



Nakusp Landfill

2025 Annual Operations and Monitoring Report

Table of Contents

Executive Summary	ii
1.0 Site Information	1
2.0 Waste Received	1
2.1 Waste Generation and Landfilling	1
2.2 Recycling, Re-Purposing and Diversion.....	1
2.3 Stockpiling.....	2
2.4 Septage	2
3.0 Airspace Consumption and Remaining Site Life	2
4.0 Site Operations and Development	3
4.1 Operational Problems and Corrective Actions	3
4.2 2025 Operational Review.....	3
4.3 2026 Operational Plan	4
5.0 Changes from Approved Plans, Programs, and Reports.....	4
6.0 Expenditures and Closure Fund	4
7.0 Wildlife Observations.....	4
8.0 Landfill Operator Training.....	5
9.0 Environmental Monitoring Program	5
10.0 References	6

FIGURES

Figure 1: Site Plan

Figure 2: Environmental Monitoring Plan Locations

APPENDICES

Appendix A: Operational Certificate No. 16521

Appendix B: 2025 Waste Stream Tonnage

Appendix C: Airspace and Life Expectancy (Fill-to-Closure Plan)

Appendix D: Nakusp Landfill Closure Plan

Appendix E: Environmental Monitoring Program

Appendix F: 2025 Annual Environmental Monitoring Program Report

Executive Summary

The 2025 Annual Operations and Environmental Monitoring Report for the Nakusp Landfill presents an overview of existing site conditions, site operations, and results of the environmental monitoring program for the 2025 reporting period. This report is submitted in fulfillment of the annual reporting requirements outlined in Section 5 of Operational Certificate 16521, and is in general accordance with Section 10.6 of the British Columbia Landfill Criteria for Municipal Solid Waste (Ministry of Environment, 2016).

The site is located on leased Crown land approximately 2 kilometers north of the Village of Nakusp, British Columbia, with an estimated total area of 11.6 hectares. The site is operated by the Regional District of Central Kootenay (RDCK). Authorized works at the site include the sanitary landfill, recycling/storage areas, two septage drying beds, and related appurtenances.

In 2025, approximately 1,787 tonnes of waste was landfilled, and 1,074 tonnes of waste was diverted. Approximately 1,113 m³ of septage was discharged on site.

Operational and maintenance expenditures for the landfill were \$343,079.03 in 2024, and \$499,874.76 in Asset Retirement Obligation (ARO) was booked for the landfill. 2024 financials were not available by the deadline for this report and will be reported in the 2025 annual report.

The Nakusp Landfill was operated and developed according to approved reports, plans and specifications. Landfilling ceased at the end of November 2025, at which point intermediate cover was applied. Final closure of the landfill is expected to proceed as per the Closure Plan in 2026-2027, pending approval by the Ministry of Environment and Parks.

Activities carried out at the site in 2025 are summarized below:

- Development of a Closure Plan by SHA, submitted to the Ministry of Environment and Parks on November 26, 2025;
- Continued diversion activities, and storing recyclables from municipal, commercial and light industrial sources as specified in the Operational Certificate;
- Continued landfilling of refuse until November 30, at which point waste was collected at the transfer facility (constructed at the site in 2024) and hauled to Ootischenia landfill for disposal;
- Continued development of the site in accordance with the Design and Operations Plan till November 30, at which point intermediate cover was applied; and,
- Continued site inspections.

Site operations to be carried out during the next reporting period include:

- Final design and tendering for landfill closure works in accordance with the Closure Plan;
- Collection and hauling of refuse from the transfer station, as well as continued collection and storing of diversion materials at the site (includes wood, scrap metal, and recyclables from municipal, commercial and light industrial sources as specified in the Operational Certificate); and,
- Continued site inspections.

The 2025 Annual Environmental Monitoring Program Report is included as an appendix in this report.

1.0 Site Information

The Nakusp Landfill, operated by the Regional District of Central Kootenay (RDCK) under operational certificate 16521 (Appendix A), is located approximately 2 kilometres north of the Village of Nakusp, British Columbia. The site is situated on Crown land leased to the RDCK described as “Unsurveyed Part of District Lot 863, Kootenay District.” The site has a total area of approximately 11.6 hectares, which consists of a 7.2 hectare waste discharge area and a 4.4 hectare designated buffer zone.

The property to the south of the site is owned by the RDCK, while the property to the north, east and west is provincial Crown land. The land immediately adjacent to the site on the north, east and west are forested primarily with coniferous trees, while the property to the south is undulating tussock lands.

The site is accessed via Hot Springs Road and is located approximately one kilometre north-east of the Nakusp Airