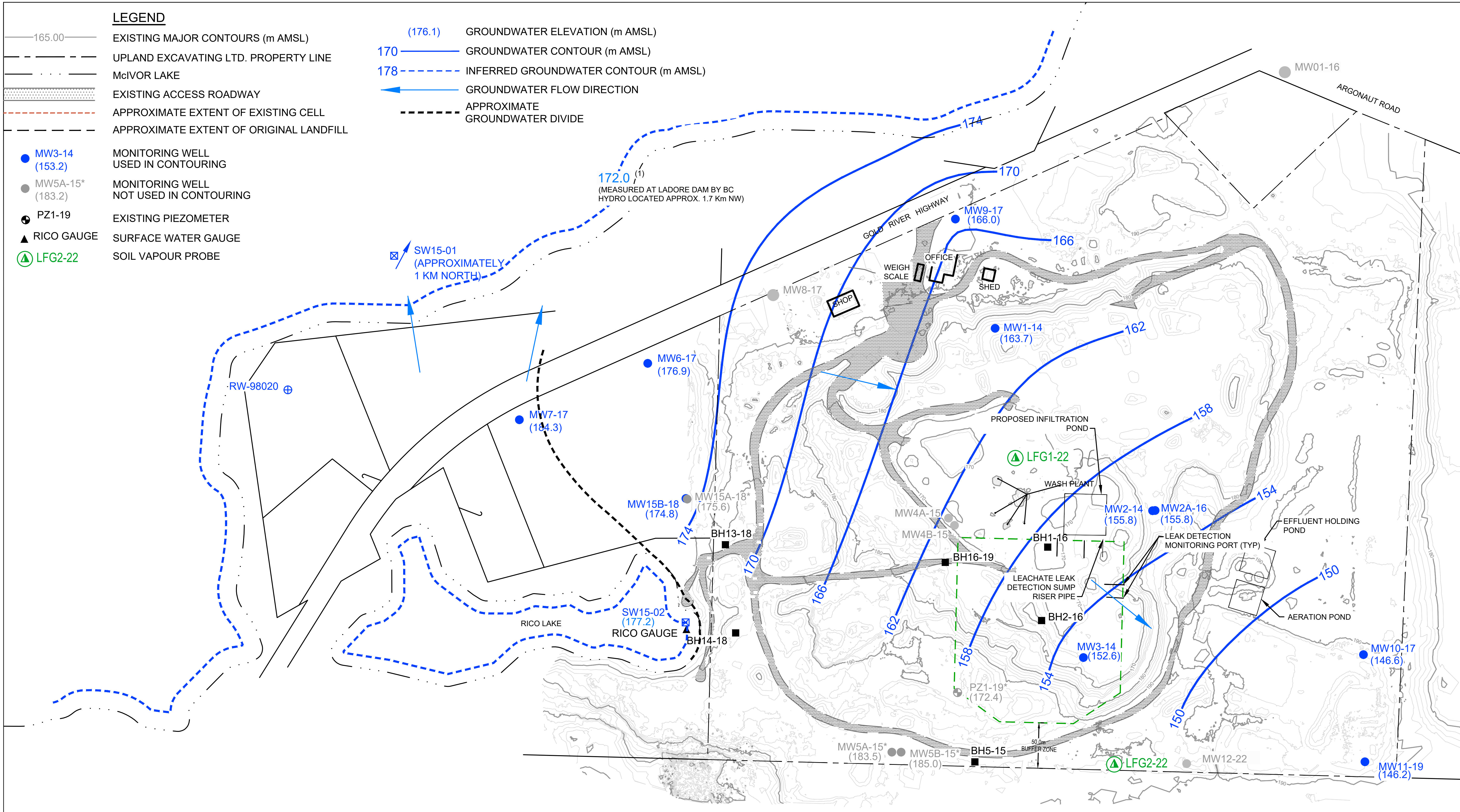
GHD

UPLAND EXCAVATING PROPERTY
NEW LANDFILL
2023 ANNUAL MONITORING REPORT

GROUNDWATER ELEVATION CONTOURS
JULY 2023

Project No. 11222680
Date March 2024

FIGURE 5



SOURCE: TOPOGRAPHICAL SURVEY CONDUCTED BY McELHANNEY ASSOCIATES LAND SURVEYING LTD., NOVEMBER 21, 2016.

NOTE:
1. BASED ON BC HYDRO RECORD OF WATER ELEVATIONS AT LADORE DAM RECORDED EVERY 3 HOURS. (https://www.bchydro.com/energy-in-bc/our_system/transmission_reservoir_data/previous_reservoir_elevations/vancouver_island/ladore_ldr.html)

0 40 80 120m
1:4000
Coordinate System: UTM ZONE 10
N

GHD

UPLAND EXCAVATING PROPERTY
NEW LANDFILL
2023 ANNUAL MONITORING REPORT

GROUNDWATER ELEVATION CONTOURS
NOVEMBER 2023

Project No. 11222680
Date March 2024

FIGURE 6

Filename: N:\CA\Vancouver\Projects\663\11222680\Digital_Design\ACAD\Figures\OM Report\11222680-GHD-00-00-RPT-EN-D102_VA-001.dwg
Plot Date: 21 March 2024 4:21 PM

Data Source: TOPOGRAPHICAL SURVEY MARCH 2, 2020

Appendices

Appendix A

Operational Certificate and Amendment

August 1, 2019

Tracking Number: 335965
Authorization Number: 107689

REGISTERED MAIL

UPLAND EXCAVATING LTD.
#201-909 ISLAND HIGHWAY
CAMPBELL RIVER BC V9W 2C2

Dear operational certificate holder:

Enclosed is Operational Certificate 107689 issued under the provisions of the *Environmental Management Act*. Your attention is respectfully directed to the terms and conditions outlined in the operational certificate. An annual fee will be determined according to the Permit and Approval Fees and Charges Regulation.

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

Requirements may also be specified by the *Environmental Management Act* and regulations including, but not limited to, the Contaminated Sites Regulation, Environmental Data Quality Assurance Regulation, Hazardous Waste Regulation, Landfill Gas Management Regulation, Organic Matter Recycling Regulation, Ozone Depleting Substances and Other Halocarbons Regulation, Recycling Regulation, Spill Reporting Regulation, Storage of Recyclable Material Regulation, Waste Discharge Regulation and Codes of Practice.

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

Administration of this operational certificate will be carried out by staff from the Environmental Protection Division's Regional Operations Branch. Documents pertinent to the operational certificate are to be submitted by email or electronic transfer to the director, in accordance with the ministry Data & Report Submissions website at: http://www2.gov.bc.ca/gov/content/environment/waste-management/waste-discharge-authorization/data-and-report-submissions, or as further instructed.

If you have any questions or concerns, please contact Authorizations - South at Authorizations.South@gov.bc.ca.

Yours truly,

Luc Lachance, P.Eng
for Director, *Environmental Management Act*
Authorizations - South Region

Enclosure

BRITISH COLUMBIA

MINISTRY OF ENVIRONMENT &
CLIMATE CHANGE STRATEGY

OPERATIONAL CERTIFICATE

107689

Under the Provisions of the Environmental Management Act

Pursuant to the Approved

Comox Valley Regional District Solid Waste Management Plan

UPLAND EXCAVATING LTD.

#201-909 ISLAND HIGHWAY
CAMPBELL RIVER BC V9W 2C2

Is authorized to manage waste at the Facility located in Campbell River, British Columbia, subject to the requirements listed below. Contravention of any of these requirements is a violation of the *Environmental Management Act* and may lead to prosecution.

Pursuant to section 24(10) of the *Environmental Management Act*, this operational certificate supersedes and cancels Permit PR-10807 issued under section 14 of the *Environmental Management Act*.

1. <u>AUTHORIZED DISCHARGES, FACILITIES AND WORKS</u>

1.1 <u>Original Landfill</u>

This section applies to the Original Landfill.

1.1.1 The maximum rate of waste discharge to the Original Lined Cell is 45,000 tonnes per calendar year.

1.1.2 The characteristics of the waste discharge to the Original Lined Cell must be:

(a) demolition waste,
(b) construction waste,
(c) land clearing waste,
(d) soil in which the concentrations of all substances are less than the lowest applicable industrial land use standard specified for those substances in
  (i) the generic numerical soil standards,
  (ii) the matrix numerical soil standards, or

Date issued: August 1, 2019

Luc Lachance, P.Eng
for Director, *Environmental Management Act*
Authorizations - South Region

(iii) a director's interim standard for soil,
referred to in section 41(1)(a) of the Contaminated Sites Regulation, B.C. Reg. 375/96,
(e) sludge from the Original Leachate Management Works, or,
(f) other waste as authorized in writing by the director,

but does not include:

(g) hazardous waste except as authorized pursuant to the Hazardous Waste Regulation, controlled waste, Attractants, and,
(h) waste and/or recyclable material prohibited in writing by the director.

1.1.3 The waste discharge is authorized to the Original Lined Cell approximately located as shown on Site Plan A. Waste discharge to the Original Un-Lined Cell is not authorized.

1.1.4 Authorization to discharge waste to the Original Lined Cell ceases on the earlier of:
(i) the date the Original Lined Cell is filled to capacity with grades not steeper than 3H:1V (33%),
(ii) the date of commencement of waste discharge to the New Landfill.

1.1.5 The authorized works are:
(i) a lined landfill footprint with a maximum area of 0.72 ha (85 m x 85 m) including from bottom to top a base with perimeter berm, 0.3 m sand cushion layer, 0.5 mm thick coated woven polyethylene liner, 0.3 m granular leak detection layer, leak detection riser pipe, 0.5 mm thick coated woven polyethylene liner, 0.3 m sand protection layer, leachate extraction chamber, final cover, and,
(ii) an un-lined landfill footprint with an approximate area of 0.7 ha, final cover,

and related appurtenances, approximately located as shown on Site Plan A.

1.1.6 The operational certificate holder must ensure the Original Landfill, excluding final cover, is complete and fully operational on or before the date of issuance of this operational certificate, and at all times thereafter, until the Original Landfill is decommissioned in compliance with the plan referred to in section 2.9(a) (plan to remove all waste from the Original Landfill) of this operational certificate.

1.2 Original Leachate Management Works

This section applies to the management of leachate from the Original Lined Cell.

1.2.1 The operational certificate holder must convey the leachate from the Original Lined Cell, that is to be discharged on the Facility site, to the Original Leachate Management Works.

1.2.2 The maximum rate of treated leachate effluent discharge to the treated leachate infiltration pond is 7,139 m^3 per calendar year.

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Luc Lachance, P.Eng
for Director, *Environmental Management Act*
Authorizations - South Region

1.2.3 The concentration of any substance in the treated leachate effluent discharge to the treated leachate infiltration pond must not be greater than the Contaminated Sites Regulation Generic Numerical Water Standards for Drinking Water (DW), for that substance.

1.2.4 The treated leachate effluent is authorized to be discharged to the treated leachate infiltration pond and infiltrated into the ground. This authorization ceases on the date the Original Leachate Management Works are decommissioned in compliance with the plan referred to in section 2.9(a) (plan to remove all waste from the Original Landfill) of this operational certificate.

1.2.5 The authorized works are leachate conveyance, storage, treatment and discharge works including pumps, pipes, leachate storage and treatment tanks, treated leachate infiltration pond, flow monitoring works, and related appurtenances approximately located as shown on Site Plan A.

1.2.6 Minimum Freeboard must be maintained at all times as follows:
treated leachate infiltration pond: 0.6 m

1.2.7 The operational certificate holder must ensure the Original Leachate Management Works are complete and fully operational on or before the date of commencement of discharge to the treated leachate infiltration pond, and at all times thereafter, until the Original Leachate Management Works are decommissioned in compliance with the plan referred to in section 2.9(a) (plan to remove all waste from the Original Landfill) of this operational certificate.

1.3 New Landfill

This section applies to the New Landfill.

1.3.1 The maximum rate of waste discharge to the New Landfill is: (45,000 minus the waste discharge to the Original Lined Cell) tonnes per calendar year.

1.3.2 The characteristics of the waste discharge to the New Landfill must be:

(a) demolition waste,
(b) construction waste,
(c) land clearing waste,
(d) soil in which the concentrations of all substances are less than the lowest applicable industrial land use standard specified for those substances in
(i) the generic numerical soil standards,
(ii) the matrix numerical soil standards, or
(iii) a director's interim standard for soil,
referred to in section 41(1)(a) of the Contaminated Sites Regulation, B.C. Reg. 375/96,
(e) sludge from the New Leachate Management Works or the New Stormwater

Management Works, or,

(f) other waste as authorized in writing by the director,

but does not include:

(g) hazardous waste except as authorized pursuant to the Hazardous Waste Regulation, controlled waste, Attractants, and,

(h) waste and/or recyclable material prohibited in writing by the director.

1.3.3 The waste discharge is authorized to the New Landfill approximately located as shown on Site Plan A.

1.3.4 The authorized works are a lined landfill footprint with a maximum area of 3.60 ha including from bottom to top a base with perimeter berm, secondary base liner, leak detection drainage layer and leak collection pipes and sump, primary base liner, leachate collection drainage layer and leachate collection pipes and sump, pumps, pipes, final cover, and related appurtenances, approximately located as shown on Site Plan A.

1.3.5 The secondary base liner and the primary base liner must each include an upper high density polyethylene double sided textured geomembrane of minimum 1.5 mm thickness and a lower geosynthetic clay liner of hydraulic conductivity less than or equal to 1×10^{-7} cm/s. However, on the south slope of the base more than 1 m above the primary base liner, the geosynthetic clay liners are not required.

1.3.6 The operational certificate holder must ensure the New Landfill, excluding final cover, is complete and fully operational on or before the date of commencement of waste discharge to the New Landfill, and at all times thereafter.

1.4 New Leachate Management Works

This section applies to the management of leachate from the New Landfill.

1.4.1 The operational certificate holder must convey the leachate from the New Landfill, that is to be discharged on the Facility site, to the New Leachate Management Works.

1.4.2 The maximum rate of treated leachate effluent discharge to the treated leachate infiltration pond is 24,633 m^3 per calendar year.

1.4.3 The concentration of any substance in the treated leachate effluent discharge to the treated leachate infiltration pond must not be greater than the Contaminated Sites Regulation Generic Numerical Water Standards for Drinking Water (DW), for that substance.

1.4.4 The treated leachate effluent is authorized to be discharged to the treated leachate infiltration pond and infiltrated into the ground.

1.4.5 The authorized works are leachate conveyance, treatment and discharge works including pumps, pipes, leachate treatment pond(s), treated leachate infiltration pond, flow monitoring works, and related appurtenances approximately located as shown on Site Plan A.

1.4.6 The leachate treatment pond(s) must include from bottom to top a secondary base liner, leak detection drainage layer and leak collection pipe(s), and a primary base liner. The secondary base liner and the primary base liner must each include an upper high density polyethylene double sided textured geomembrane of minimum 1.5 mm thickness and a lower geosynthetic clay liner of hydraulic conductivity less than or equal to 1×10^{-7} cm/s.

1.4.7 Minimum Freeboard must be maintained at all times as follows:
leachate treatment pond(s): 0.6 m
treated leachate infiltration pond: 0.6 m

1.4.8 The operational certificate holder must ensure the New Leachate Management Works are complete and fully operational on or before the date of commencement of waste discharge to the New Landfill, and at all times thereafter.

1.5 **New Stormwater Management Works**

This section applies to the management of stormwater from the New Landfill.

1.5.1 The operational certificate holder must manage stormwater from the New Landfill such that stormwater is infiltrated into the ground with the authorized works.

1.5.2 The stormwater must not include leachate and the concentration of any substance in the stormwater must not be greater than the Contaminated Sites Regulation Generic Numerical Water Standards for Drinking Water (DW), for that substance.

1.5.3 The authorized works are diversion berm, perimeter berm, mid slope swales, drop down channels, ditches, energy dissipation and sediment traps, stormwater infiltration area, and related appurtenances approximately located as shown on Site Plan A.

1.5.4 Minimum Freeboard must be maintained at all times as follows:
stormwater infiltration area: 0.6 m
all other authorized works: 0.3 m

1.5.5 The operational certificate holder must ensure that adequate authorized works to manage stormwater, such that stormwater is infiltrated into the ground with the authorized works, are complete and fully operational on or before the date of commencement of waste discharge to the New Landfill, and at all times thereafter.

1.6 **Facility Entrance**

This section applies to the Facility entrance.

1.6.1 The authorized works are sign(s), gate, fence, weigh scale, and related appurtenances approximately located as shown on Site Plan A.

1.6.2 The operational certificate holder must ensure the authorized works are complete and fully operational on or before the date of issuance of this operational certificate and at all times thereafter.

1.7 **Location of Facility**

This section applies to the location of the Facility.

1.7.1 The location of the Facility is PID 001-223-321, LOT A, DISTRICT LOT 85, SAYWARD DISTRICT, PLAN 30709 EXCEPT PART IN PLAN EPP15087, approximately located as shown on Site Plan A.

2. **GENERAL REQUIREMENTS**

2.1 **Glossary**

The following capitalized terms referred to in this authorization are defined in the Glossary below. Other terms used in this authorization have the same meaning as those defined in the *Environmental Management Act*, applicable regulations, and the Landfill Criteria;

"Attractant" means food or food waste, compost, carcass or part of an animal, fish, or other meat, or other waste or garbage, that could attract bears, birds, rodents, insects, vectors or wildlife, but does not include grass, leaves, weeds, branches and woodwaste;

"Facility" means the Original Landfill, Original Leachate Management Works, New Landfill, New Leachate Management Works, New Stormwater Management Works and the authorized works in section 1.6.1 (Facility Entrance) of this operational certificate;

"Freeboard" means the difference in elevation between the contained liquid level and the top of the containment works at its lowest point;

"Landfill Criteria" means the Landfill Criteria for Municipal Solid Waste Second Edition June 2016, as amended or replaced from time to time;

"New Landfill" means the authorized works in section 1.3.4 of this operational certificate;

"New Leachate Management Works" means the authorized works in section 1.4.5 of this operational certificate;

"New Stormwater Management Works" means the authorized works in section 1.5.3 of this operational certificate;

"Original Landfill" means the Original Lined Cell and the Original Un-Lined Cell;

"Original Leachate Management Works" means the authorized works in section 1.2.5 of this operational certificate;

"Original Lined Cell" means the authorized works in section 1.1.5(i) of this operational certificate;

"Original Un-Lined Cell" means the authorized works in section 1.1.5(ii) of this operational certificate;

"Province" means Her Majesty the Queen in right of British Columbia;

"Regulatory Document" means any document that the operational certificate holder is required to cause to be prepared, prepare or submit to the director or the Province, pursuant to: (i) this authorization; (ii) any regulation made under the *Environmental Management Act* that regulates the Facility described in this authorization or the discharge of waste from that Facility; or (iii) any order issued under the *Environmental Management Act* directed against the operational certificate holder that is related to the Facility described in this authorization or the discharge of waste from that Facility;

"Significant Works" means the Facility excluding the authorized works in section 1.6.1 (Facility Entrance) of this operational certificate.

2.2 <u>Use of Qualified Professional(s)</u>

The operational certificate holder must cause a Qualified Professional to:

(a) Design and inspect the construction of the Facility, and,

(b) Certify documents related to the Facility including plans, specifications, drawings, construction reports, assessments, reviews, investigations, studies, surveys, programs, reports and as-built record drawings.

(d) Submit a completed Declaration of Competency and a Conflict of Interest Disclosure Statement with each document.

2.3 **Operations and Closure Plan (OCP)**

(a) The operational certificate holder must cause a Qualified Professional to certify and submit an up to date OCP for the Original Landfill and the Original Leachate Management Works, to the director, on or before the earlier of:

(i) 30 days before the date of commencement of waste discharge to the Original Lined Cell,
(ii) 30 days after the date of issuance of this operational certificate.

(b) The OCP must comply with the requirements of this operational certificate, include information specified in relevant items listed in the Landfill Criteria Section 10.3 Design, Operations and Closure Plan including a site layout plan, a filling plan, a lifespan analysis table, a stormwater management plan, a leachate management plan, an environmental monitoring plan, an operations plan, a closure plan, and the information specified in the following sections of this operational certificate:

2.7(a) (soil acceptance plan), and,
2.10(a) (financial security plan).

(c) The operational certificate holder must carry out the most recent OCP and design, construct, operate, inspect, maintain, monitor and close the Original Landfill and the Original Leachate Management Works, in compliance with the most recent OCP and this operational certificate, until the Original Landfill and the Original Leachate Management Works are decommissioned in compliance with the plan referred to in section 2.9(a) (plan to remove all waste from the Original Landfill) of this operational certificate.

2.4 **Hydrogeology and Hydrology Characterization Report (HHCR)**

(a) The operational certificate holder must cause a Qualified Professional to certify and submit an up to date HHCR, to the director, on or before 90 days before the date of commencement of waste discharge to the New Landfill.

(b) The HHCR must include characterization of the geology, hydrogeology, and surface hydrology at and near the Facility site, and the information specified in all the items listed in the Landfill Criteria, section 10.1 Hydrogeology and Hydrology Characterization Report.

(c) The operational certificate holder must cause a Qualified Professional to certify and submit an updated HHCR to the director, at least once every five years after the date of commencement of waste discharge to the New Landfill.

2.5 **Design, Operations and Closure Plan (DOCP)**

(a) The operational certificate holder must cause a Qualified Professional to certify and submit an up to date DOCP, for the Facility, to the director, on or before 90 days before the date of commencement of waste discharge to the New Landfill.

(b) The DOCP must comply with the requirements of this operational certificate, include the information specified in all the items listed in the Landfill Criteria Section 10.3 Design, Operations and Closure Plan, and the information specified in the following sections of this operational certificate:

2.6(a) (New Leachate Management Works commissioning plan),
2.7(a) (soil acceptance plan),
2.8(a) (trigger level assessment plan),
2.9(a) (plan to remove all waste from the Original Landfill), and,
2.10(b) (financial security plan).

(c) The operational certificate holder must cause a Qualified Professional to certify and submit an updated DOCP to the director, as necessary to keep the DOCP up to date, at least once every five years after the date of commencement of waste discharge to the New Landfill.

(d) The operational certificate holder must carry out the most recent DOCP and design, construct, operate, inspect, maintain, monitor, and close the Facility, in compliance with most recent DOCP and this operational certificate.

2.6 **New Leachate Management Works Commissioning Plan and Report**

(a) The DOCP submitted pursuant to section 2.5 of this operational certificate must include a New Leachate Management Works commissioning plan that includes:

(i) the expected duration of the New Leachate Management Works commissioning period,
(ii) description of the New Leachate Management Works and design, including treatment of leachate from soil and treated leachate infiltration pond design and infiltration tests,
(iii) the monitoring, sampling and analyses that will be carried out during the New Leachate Management Works commissioning period including the quantity and quality of leachate and treated leachate effluent, and confirmatory sampling before the discharge of any treated leachate effluent to the treated leachate infiltration pond,
(iv) operating procedures that will be carried out during the New Leachate Management Works commissioning period including review of confirmatory sampling results before the discharge of any treated leachate effluent to the treated leachate infiltration pond,
(v) contingency measures that will be carried out during the New Leachate Management Works

commissioning period if the treated leachate effluent quality does not comply with this operational certificate, including storage, retreatment, and transport to an off-site authorized treatment facility,
(vi) New Leachate Management Works commissioning report description, table of contents and summary of contents.

(b) The operational certificate holder must cause a Qualified Professional to certify and submit a New Leachate Management Works commissioning report, that includes the information contemplated in section 2.6(a)(vi) of this operational certificate, to the director, on or before 30 days after the completion of the New Leachate Management Works commissioning period, or as specified by the director.

2.7 **Soil Acceptance Plan**

(a) The OCP submitted pursuant to section 2.3, and the DOCP submitted pursuant to section 2.5, of this operational certificate, must include a soil acceptance plan that includes procedures that will be carried out before soil is accepted at the Facility including receipt and review of documents required by section 2.7(b) of this operational certificate, and consideration of the applicable Original Leachate Management Works or New Leachate Management Works adequacy to treat leachate from the soil.

(b) Before a specific quantity of soil is accepted at the Facility, the operational certificate holder must cause a Qualified Professional to certify and submit to the operational certificate holder, a document pertaining to the specific quantity of soil that includes:
(i) the soil tonnage(s) and soil quality class(es) as described in the most recent version of Technical Guidance 1 on Contaminated Sites Site Characterization and Confirmation Testing,
(ii) the soil origin including applicable civic address, site identification number, parcel identifier, parcel identification number, legal description, and,
(iii) characterization of the soil in accordance with ministry procedures and applicable Contaminated Sites Regulation Guidance, Protocols and Procedures.

2.8 **Trigger Level Assessment Plan**

(a) The DOCP submitted pursuant to section 2.5 of this operational certificate must include a trigger level assessment plan that includes:
(i) Description of the routine monitoring of the quantity and quality of leachate leakage through the primary liner and into the leak detection layer for the New Landfill, and for the leachate treatment pond(s), and related leachate leakage quantities and qualities that will trigger corresponding described increased monitoring, investigations, contingency measures and actions.
(ii) Description of the routine monitoring of groundwater quality immediately downgradient of the New Landfill, the leachate treatment pond(s), and the treated leachate infiltration pond, and related groundwater substance concentrations that will trigger corresponding described increased

monitoring, investigations, contingency measures and actions.

2.9 **Plan to Remove all Waste from the Original Landfill**

(a) The DOCP submitted pursuant to section 2.5 of this operational certificate must include a plan to remove all waste from the Original Landfill, categorize such waste, discharge all such waste to the New Landfill or to other identified and authorized waste management facility(ies), carry out sampling to confirm all such waste has been removed, and decommission the Original Landfill and the Original Leachate Management Works.

(b) Subject to section 1.3.2 of this operational certificate, waste removed from the Original Landfill is authorized to be discharged to the New Landfill. The tonnage of such waste must not be included for the purpose of determining compliance with section 1.3.1 of this operational certificate.

(c) The director may require the operational certificate holder to carry out and complete the plan referred to in section 2.9(a) of this operational certificate, in accordance with the director's requirements.

(d) If the plan referred to in section 2.9(a) of this operational certificate is carried out, the operational certificate holder must cause a Qualified Professional to certify and submit a report to the director that confirms that the plan has been carried out and completed in accordance with the director's requirements, describes the plan implementation, describes and provides the waste categorization, describes and provides the sampling and results, describes the decommissioning of the Original Landfill and the Original Leachate Management Works, provides photos documenting the implementation of the plan referred to in section 2.9(a) of this operational certificate, and lists the tonnages or volumes, and categories of waste removed and discharged to the New Landfill and to other identified and authorized waste management facility(ies), on or before 60 days after the plan referred to in section 2.9(a) of this operational certificate has been carried out and completed.

2.10 **Financial Security**

(a) The OCP submitted pursuant to section 2.3 of this operational certificate must include a financial security plan that includes:

(i) the calculations of the amounts of financial security and time periods for each phase of development for the Original Landfill in accordance with the Landfill Criteria Section 8.0 Financial Security, and,

(ii) the amounts of financial security for the corresponding time periods.

(b) The DOCP submitted pursuant to section 2.5 of this operational certificate must include a financial security plan that includes:

(i) the tasks, estimated costs, contingency costs, calculations of the amounts of financial security

and time periods, to carry out and complete the plan referred to in section 2.9(a) of this operational certificate (plan to remove all waste from the Original Landfill),
(ii) the calculations of the amounts of financial security and time periods for each phase of development for the New Landfill in accordance with the Landfill Criteria Section 8.0 Financial Security, and,
(iii) the amounts of financial security for the corresponding time periods.

(c) The operational certificate holder must provide the director with financial security, on or before the earlier of:
(i) 30 days before the date of commencement of waste discharge to the Original Lined Cell,
(ii) 30 days after the date of issuance of this operational certificate,
(iii) 90 days before the date of commencement of waste discharge to the New Landfill,
and at all times thereafter.

(d) The amount of financial security at any time must be equal to or greater than:
(i) Before the report referred to in section 2.9(d) (report that confirms that the plan referred to in section 2.9(a) of this operational certificate has been carried out and completed) of this operational certificate is submitted to the director, the greater amount specified for the corresponding time period in:
- the financial security plan in the most recent OCP,
- the financial security plan in the most recent DOCP.
(ii) On and after the report referred to in section 2.9(d) (report that confirms that the plan referred to in section 2.9(a) of this operational certificate has been carried out and completed) of this operational certificate is submitted to the director, the amount specified for the corresponding time period in the financial security plan in the most recent DOCP.

(e) The form of financial security must be satisfactory to the director.

(f) At the discretion of the director, such financial security may be used among other things:
(i) to correct any inadequacy of the Facility relating to its design, construction, operation, inspection, maintenance, monitoring, closure, and post-closure;
(ii) to correct any default in compliance with this operational certificate or the *Environmental Management Act*; and,
(iii) for remediation of the Facility.

(g) The operational certificate holder must replenish any amounts drawn from the posted financial security within 60 days of such amounts being drawn or as otherwise specified by the director.

2.11 **<u>Construction Report(s)</u>**

(a) The operational certificate holder must cause a Qualified Professional to carry out inspections before and during the construction or modification of Significant Works, and, after the completion of construction or modification of Significant Works, to certify and submit construction report(s) to the director:

(i) for construction of the New Landfill and the New Leachate Management Works, on or before 30 days before the date of commencement of waste discharge to those new Significant Works, and,
(ii) for all Significant Works, on or before 60 days after the completion of construction or modification of the Significant Works.

(b) The construction report(s) must demonstrate that the Significant Works have been constructed in accordance with this operational certificate and the applicable most recent OCP or DOCP, describe any technical concerns that arose from the inspections and testing and how they were addressed, and include as-built record drawings of the constructed Significant Works, all the inspection and testing reports and results including geologic inspection report, quality control and quality assurance testing, soil test data including field and laboratory data, as described in the Landfill Criteria section 10.2 Construction Report(s).

2.12 **Notification of Commencement of Waste Discharge**

The operational certificate holder must notify the director of:
(a) the date of commencement of waste discharge to the Original Lined Cell, on that date,
(b) the date of commencement of waste discharge to the New Landfill, on that date,
(c) the date the Original Lined Cell has reached capacity, on that date, and,
(d) the date the plan referred to in section 2.9(a) of this operational certificate has been carried out and completed, on that date.

2.13 **Buffer Zone**

The operational certificate holder must ensure that the New Landfill, New Leachate Management Works, and New Stormwater Management Works, are located a minimum of 50 m from the Facility site boundary.

2.14 **Depth to Groundwater**

The operational certificate holder must ensure that the New Landfill secondary base liner, and the New Leachate Management Works leachate treatment pond(s) secondary base liner, are a minimum of 1.5 m above groundwater at all times.

2.15 **Covenant**

On or before the date of commencement of waste discharge to the New Landfill, the operational certificate holder must register a covenant under section 219 (1) of the *Land Title Act*, in a form acceptable to the director, that binds successors in title to uphold the continued implementation of the closure plan in the most recent DOCP, and prohibits development of the Facility other than as contemplated by this operational certificate or approved by the director. Such covenant must include an acknowledgement that the property was used for the purpose of waste disposal, must be registered as a charge against title to the property on which the facility is located and must be registered in priority to all charges except charges which do not give the holders any rights which might conflict with the covenant.

2.16 Additional Requirements

The director may require the operational certificate holder to:

(a) Cause a Qualified Professional to certify and submit to the director additional, amended or improved documents of the Facility including plans, specifications, drawings, construction reports, assessments, reviews, investigations, studies, surveys, programs, reports and as-built record drawings.

(b) Carry out actions in accordance with the additional, amended or improved documents submitted, and additional actions as specified.

(c) Repair, alter, remove, improve or add to existing facilities and works, or construct new facilities and works, at the Facility.

(d) Temporarily or permanently cease waste discharge to the Original Lined Cell and/or the New Landfill, cover part(s) or all of the Original Landfill and/or the New Landfill with final cover, and close and decommission the Facility, as specified.

2.17 Authorization Requirements

Where this authorization provides that the director may specify a matter or require an action to be carried out, the operational certificate holder must comply with the specification and carry out the action in accordance with the requirements of the director.

3. OPERATING AND PERFORMANCE REQUIREMENTS

3.1 Multiple and/or Spare Works and Auxiliary Power Facilities

The operational certificate holder must provide and install multiple and/or spare works and auxiliary power facilities to ensure the Original Lined Cell, Original Leachate Management Works, New Landfill, New Leachate Management Works, and New Stormwater Management Works, are complete and fully operational as specified in this operational certificate, including during maintenance, breakdowns and electrical power outages.

3.2 Maintenance of the Facility

(a) The operational certificate holder must cause persons that are qualified and trained to operate, regularly inspect, and maintain the Facility, in good working order. If components of the Facility have a manufacturer's recommended maintenance schedule, then those components must, at a minimum, be maintained in accordance with that schedule.

(b) The operational certificate holder must prepare documents of the qualification and training of the persons operating, inspecting and maintaining the Facility, and of Facility inspections, operation and maintenance.

3.3 Facility Manager and Operator Certification

(a) The operational certificate holder must ensure that at least one person responsible for the management of the Facility is certified, and maintains certification, by The Solid Waste Association of North America (SWANA) as a Manager of Landfill Operations, and at least one person responsible for the operation of the Facility has, within the preceding five years, successfully completed the SWANA Landfill Operations Basics course, on or before the earlier of:

(i) the date of commencement of waste discharge to the Original Lined Cell,

(ii) the date of commencement of waste discharge to the New Landfill,

and at all times thereafter.

(b) The operational certificate holder must prepare documents of the SWANA certification and training of the person(s) responsible for the management and operation of the Facility.

3.4 New Leachate Management Works Classification and Operator Certification

(a) The operational certificate holder must have the New Leachate Management Works classified by the Environmental Operators Certification Program (EOCP), on or before the date of commencement of waste discharge to the New Landfill, and at all times thereafter.

(b) The operational certificate holder must ensure that the person(s) responsible for the operation and maintenance of the New Leachate Management Works is(are) certified at an EOCP certification level equivalent to or higher than the EOCP classification level of the New Leachate Management Works, on or before the date of commencement of waste discharge to the New Landfill, and at all times thereafter.

(c) The operational certificate holder must prepare documents of the EOCP classification level of the New Leachate Management Works and the EOCP certification level(s) of the person(s) responsible for the operation and maintenance of the New Leachate Management Works.

3.5 Groundwater Quality

(a) The operational certificate holder must ensure that the Facility does not cause the concentration of any substance in groundwater flowing from the Facility site boundary to be greater than:

(i) the Contaminated Sites Regulation Generic Numerical Water Standards for Drinking Water (DW), for that substance,

or,

(ii) if the local background concentration of any substance is greater than (i), the local background concentration of that substance.

(b) If section 3.5(a)(ii) of this operational certificate is being used, the operational certificate holder must cause a Qualified Professional to determine the local background concentration of substance(s) in (a), in accordance with the latest approved version of Protocol 9 for Contaminated Sites, Determining Background Groundwater Quality, and include such determination(s) in the Annual Operations and Monitoring Report.

(c) The director may specify more stringent groundwater quality standards than those set out in this section.

3.6 Landfill Gas Management

The operational certificate holder must ensure that:

(a) The Facility does not cause:

(i) combustible gas concentrations to exceed the lower explosive limit of methane (5 percent by volume), or a lower concentration specified by the director, in soil at the Facility site boundary;
(ii) combustible gas concentrations to exceed 20 percent of the lower explosive limit of methane (1 percent by volume) in any building; and
(iii) federal, provincial, or local ambient air quality objectives and standards to be exceeded in air at the Facility site boundary.

(b) Landfill gas is managed in accordance with all migration and health and safety requirements.

3.7 Nuisance

The operational certificate holder must ensure that the Facility does not cause a nuisance including with regard to birds, rodents, insects, odour, noise, dust, litter, vector and wildlife attraction.

3.8 Complaints

The operational certificate holder must prepare documents of complaints with regard to matters relevant to this operational certificate, including environmental and nuisance complaints. These documents must include the source and nature of the complaint, actions, responses, and corresponding dates and times.

3.9 **Regulatory Documents**

(a) The operational certificate holder must retain all Regulatory Documents.

(b) The operational certificate holder must retain all Regulatory Documents for the last seven years at the Facility and such documents must be available for immediate inspection at the Facility by a director or an officer.

(c) If requested by a director or an officer, the operational certificate holder must submit the requested Regulatory Documents to the director or officer within 14 days of the request.

4. **SAMPLING REQUIREMENTS**

4.1 **Sampling Procedures**

The operational certificate holder must carry out required sampling in accordance with the procedures described in the "British Columbia Field Sampling Manual for Continuous Monitoring and the Collection of Air, Air-Emission, Water, Wastewater, Soil, Sediment, and Biological Samples, 2013 Edition (Permittee)" or most recent edition, or by alternative procedures as authorized by the director. A copy of the above manual is available on the Ministry web page at https://www2.gov.bc.ca/gov/content/environment/research-monitoring-reporting/monitoring/laboratory-standards-quality-assurance.

4.2 **Analytical Procedures**

The operational certificate holder must carry out required analyses in accordance with procedures described in the "British Columbia Laboratory Manual (2015 Permittee Edition)", or the most recent edition or by alternative procedures as authorized by the director. A copy of the above manual is available on the Ministry web page at https://www2.gov.bc.ca/gov/content/environment/research-monitoring-reporting/monitoring/laboratory-standards-quality-assurance.

4.3 **Quality Assurance**

(a) The operational certificate holder must obtain from the analytical laboratory(ies) their precision, accuracy and blank data for each sample set submitted by the operational certificate holder and an evaluation of the data acceptability, based on criteria set by such laboratory.

(b) The operational certificate holder must submit samples to analytical laboratory(ies) that meet the definition of a qualified laboratory under the Environmental Data Quality Assurance Regulation.

(c) The operational certificate holder must collect, prepare and submit for analysis by the analytical laboratory(ies) quality control (QC) samples for each parameter. As a minimum,

(i) The number of QC samples should be 20% of all samples collected (environmental + QC samples) within 48 hours of each other, and

(ii) Include duplicate, field and trip blank samples for each parameter.

5. REPORTING REQUIREMENTS

5.1 Routine Reporting

The operational certificate holder must submit all routine Regulatory Documents required by this operational certificate by email to the Ministry's Routine Environmental Reporting Submission Mailbox at EnvAuthorizationsReporting@gov.bc.ca or as otherwise instructed by the director. For guidelines on how to properly name the files and email subject lines or for more information visit the Ministry website http://www2.gov.bc.ca/gov/content/environment/waste-management/waste-discharge-authorization/data-and-report-submissions/routine-environmental-reporting-submission-mailbox.

5.2 Non-compliance Notification

(a) The operational certificate holder must immediately notify the director or designate by email at EnvironmentalCompliance@gov.bc.ca, or as otherwise instructed by the director of any non-compliance with the requirements of this authorization by the operational certificate holder and must take remedial action to remedy any effects of such non-compliance.

(b) The operational certificate holder must provide the director with written confirmation of all such non-compliance events, including available test results within 24 hours of the original notification by email at EnvironmentalCompliance@gov.bc.ca, or as otherwise instructed by the director.

5.3. Non-compliance Reporting

(a) If the operational certificate holder fails to comply with any of the requirements of this authorization, the operational certificate holder must, within 30 days of such non-compliance, submit to the director a written report that is satisfactory to the director and includes, but is not necessarily limited to, the following:

(i) all relevant test results obtained by the operational certificate holder related to the non-compliance,

(ii) an explanation of the most probable cause(s) of the non-compliance, and
(iii) a description of remedial action planned and/or taken by the operational certificate holder to prevent similar non-compliance(s) in the future.

(b) The operational certificate holder must submit all non-compliance reporting required to be submitted under this section by email to the Ministry's Compliance Reporting Submission Mailbox at EnvironmentalCompliance@gov.bc.ca or as otherwise instructed by the director. For guidelines on how to report a non-compliance or for more information visit the Ministry website http://www2.gov.bc.ca/gov/content/environment/waste-management/waste-discharge-authorization/data-and-report-submissions/non-compliance-reporting-mailbox.

5.4 **Annual Operations and Monitoring Report**

(a) The operational certificate holder must cause a Qualified Professional to certify and submit an Annual Operations and Monitoring Report in a format suitable for public release, for the preceding calendar year, to the director on or before March 31 of each year. On or before March 31 of each year, the operational certificate holder must post a copy of the Annual Operations and Monitoring Report online, on a website accessible to the public, and in accordance with any requirements of the director.

(b) The Annual Operations and Monitoring Report must include the following information:
Operations Report:

(i) Summary of OCP implementation that addresses the information in section 2.3(b), and summary of DOCP implementation that addresses the information in 2.5(b), of this operational certificate,
(ii) Summary of construction report(s),
(iii) Annual and cumulative tonnages and categories of waste including soil tonnage(s) and soil quality class(es) discharged to the Original Lined Cell and to the New Landfill,
(iv) Remaining volume and life of the Original Lined Cell and of the New Landfill,
(v) Summary of treated leachate effluent quantity and quality discharged to the treated leachate infiltration pond,
(vi) Summary of complaints and nuisances and description of remedial action planned and/or taken by the operational certificate holder to prevent similar complaints and nuisances in the future,
(vii) Summary of non-compliance notifications and non-compliance reporting and description of remedial action planned and/or taken by the operational certificate holder to prevent similar non-compliance(s) in the future ,
(viii) Annual status form in accordance with the instructions and template at the ministry website https://www2.gov.bc.ca/gov/content/environment/waste-management/waste-discharge-authorization/data-and-report-submissions/annual-status-form
(ix) Summary of OCP and DOCP implementation, and construction of Significant Works, planned for the next calendar year,

Environmental Monitoring Plan Report:

(x) Site plan(s), sampling locations, stormwater flow paths, groundwater elevations, gradients and flow directions,
(xi) Sampling facilities, frequencies, substances, sampling and analytical procedures,
(xii) Data including laboratory analysis and quality assurance and quality control results,
(xiii) Data tabulation, trend analysis, graphs, diagrams, and interpretation,
(xiv) Trigger level assessment plan monitoring, data, results and interpretation,
(xv) Any determination(s) of the local background concentration of substance(s) in accordance with section 3.5 of this operational certificate,
(xvi) Comparison of the data with the standards for treated leachate effluent discharge, stormwater quality, groundwater quality, and landfill gas management, specified in sections 1.2, 1.4, 1.5, 3.5 and 3.6 of this operational certificate, and identification of any non-compliance and predicted future non-compliance,
(xvii) Results, conclusions, recommendations and changes to the environmental monitoring plan.

(c) The operational certificate holder must upload monitoring data associated with this operational certificate to the Ministry's Environmental Monitoring System (EMS) database, within 45 days of the end of the 3 month period in which the data is collected.

5.5 **<u>Licence to Publish Documents</u>**

(a) Subject to paragraph (b), the operational certificate holder authorizes the Province to publish on the Ministry of Environment and Climate Change Strategy website the entirety of any Regulatory Document.

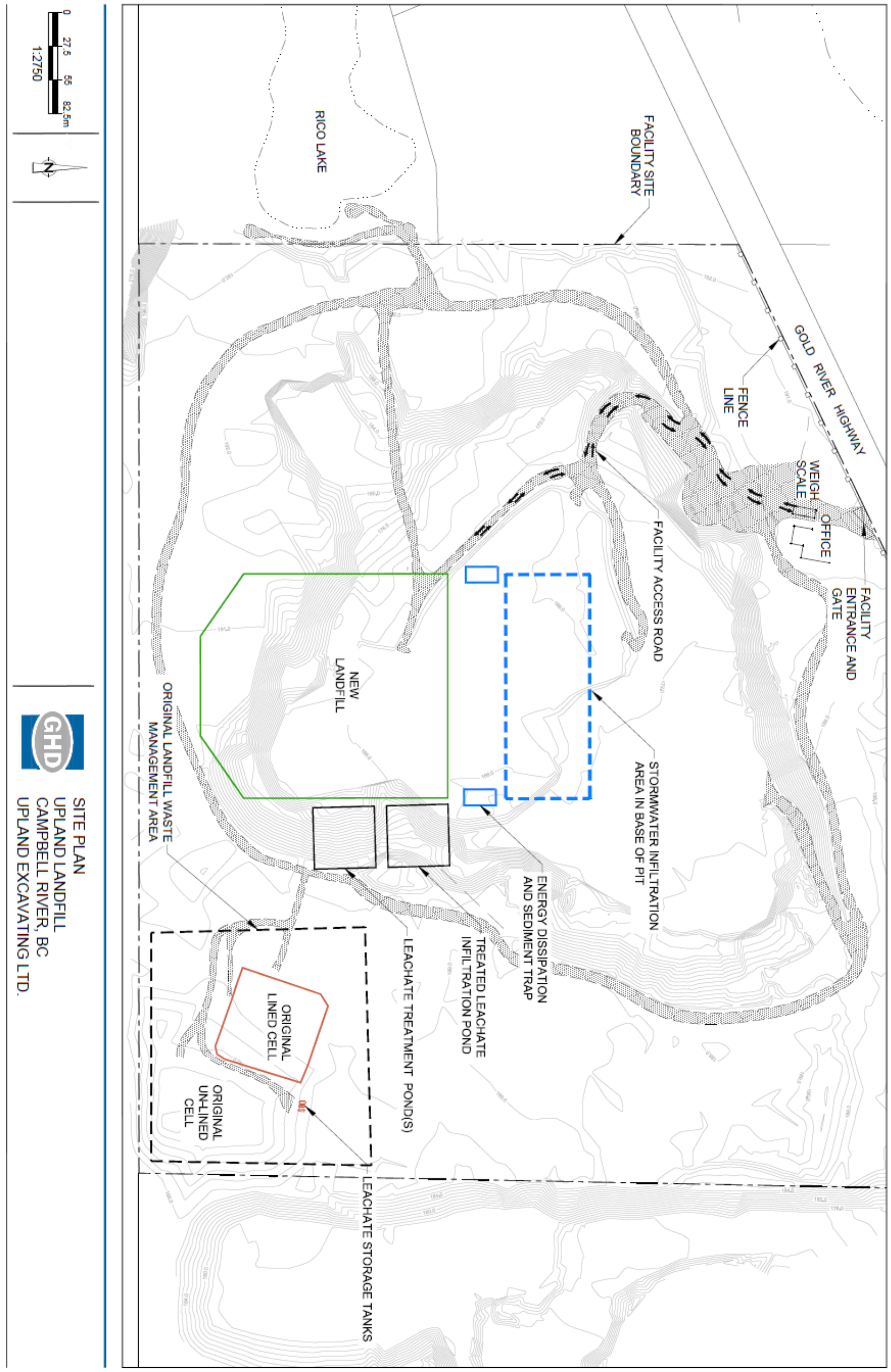
(b) The Province will not publish any information that could not, if it were subject to a request under section 5 of the *Freedom of Information and Protection of Privacy Act*, be disclosed under that Act.

(c) The operational certificate holder will indemnify and save harmless the Province and the Province's employees and agents from any claim for infringement of copyright or other intellectual property rights that the Province or any of the Province's employees or agents may sustain, incur, suffer or be put to at any time that arise from the publication of a Regulatory Document.

Date issued: August 1, 2019

Luc Lachance, P.Eng
for Director, *Environmental Management Act*
Authorizations - South Region

Site Plan A



Date issued: August 1, 2019

Luc Lachance, P.Eng
for Director, *Environmental Management Act*
Authorizations - South Region

Operational Certificate Number: 107689

April 26, 2022

Tracking Number: 405141
Authorization Number: 107689

UPLAND EXCAVATING LTD.
#201-909 ISLAND HIGHWAY
CAMPBELL RIVER BC V9W 2C2

Re: Your application dated June 07, 2021, for amendments to Operational Certificate 107689, under the *Environmental Management Act*

In response to the subject application, and pursuant to Section 16 of the *Environmental Management Act*, Operational Certificate 107689 is hereby amended as follows:

The subject part of the preamble page 1 is amended from:

> Is authorized to manage waste at the Facility located in Campbell River, British Columbia, subject to the requirements listed below. Contravention of any of these requirements is a violation of the *Environmental Management Act* and may lead to prosecution.

to:

> Is authorized to manage waste at the Facility located in Campbell River, British Columbia, provided that the operational certificate holder complies with all provisions of this operational certificate. Unless a contrary intention appears, the provisions of this operational certificate are requirements that must be complied with regardless of whether the operational certificate holder introduces waste to the environment. Contravention of any of these requirements, and any discharge of waste while out of compliance with any provisions of this operational certificate, is a violation of the *Environmental Management Act*, and may lead to prosecution.

Sub-section 1.3.2 (d) is amended to:

> (d) soil that is not hazardous waste,

Sub-section 1.4.5 is amended after “leachate treatment pond(s)” by adding:

> treated leachate holding pond or tank,

Sub-section 1.4.6 is amended after “1x 10^{-7} cm/s.” by adding:

> The treated leachate holding pond must include from bottom to top a secondary base liner, leak detection drainage layer and leak collection pipe(s), and a primary base liner. The treated leachate holding pond secondary base liner and the primary base liner must each include a coated woven polyethylene geomembrane of minimum 0.75 mm thickness.

Sub-section 1.4.7 is amended after "treated leachate infiltration pond: 0.6 m" by adding:
treated leachate holding pond: 0.6 m.

4. Sub-sections 2.9(c) and 2.9(d) are amended to:

(c) The operational certificate holder must carry out and complete the plan referred to in section 2.9(a) of this operational certificate, on or before one year after the date of this letter.

(d) The operational certificate holder must cause a Qualified Professional to certify and submit a report to the director that confirms that the plan referred to in section 2.9(a) of this operational certificate has been carried out and completed, describes the plan implementation, describes and provides the waste categorization, describes and provides the sampling and results, describes the decommissioning of the Original Landfill and the Original Leachate Management Works, provides photos documenting the implementation of the plan referred to in section 2.9(a) of this operational certificate, and lists the tonnages or volumes, and categories of waste removed and discharged to the New Landfill and to other identified and authorized waste management facility(ies), on or before 60 days after the plan referred to in section 2.9(a) of this operational certificate has been carried out and completed.

5. Site Plan A is amended to the enclosed Site Plan A.

All other terms and conditions of the operational certificate remain in full force and effect.

Please note that although a revised operational certificate document has not been produced at this time a copy of this letter is being placed on the operational certificate file, as an addendum to the operational certificate, to formally reflect the change.

This operational certificate does not authorize entry upon, crossing over, or use for any purpose of private or Crown lands or works, unless and except as authorized by the owner of such lands or works. The responsibility for obtaining such authority rests with the operational certificate holder. This operational certificate is issued pursuant to the provisions of the *Environmental Management Act* to ensure compliance with Section 120(3) of that statute, which makes it an offence to discharge waste, from a prescribed industry or activity, without proper authorization. It is also the responsibility of the operational certificate holder to ensure that all activities conducted under this operational certificate are carried out with regard to the rights of third parties, and comply with other applicable legislation that may be in force.

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

Administration of this operational certificate will be carried out by staff from the Environmental Protection Division's Regional Operations Branch. For guidance regarding how to comply with a waste discharge authorization including submitting reports and reporting non-compliance, please refer to the ministry website at: https://www2.gov.bc.ca/gov/content/environment/waste-management/waste-discharge-authorization/comply, or as further instructed.

For more information about how the Ministry will assess compliance with your operational certificate please refer to gov.bc.ca/environmentalcompliance.

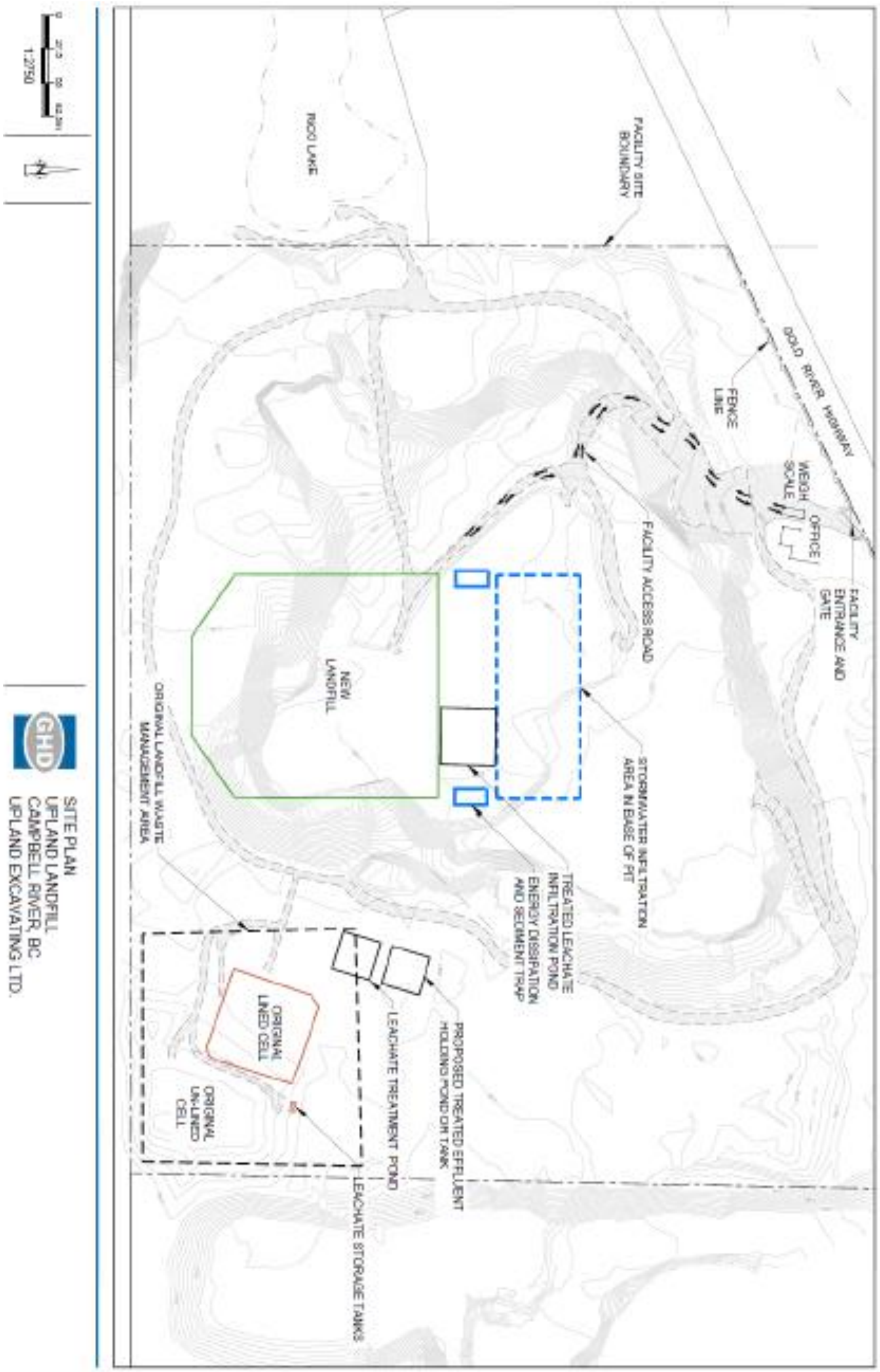
For more information about how to make changes to your operational certificate and to access waste discharge amendment forms and guidance, please refer to gov.bc.ca/wastedischarge-authorizations.

Sincerely,

Carol Danyluk, P.Eng.
Director's Designate
Environmental Management Act

ENCL: None

Site Plan A


1:2750
RICO LAKE
FACILITY SITE BOUNDARY
GOLD RIVER HIGHWAY
FENCE LINE
WEIGH SCALE
OFFICE
FACILITY ENTRANCE AND GATE
FACILITY ACCESS ROAD
STORMWATER INFILTRATION AREA IN BASE OF PIT
NEW LANDFILL
TREATED LEACHATE INFILTRATION POND
ENERGY DISSIPATION AND SEDIMENT TRAP
ORIGINAL LANDFILL WASTE MANAGEMENT AREA
PROPOSED TREATED EFFLUENT HOLDING POND OR TANK
LEACHATE TREATMENT POND
ORIGINAL LINED CELL
ORIGINAL UN-LINED CELL
LEACHATE STORAGE TANKS
GHD
SITE PLAN
UPLAND LANDFILL
CAMPBELL RIVER, BC
UPLAND EXCAVATING LTD.

Appendix B

Cell 1 West Construction Report

Cell 1 West Construction Report

Northwin Landfill

Upland Excavating Ltd.

19 March 2024

→ The Power of Commitment

GHD Limited 735
138 East 7th Avenue, Suite 100
Vancouver, BC V5T 1M6, Canada

Document status

Status Code	Revision	Author	Reviewer		Approved for issue		
			Name	Signature	Name	Signature	Date
S3	00	David Barbour	Roxy Hasior		Rose Marie Rocca		March 19, 2024
[Status code]							

Contents

Appendices

1. Introduction

The Northwin Landfill (Landfill or Site) is owned by Upland Excavating Ltd. (Upland) and operated by Northwin Environmental (Northwin). The Site has an area of approximately 48 hectares (ha) and is located at civic address 7295 and 7311 Gold River Highway, Campbell River, BC, approximately 7 kilometres (km) southwest of Campbell River city centre. The Site operates as a sand, gravel and rock quarry and a waste management facility.

This Construction Report (Report) documents the construction of Cell 1 West carried out by Upland Contracting Ltd. (Contractor), Northwin and other contractors hired by Upland.

The Report has been prepared by GHD for Upland for submission to the Ministry of Environment and Climate Change Strategy (ENV) as required by Section 2.11 of the Landfill's OC and also satisfies the requirements of Section 10.2 of the Landfill Criteria for Municipal Solid Waste (Second Edition), BC Ministry of Environment, June 2016 (the Criteria).

Upland, as the OC holder retained GHD to act as the Qualified Professional (QP) for this project scope. In this capacity, GHD designed the civil work for Cell 1 West, carried out inspections during construction, and completed this construction report.

1.1 Project Scope

Cell 1 West is the second cell constructed in the Landfill. In accordance with the 2022 Design Operations and Closure Plan (DOCP) for the Landfill and the detailed design, the Cell 1 West base consists of a double liner system and includes a leak detection layer. Leachate generated from the Landfill will be collected within the cell and conveyed to the existing Cell 1 East sump, and then to the leachate treatment system. The leachate treatment system is a batch treatment system and includes the leachate collection system, aerated equalization pond, a treated leachate holding pond and an infiltration pond, which were initially designed and constructed in 2021.

The composite double liner system for Cell 1 West is comprised of a primary and secondary base liner. The primary base liner refers to the composite liner system that consists of an HDPE geomembrane liner and geosynthetic clay liner (GCL) which underlies the leachate collection system, and the secondary base liner refers to the composite liner system comprised from of an HDPE geomembrane liner and GCL which underlies the leak detection system.

The leachate collection system includes perforated leachate collection pipes within a stone drainage blanket sloped towards the leachate sump, with the following components:

– 300 mm thick, 50 mm diameter, clear, round stone drainage blanket, with minimal fines
– Perforated leachate collection pipes (LCP) with minimum diameter of 200 mm
– Maximum 15 m lateral spacing between leachate collection pipes (LCP) running south to north
– Maximum 50 m drainage path for leachate to travel before it is intercepted by the LCPs
– Clean-outs at each end of the LCPs
– Leachate collection header pipe at the east end of the Landfill running towards the leachate collection sump at a minimum slope of 2 percent
– Leachate sump at elevation 164 m AMSL with two leachate sump riser pipes with diameters of 450 mm
– Leak detection system with four 50 mm leak detection monitoring riser pipes

2. Construction Narrative

The following sections provide the construction narrative for Cell 1 West. Record drawings are provided in Appendix A.

Construction activities began on October 12, 2022, and were completed on September 22, 2023

In general, construction generally progressed as follows:

– Site preparation and excavation

– Cell 1 West double liner installation
– Cell 1 West leachate collection and leak detection system installation

2.1 Site Preparation & Excavation

Site preparation activities including excavation of the Cell 1 West base, preparation of subgrade contours, and construction of berms around the Cell 1 West perimeter began in September 2022 and continued through October 12, 2022. Site preparation works were completed prior to GHD arriving on site.

2.2 Cell 1 West - Composite Double Liner

Joe Cassidy (Liner Installer) was hired as an independent contractor to oversee the geosynthetic installation. Mr. Cassidy is an experienced liner installer with over thirty years of experience in the industry. Several experienced liner technicians were also hired for the installation and worked alongside Upland (the Contractor) employees with Mr. Cassidy overseeing the work. The geosynthetic installation crew mobilized to site on October 12, 2022 and the installers met with GHD to confirm QA/QC requirements.

Installation of geosynthetics in the Cell 1 West began on October 14, 2022. The QA/QC program for the construction of the base liner systems included non-destructive testing of each seam. Details of the QA/QC program are described in Section 3.

The geosynthetic deployment began with the placement of a non-woven geotextile on the slopes and floor of the landfill cell, starting at the Cell 1 East tie in berm. Geosynthetic rolls were deployed using a telehandler forklift. An excavator was used to deploy geosynthetics for the rest of the Landfill cell.

GCL was placed over top of the non-woven geotextile. Rolls in the east section of the cell were installed in a north-south direction working from the east end of the landfill to the west. For the west section of the cell, rolls were installed in a west-east direction working from the north end of the landfill to the south. The seams of the GCL were overlapped, with the crew using factory provided indicating lines that marked the minimum overlap. The seams were heat seamed shortly after the GCL deployment. In general, the geomembrane was installed on top of the GCL as soon as the width of GCL panels would allow. This process continued until the primary GCL and geomembrane layer was installed across the landfill floor.

Geocomposite installation began after the primary geomembrane installation on the landfill floor. The geocomposite was installed with panels in the same direction starting near the north toe working south. A skid-steer with smooth rubber tracks was used to deploy the geocomposite on the liner while an excavator held the rolls. GHD observed the procedures being followed by the operators and determined they were acceptable to avoid damage to the liner. The deployment procedure involved using a leaf blower to remove any debris from the area being driven on, having a spotter observe the geomembrane between the skid-steer tracks and the geo-composite, and skid steer operator never turning the equipment on the exposed geomembrane. Nylon cable ties were applied at 1.5 m intervals at the edge netting and the overlapping geotextile was heat seamed.

As the geocomposite was being placed on the base of the landfill, the crew began deploying non-woven geotextile on the slopes of the landfill. The geotextile rolls were held with an excavator while the crew placed the material manually on the slopes. The geotextile was heat seamed shortly after deployment.

The GCL was placed on the slopes after the geotextile using the same method. GCL was heat seamed shortly after it was placed and covered with the second layer of Geomembrane. The primary layer of GCL and geomembrane was completed and tied into the geosynthetics on the floor of the landfill before the secondary containment layers were installed. The same procedures were followed to install the secondary geomembrane. The smooth tracked skid steer was used to pull the geosynthetics on the base of the landfill and while the excavator held the rolls and materials were pulled by hand down the slopes. Installation of geosynthetics was completed on November 20, 2022, with the final placement of non-woven geotextile on the floor of the landfill.

Some damage to the liner was observed and repaired on November 18, 2022. Photos of the repairs are provided in the Appendix B (photo log).

2.3 Leachate Collection System

The Contractor began installing the leachate collection pipes and the stone drainage layer in November of 2022 after completion of the geosynthetics work, however construction was postponed for the winter and resumed on June 7, 2023.

The leachate collection system was installed per the drawings with one 300 mm HDPE leachate collection header pipe running south to north, and seven 300 mm HDPE leachate collection pipes running west to east. To facilitate installation of the leachate collection system over the liner, the Contractor initially placed the stone drainage layer in 3 rows of 900 mm high lifts to form roadways from the south to the north side of the landfill cell. The material was hauled with rock trucks and placed with an excavator. Traffic cones were used for visual aids to ensure the minimum 900 mm depth of material was placed. After the drain rock roads were built the Contractor fused and placed perforated leachate collection pipe on the base of the landfill. A Caterpillar mini excavator was then used to spread the drain rock in 300 mm lifts across the floor of the landfill. The Contractor placed woven geotextile on top of the drain rock, completing the leachate collection system installation.

2.4 Close-Out

GHD performed an inspection of the Cell 1 West Works on July 7, 2023, and created a deficiency list which was provided to the Contractor. All deficiencies were addressed to the satisfaction of GHD and Upland by September 22, 2023.

3. Construction Quality Assurance & Quality Control

GHD carried out regular inspections throughout the duration of the construction to assure construction quality and quality control (QA/QC). The QA/QC program included product data review and geosynthetics installation QA/QC according to the design specifications.

A photo log with select photographs from throughout the construction is provided in Appendix B. Appendix C provides the material test results. Product data sheets and reviewed submittals are provided in Appendix D. Appendix E provides geosynthetics QA/QC information including the results of destructive and non-destructive quality testing. GHD's inspection notes from select field inspections during liner installation are included in Appendix F.

3.1 Earthworks

Site preparation and excavation activities were completed by the contractor prior to GHD's first inspection. Based on GHD's earthworks inspection was conducted prior to geosynthetics placement, the materials installed were in conformance with design specifications and drawings (refer to Section 4.1).

3.2 Leachate Collection System & Leak Detection Piping

QA/QC activities carried out during leachate collection system installation include the following:

- Inspection to witness placement of materials
- Review of submittals for pipe materials
- Review of results of sieve analysis performed on a sample of drain rock material collected by Contractor. A total of 1 sample was collected and analysed (results are presented in Appendix C).

3.3 Geosynthetics QA/QC

The Liner Installer performed QA/QC according to the design specifications on all geomembrane installed. QC included performing field sheer and peel on a test weld before welding began and whenever conditions changed, pressure testing each welded seam, recording roll number and location of each panel placed, location of each repair. After each repair was made the weld was tested with a vacuum box.

GHD collected samples of welds at intervals less than 300 m of seams. The samples were sent to TRI Environmental Inc. for peel and sheer testing and the results were reviewed by GHD. Laboratory results are presented in Appendix E.

Geotextile material met the specifications and was installed both on the side slopes per the design and the landfill base. The geotextile on the landfill based was installed in place of the bedding sand in the design and was approved by GHD.

Geocomposite material met the specifications and was installed both on the side slopes per the design, and on a portion of the west berm of the cell base, a design change that was approved by GHD. The affected area is shown on the record drawings and notes are provided in the June 13 inspection report.

4. Conformance with Design

In general, the construction of the Cell 1 West landfill cell was carried out according to the design and specifications prepared by GHD. The below documents conformance with the original design.

4.1 Earthworks

A berm was constructed on the north end of Cell 1 West, along the road from approximately the middle of Cell 1 West to the western edge. This berm was not included in the design or inspected by GHD.

Material was left on a portion of the cell base along the western edge of Cell 1 West to cover a bedrock outcrop. This was completed to protect the liner and achieve minimum depth to groundwater. The remainder of the earthworks were carried out in accordance with the design.

4.2 Leachate Collection System & Leak Detection Piping

The 300 mm HDPE leak detection system riser was constructed as shown on Detail 15 of Drawing CI-0104.The perforated portion of the pipe was wrapped in geo-composite and sandbags were placed on the east side of the pipe to secure the pipe in place. Wrapping the pipe in geo-composite ensured there was hydraulic connectivity around the pipe.

A sample of the drain rock was collected to carry out sieve analysis and confirm whether gradation met design specifications. The results of the sieve analysis showed gravel larger than 50 mm and fines content above the design specification. The fines content was less than or equal to 1% and the material was accepted by GHD.

The stone drainage layer was placed on the non-woven geotextile layer. The Contractor exposed the top of leachate pipe by hand to confirm pipe location prior to mounding drainage rock overtop to a depth of greater than 300 mm. The area was visually inspected and large rocks were identified and removed from the cell.

During an inspection, GHD noted that 20% of loads placed within a 20 x 30 m area on the southeast section of the cell had silty sand mixed into the drainage rock. Upland discussed with the loading operator to avoid material sitting directly on the pit floor, which resulted in the material meeting specifications and resolving the material issue.

The remaining components of the leachate collection system and leak detection piping were installed in conformance with the design drawings and specifications.

4.3 Geosynthetics

Non-woven geotextile was placed on the subgrade in place of bedding sand, on the landfill base as well as the side slopes. The geotextile placed on the landfill base was a deviation from design, which was approved by GHD.

Geocomposite material was placed on an area of the west side of the cell where a grade break was present due to the bedrock outcropping mentioned in Section 4.1. =

All other geosynthetics were installed in conformance with the design.

5. Certification

This construction report dated MONTH X, 2024, demonstrates that the Cell 1 West has been constructed in accordance with OC and the most recent DOCP, with the changes noted below and approved by the undersigned during construction. Qualified Professionals completed inspections before and during construction of Cell 1 West.

This construction report includes the information described in Section 10.2 Construction Report(s) of the Landfill Criteria and Section 2.11 of the OC, specifically:

– Changes from the original design that were approved during construction
– As-built record drawings of Cell 1 West
– All inspection and testing reports
– Quality control and quality testing results
– Soil test data including field and laboratory testing

All of Which is Respectfully Certified and Submitted by:

GHD

Deacon Liddy

David Barbour

Roxy Hasior

Appendices

Appendix A

Record Drawings

UPLAND EXCAVATING LTD.
CAMPBELL RIVER, B.C.

NEW LANDFILL (NORTHWIN LANDFILL)
STAGE 1 WEST - ISSUED FOR RECORD
NOVEMBER 2023

SOURCE:
JANUARY 01, 2007. GOVERNMENT OF CANADA, NATURAL RESOURCES CANADA.

AREA MAP

SOURCE:
BING IMAGERY: MICROSOFT PRODUCT SCREEN SHOT(S) REPRINTED WITH PERMISSION FROM MICROSOFT CORPORATION

LOCATION MAP

DRAWING LIST	
DWG NO	DRAWING TITLE
GN-0001	COVER AND INDEX
CI-0101	EXISTING CONDITIONS
CI-0102	FINAL CONDITIONS
CI-0103	TOP OF SUBGRADE
CI-0104	TOP OF DOUBLE LINER SYSTEM
CI-0105	TOP OF DRAINAGE LAYER
CI-0301	STAGE 1 WEST CROSS-SECTIONS
CI-0501	LINER SYSTEM DETAILS
CI-0502	PERIMETER TIE-IN DETAILS
CI-0503	LEACHATE COLLECTION SUMP DETAILS
CI-0504	LEACHATE LEAK DETECTION SUMP DETAILS
CI-0505	LEACHATE COLLECTION SYSTEM DETAILS

THESE RECORD DRAWINGS HAVE BEEN PREPARED, IN PART, ON THE BASIS OF INFORMATION COMPILED AND FURNISHED BY THE PROJECT CONTRACTOR AND OTHERS. THE ENGINEER WILL NOT BE RESPONSIBLE FOR ANY ERRORS OR OMISSIONS WHICH HAVE BEEN INCORPORATED INTO THIS DOCUMENT AS A RESULT. FIELD VERIFICATION OF FACTS AND DATA SHOULD BE MADE IF THESE DOCUMENTS ARE TO BE USED AS A BASIS FOR FUTURE WORK.

DRAFT

www.ghd.com

GHD Limited
138 East 7th Avenue, Suite 100
Vancouver, British Columbia V5T 1M6 Canada
T 1 604 214 0510 F 1 604 214 0525

Bar is 25mm on original size sheet
0 25mm

No.	Issue	Checked	Approved	Date

Author T.WAGSTAFF	Designer
Drafting Check	Design Check
Project Manager	Project Director

Client
UPLAND EXAVATING LTD.
CAMPBELL RIVER, B.C.

Project
STAGE 1 WEST
ISSUED FOR RECORD

Date	Scale
2023-11-06	N.T.S.

Project No.
11222680

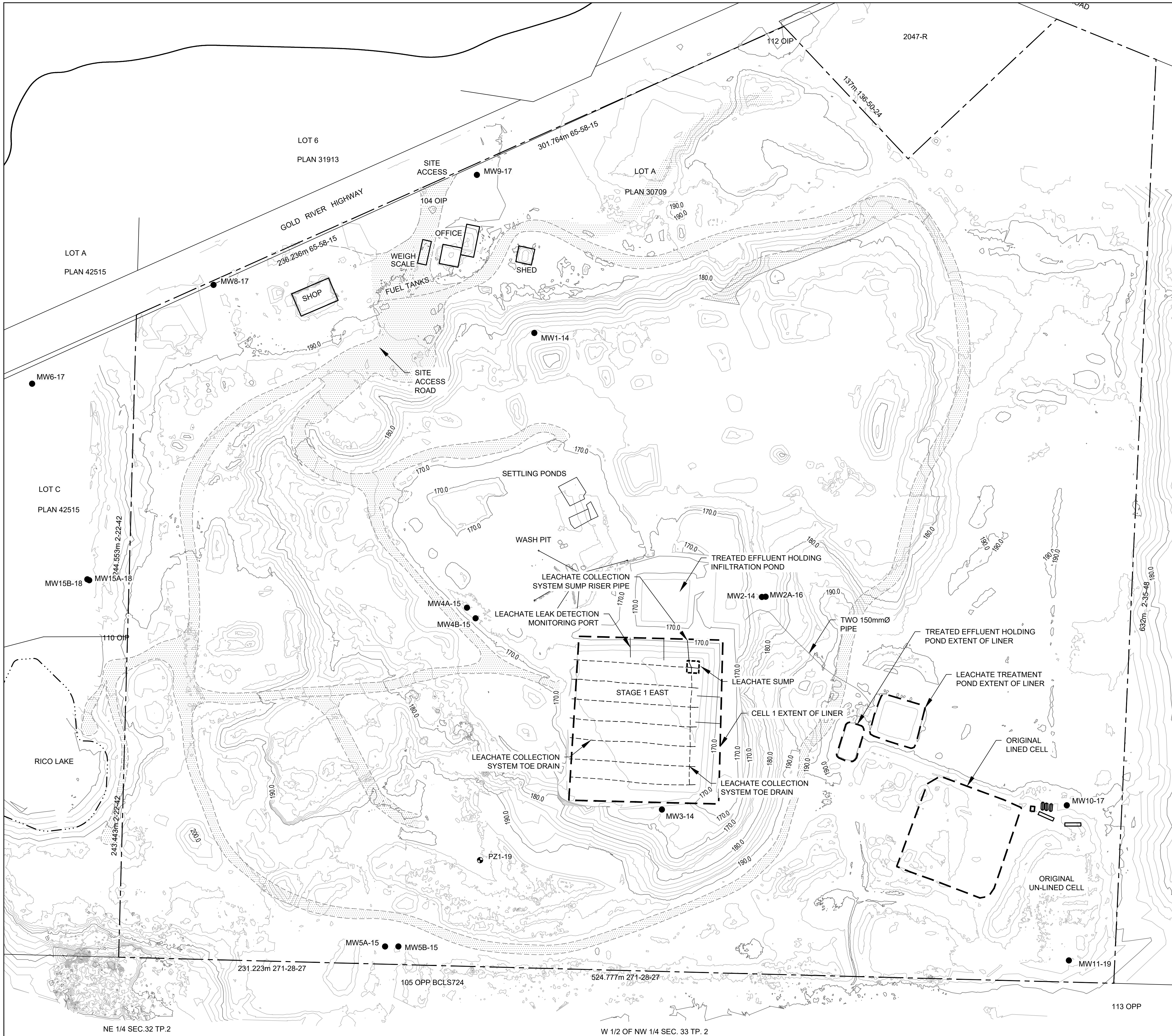
Title
COVER AND INDEX

Size
ANSI D

Status Code

Sheet No.
GN-0001

Sheet
1 of 10



LEGEND

160.0	EXISTING CONTOUR (MAJOR) - 10m
	EXISTING CONTOUR (MINOR) - 2m
	PROPERTY BOUNDARY
	EXISTING LAKE SHORELINE
	EXISTING ROADWAY
● MW1-14	EXISTING MONITORING WELL

THESE RECORD DRAWINGS HAVE BEEN PREPARED, IN PART, ON THE BASIS OF INFORMATION COMPILED AND FURNISHED BY THE PROJECT CONTRACTOR AND OTHERS. THE ENGINEER WILL NOT BE RESPONSIBLE FOR ANY ERRORS OR OMISSIONS WHICH HAVE BEEN INCORPORATED INTO THIS DOCUMENT AS A RESULT. FIELD VERIFICATION OF FACTS AND DATA SHOULD BE MADE IF THESE DOCUMENTS ARE TO BE USED AS A BASIS FOR FUTURE WORK.

DRAFT

GHD

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T 1 604 214 0510 **F** 1 604 214 0525

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0 25mm

No.	Issue	Checked	Approved	Date

Author T.WAGSTAFF | Designer
Drafting Check | Design Check
Project Manager | Project Director

Client
UPLAND EXAVATING LTD.
CAMPBELL RIVER, B.C.

Project
STAGE 1 WEST
ISSUED FOR RECORD

Date **2023-11-06** | Scale **1:1500**

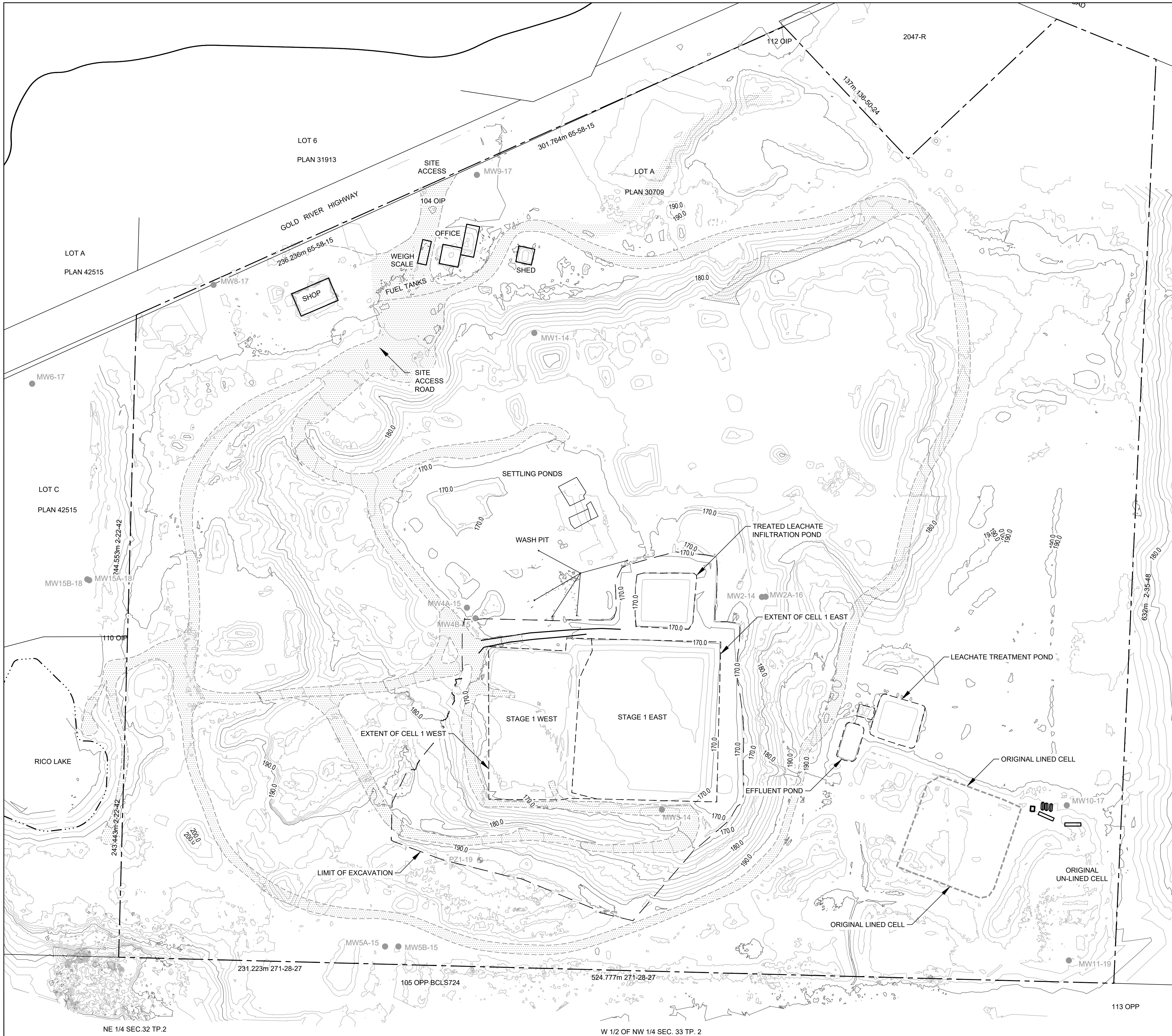
Project No. **11222680**

Title
EXISTING CONDITIONS

Size **ANSI D**

Status Code

Sheet No. **CI-0101** | Sheet 1 of 10



LEGEND

180.0	EXISTING CONTOUR (MAJOR) - 10m
	EXISTING CONTOUR (MINOR) - 2m
	PROPERTY BOUNDARY
	EXISTING LAKE SHORELINE
	EXISTING ROADWAY
MW1-14	EXISTING MONITORING WELL
	LIMIT OF EXCAVATION (APPROXIMATE)
	EXTENT OF CELL / POND

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Project Manager | Project Director

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Project
STAGE 1 WEST
ISSUED FOR RECORD

Date	Scale
2023-11-06	1:1500

Project No.
11222680

Title
FINAL CONDITIONS

Size ANSI D
Status Code
Sheet No. CI-0102
Sheet 1 of 10

LEGEND

168.0	EXISTING CONTOUR (MAJOR) - 4m
	EXISTING CONTOUR (MINOR) - 1m
172.0	TOP OF SUBGRADE CONTOUR (MAJOR) - 4m
	TOP OF SUBGRADE CONTOUR (MINOR) - 1m
	PROPERTY BOUNDARY
	EXISTING ROADWAY
	LIMIT OF WASTE
	EXTENT OF CELL 1 WEST AND EXCAVATION
	SWALE

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Project Manager Project Director

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Project
**STAGE 1 WEST
ISSUED FOR RECORD**

Date **2023-11-06** Scale **1:500**

Project No. **11222680**

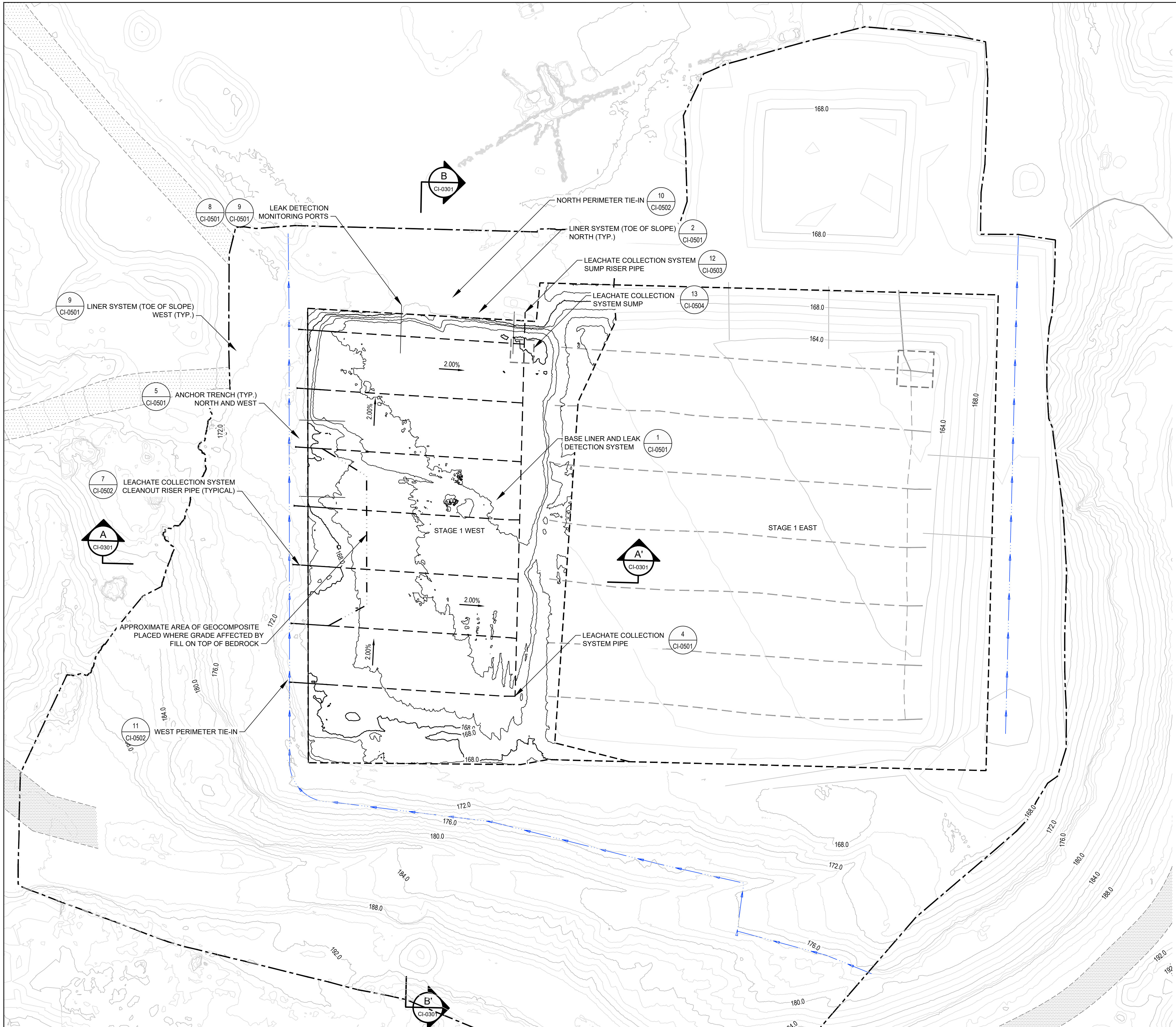
Title **TOP OF SUBGRADE**

Size **ANSI D**

Status Code

Sheet No. **CI-0103** Sheet 1 of 10

Plot Date: 5 November 2023 - 6:19 PM Plotted By: Tyler Wagstaff Path and Filename: N:\CA\Vancouver\Projects\663\11222680\Digital_Design\ACAD\Sheets\RPT002 - NORTHWIN LANDFILL - PHASE 1 WEST - ISSUED FOR RECORD - NOV 2023\11222680-GHD-0000-DWG-CI-0103 - RPT002.dwg



N

0 5 10 15m

LEGEND

172.0	EXISTING CONTOUR (MAJOR) - 4m
	EXISTING CONTOUR (MINOR) - 1m
168.0	BOTTOM OF LINER CONTOUR (MAJOR) - 4m
	BOTTOM OF LINER CONTOUR (MINOR) - 1m
	PROPERTY BOUNDARY
	LEACHATE COLLECTION SYSTEM PIPE (PERFORATED)
	LEACHATE COLLECTION SYSTEM PIPE (NON-PERFORATED)
	EXISTING ROADWAY
	LIMIT OF WASTE
	EXTENT OF CELL 1 WEST AND EXCAVATION
	SWALE
	AREA OF GEOCOMPOSITE

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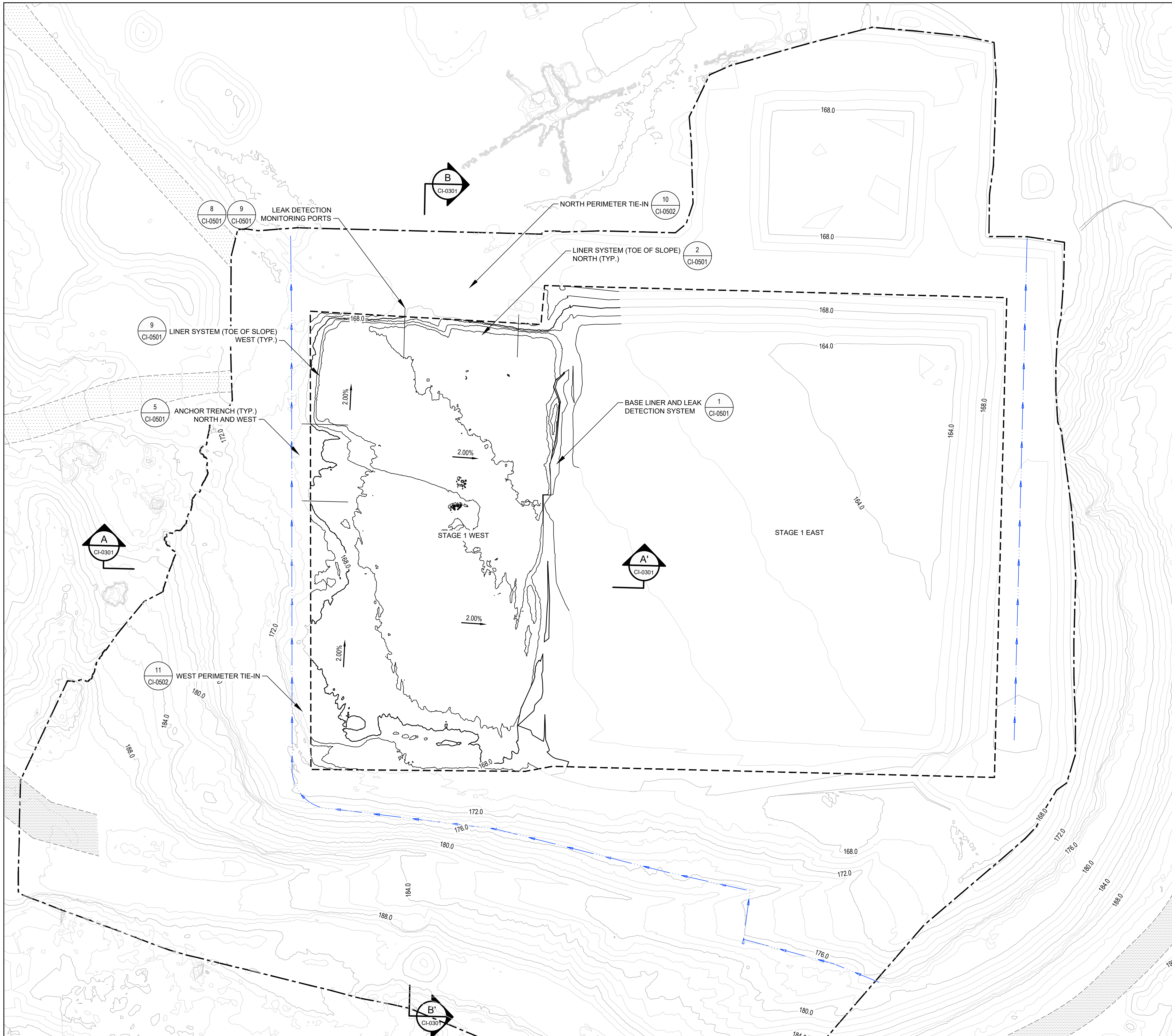
Project
STAGE 1 WEST
ISSUED FOR RECORD

Date **2023-11-06**
Scale **1:500**
Project No. **11222680**
Title **TOP OF DOUBLE LINER SYSTEM**
Size **ANSI D**
Status Code
Sheet No. **CI-0104**
Sheet 1 of 10



LEGEND

- 172.0 — EXISTING CONTOUR (MAJOR) - 4m
- EXISTING CONTOUR (MINOR) - 1m
- 168.0 — TOP OF DRAINAGE LAYER CONTOUR (MAJOR) - 4m
- TOP OF DRAINAGE LAYER CONTOUR (MINOR) - 1m
- PROPERTY BOUNDARY
- EXISTING ROADWAY
- LIMIT OF WASTE
- EXTENT OF CELL 1 WEST AND EXCAVATION
- SWALE

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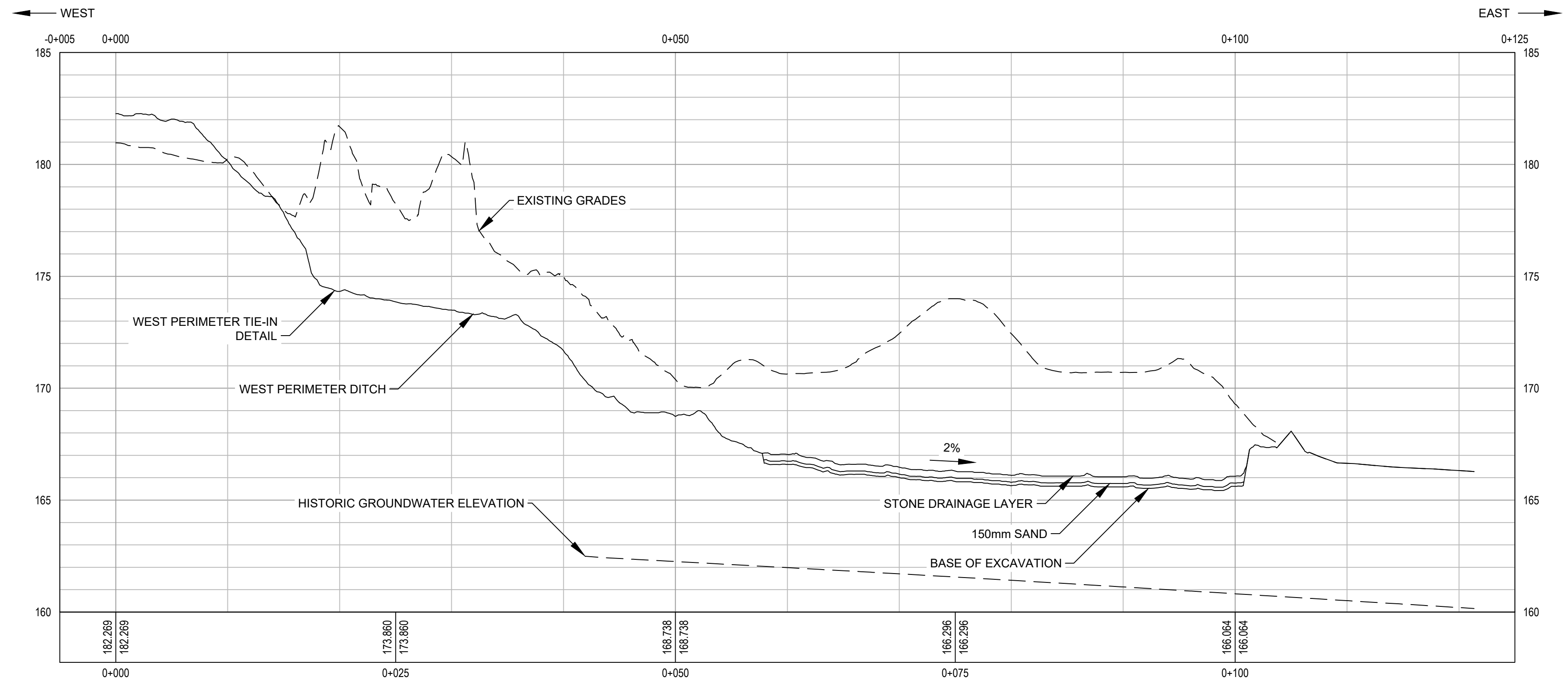
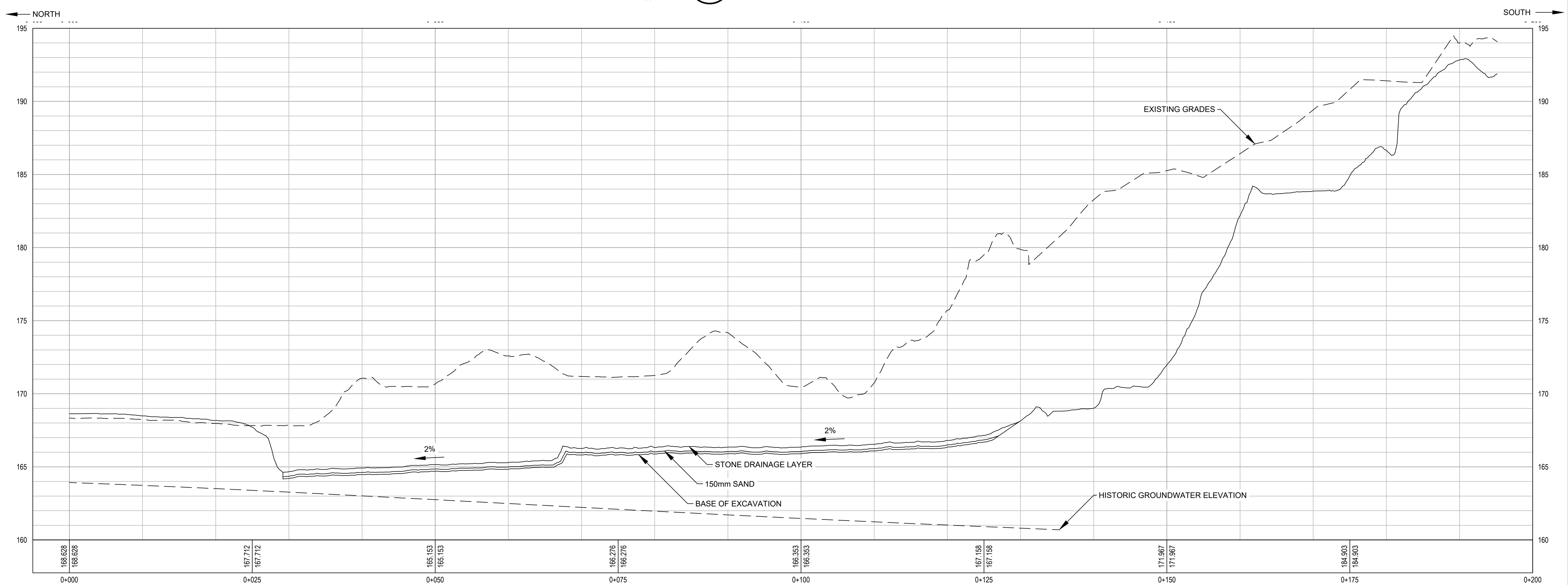
Project
STAGE 1 WEST
ISSUED FOR RECORD

Date **2023-11-06**
Scale **1:500**
Project No. **11222680**
Title **TOP OF DRAINAGE LAYER**
Size **ANSI D**
Status Code
Sheet No. **CI-0105**
Sheet 1 of 10



SECTION A-A'
CI-0103
HORZ: 1:300
VERT: 1:150



SECTION B-B'
CI-0103
HORZ: 1:300
VERT: 1:150

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ISSUED FOR RECORD**

Date	Scale
2023-11-06	**AS SHOWN**

Project No.
11222680

Title
**STAGE 1 WEST
CROSS-SECTIONS**

Size ANSI D
Status Code

Sheet No. CI-0301
Sheet 1 of 10

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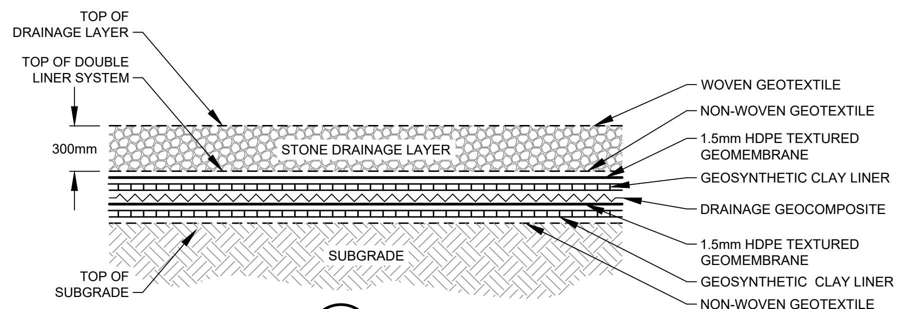
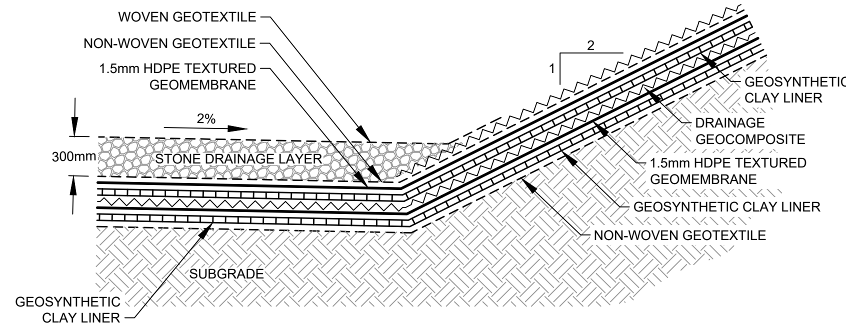
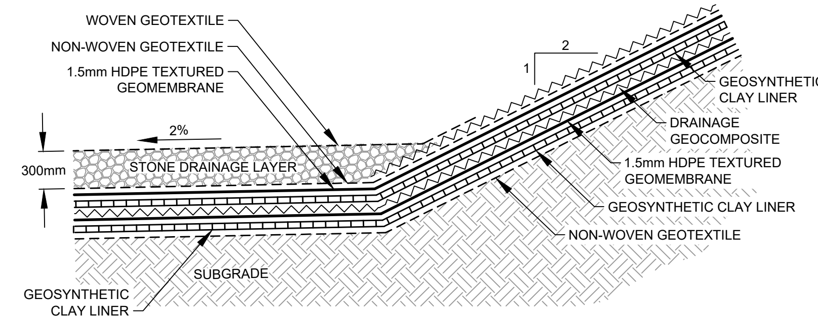


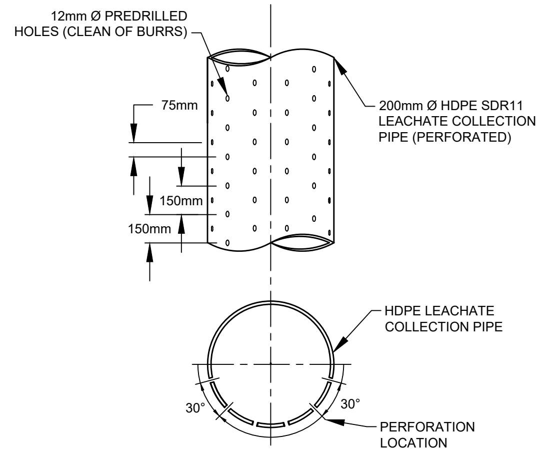
DETAIL 1 BASE LINER AND LEAK DETECTION SYSTEM
1:25 CI-0103



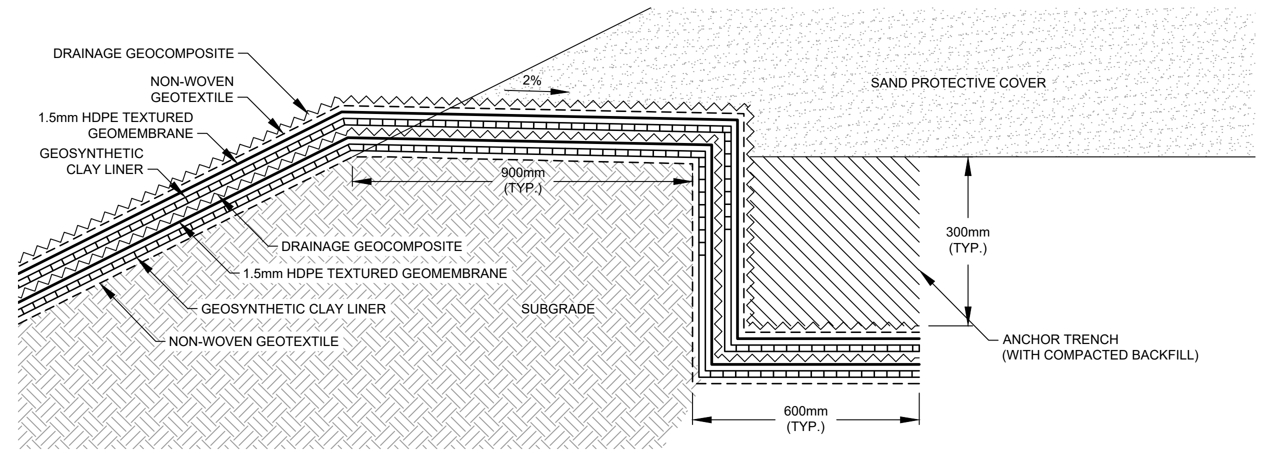
DETAIL 2 LINER SYSTEM (TOE OF SLOPE) NORTH (TYP.)
1:30 CI-0103



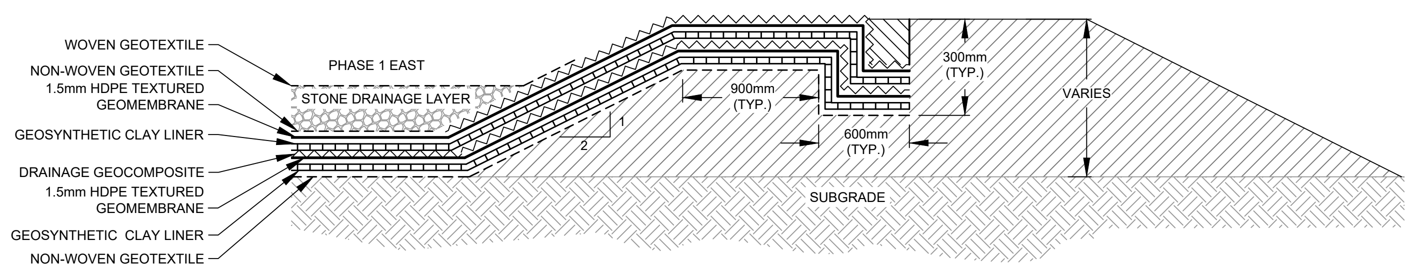
DETAIL 3 LINER SYSTEM (TOE OF SLOPE) WEST (TYP.)
1:30 CI-0103



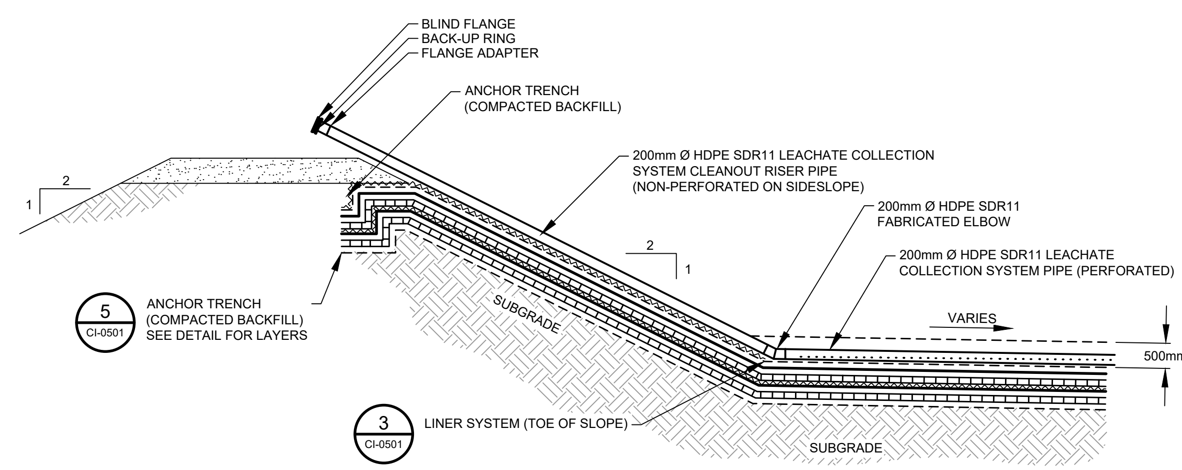
DETAIL 4 LEACHATE COLLECTION SYSTEM TOE DRAIN / LEACHATE COLLECTION SYSTEM PIPE PERFORATIONS
N.T.S. CI-0104



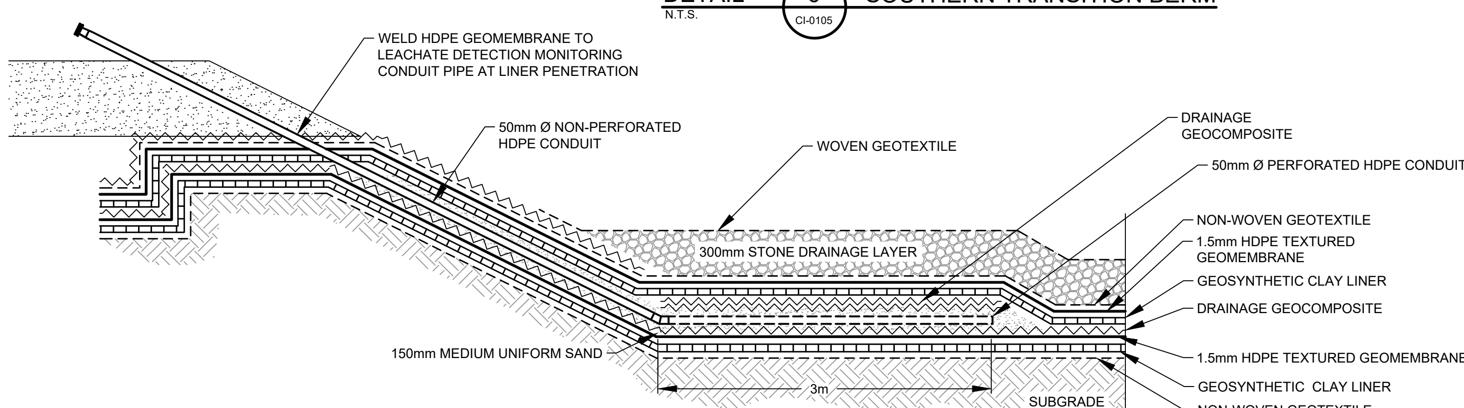
DETAIL 5 ANCHOR TRENCH (TYPICAL) NORTH AND WEST
1:10 CI-0103



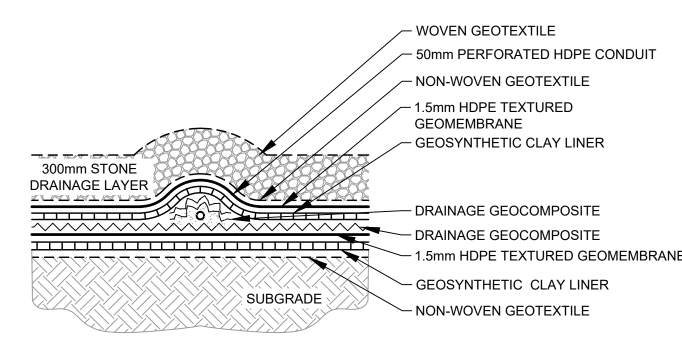
DETAIL 6 SOUTHERN TRANSITION BERM
N.T.S. CI-0105



DETAIL 7 LEACHATE COLLECTION SYSTEM CLEANOUT RISER PIPE (TYPICAL)
1:75 CI-0104



DETAIL 8 LEAK DETECTION DETECTION PORT (TYP.) PROFILE
N.T.S. CI-0103



DETAIL 9 LEAK DETECTION MONITORING PORT (TYP.) CROSS-SECTION
1:25 CI-0103

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Project
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Date	Scale
2023-11-06	AS SHOWN

Project No.
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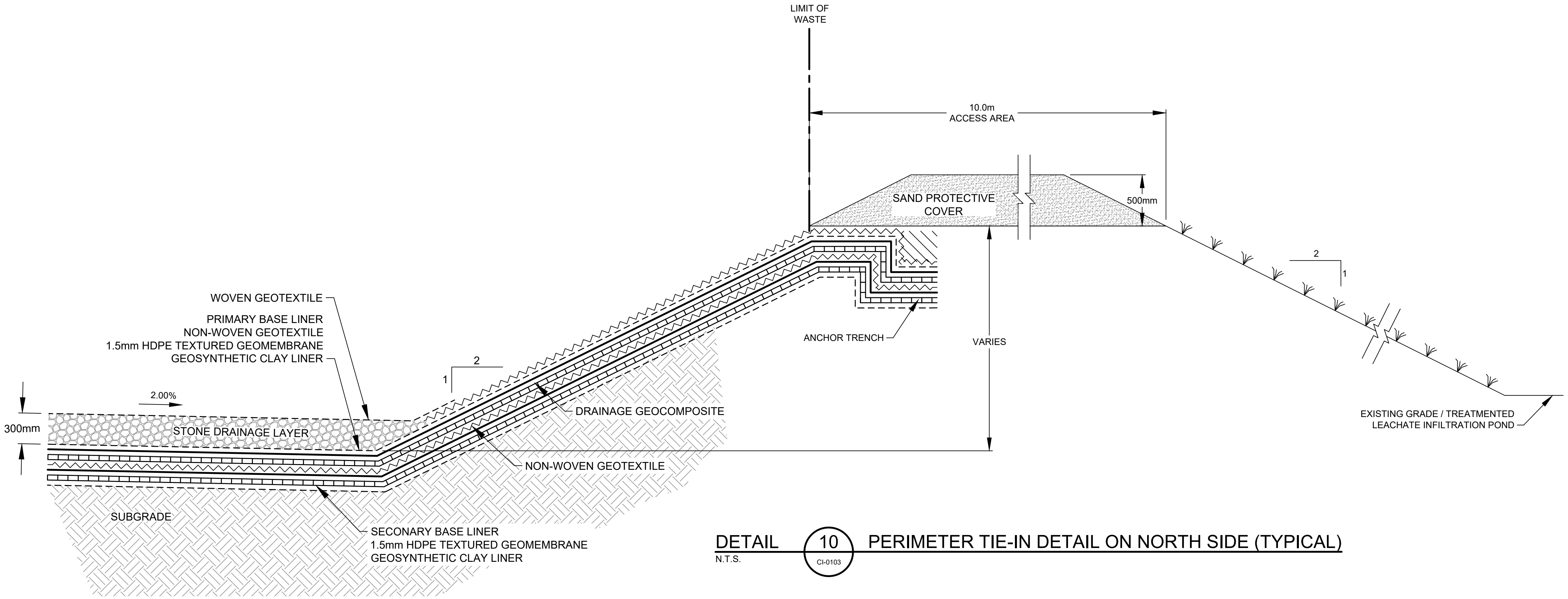
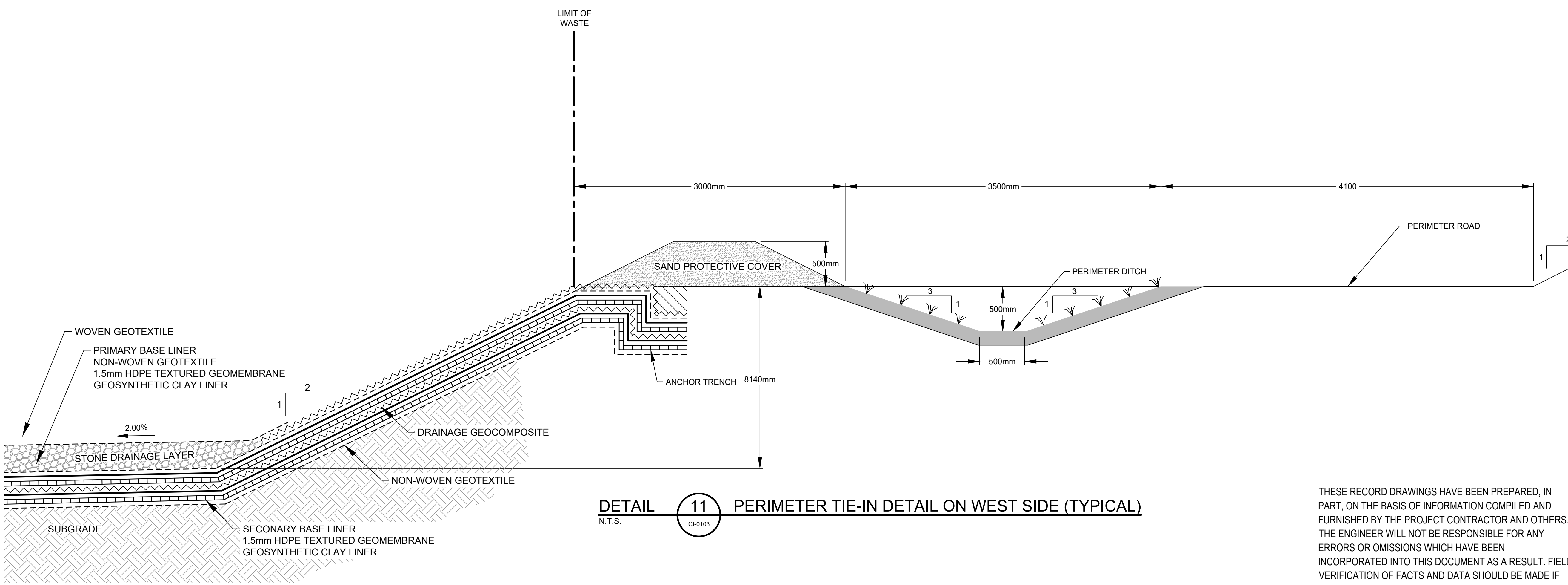
Title
LINER SYSTEM DETAILS

Size ANSI D
Status Code
Sheet No. CI-0501
Sheet 1 of 10



DETAIL 10 PERIMETER TIE-IN DETAIL ON NORTH SIDE (TYPICAL)
N.T.S. CI-0103



DETAIL 11 PERIMETER TIE-IN DETAIL ON WEST SIDE (TYPICAL)
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Date **2023-11-06** | Scale **N.T.S.**

Project No. **11222680**

Title
PERIMETER TIE-IN DETAILS

Size ANSI D
Status Code
Sheet No. CI-0502 | Sheet 1 of 10

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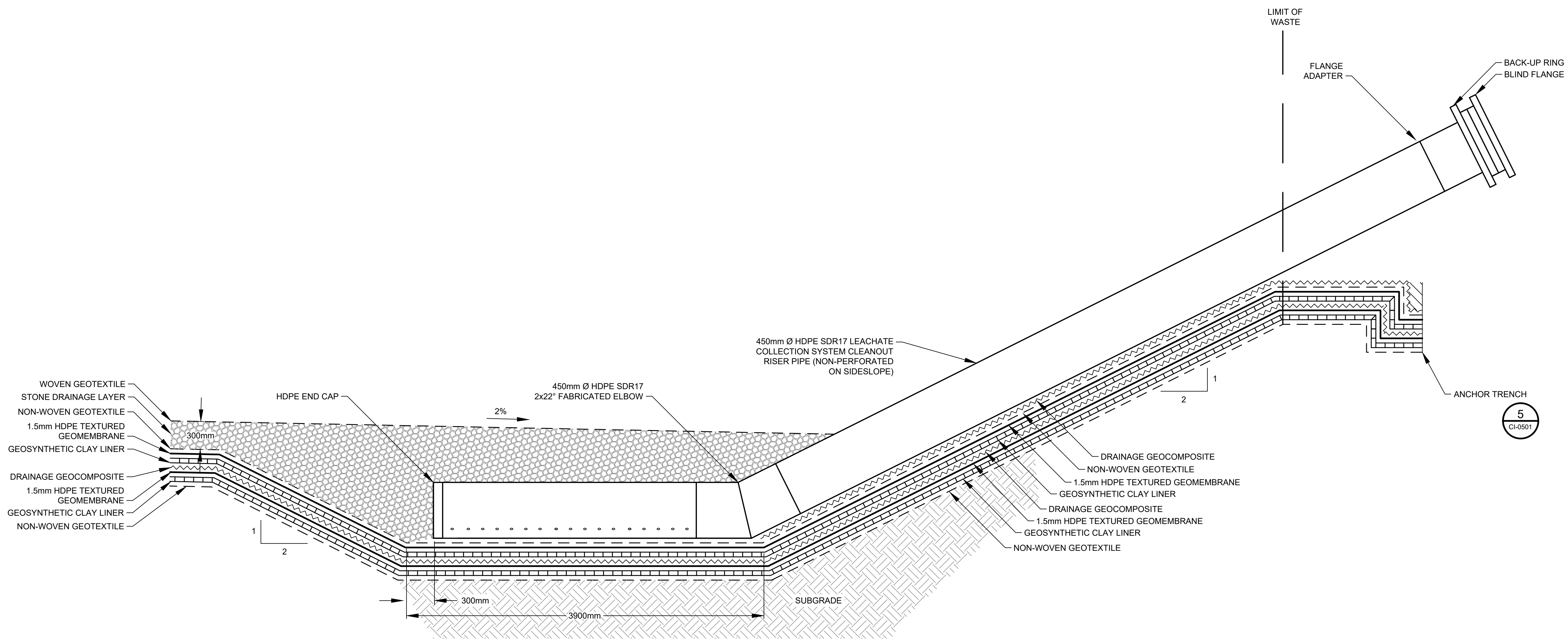

DETAIL 12 (CI-0104) LEACHATE COLLECTION SYSTEM SUMP, SUMP RISER PIPE, AND LEACHATE LEVEL MONITORING PIPE

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ISSUED FOR RECORD

Date	Scale
2023-11-06	**N.T.S.**

Project No.
11222680

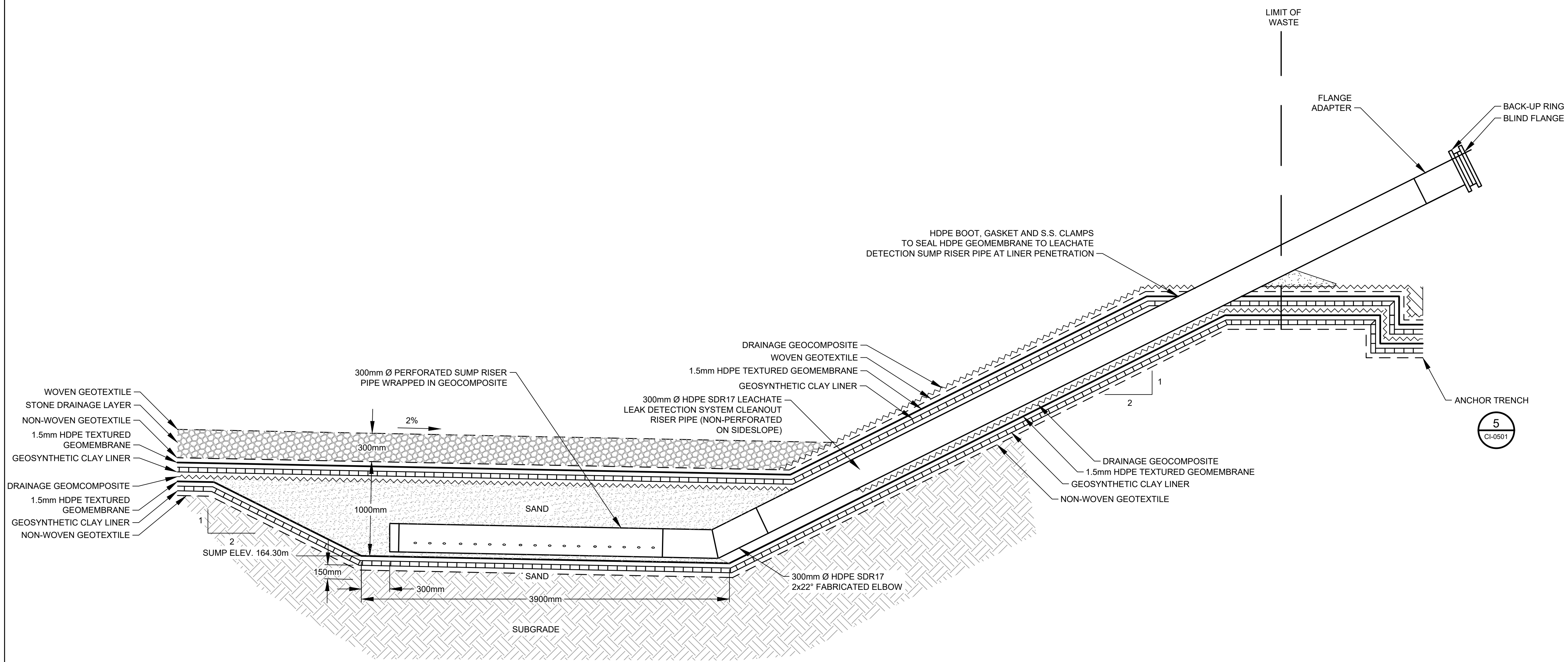
Title
LEACHATE COLLECTION SUMP DETAILS

Size **ANSI D**

Status Code

Sheet No. **CI-0503**

Sheet 1 of 10



DETAIL 13 (CI-0104) LEACHATE LEAK DETECTION SUMP, SUMP RISER PIPE

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Drafting Check — Design Check
Project Manager — Project Director

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Project
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Date **2023-11-06** — Scale **N.T.S.**

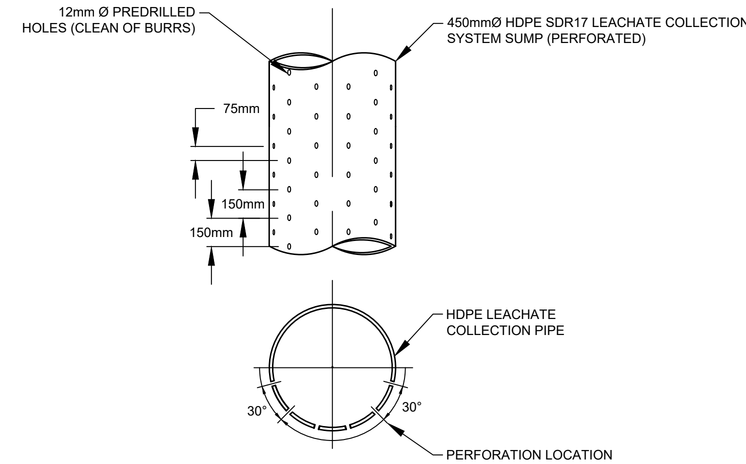
Project No. **11222680**

Title
LEACHATE LEAK DETECTION SUMP DETAILS

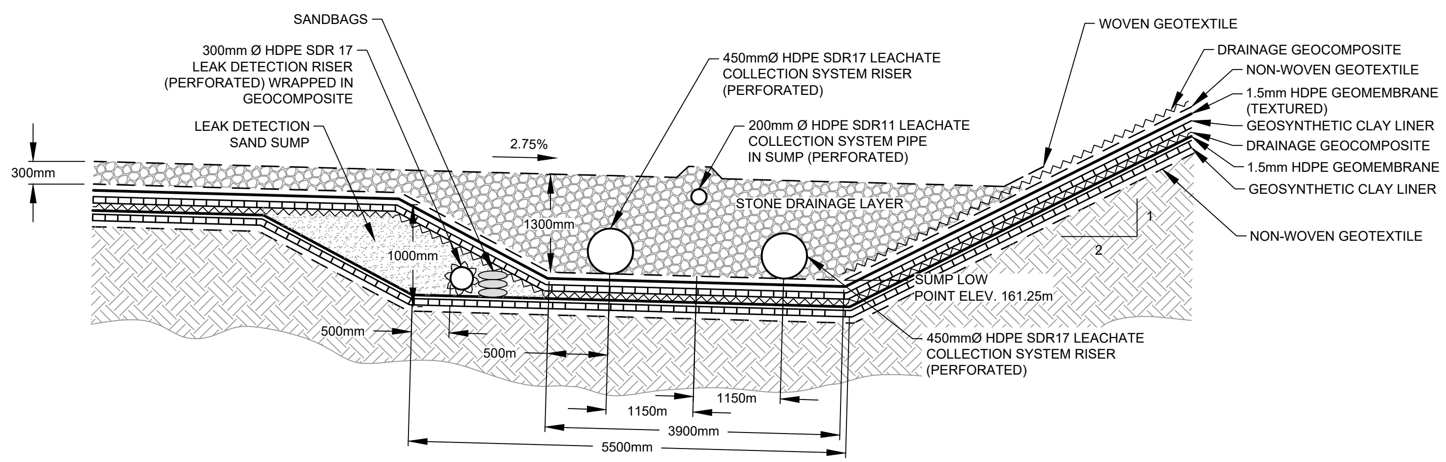
Size ANSI D

Status Code

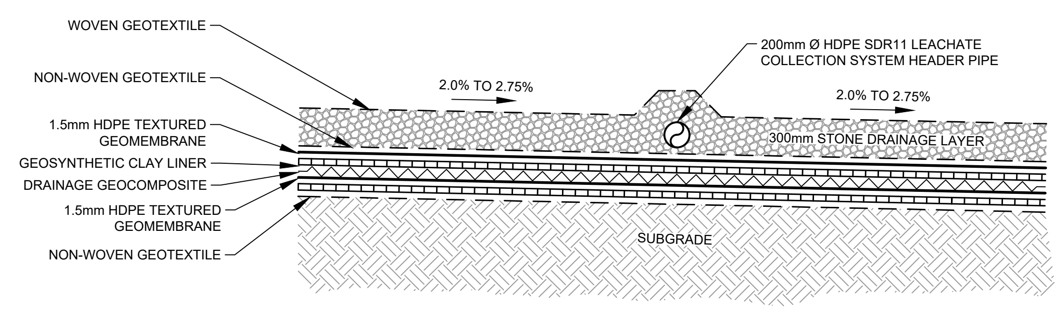
Sheet No. CI-0504 — Sheet 1 of 10



DETAIL 14 CI-0501 NTS 450mmØ LEACHATE COLLECTION SYSTEM SUMP PIPE PERFORATIONS



DETAIL 15 CI-0104 N.T.S. LEACHATE COLLECTION SYSTEM SUMP



DETAIL 16 CI-0104 N.T.S. LEACHATE COLLECTION SYSTEM TOE DRAIN/ LEACHATE COLLECTION SYSTEM PIPE

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Project Manager		Project Director	

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Project
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ISSUED FOR RECORD

Date	Scale
2023-11-06	**N.T.S.**

Project No.
11222680

Title
LEACHATE COLLECTION SYSTEM DETAILS

Size **ANSI D**

Status Code

Sheet No. **CI-0505** Sheet **1** of **10**

Appendix B

Photograph Log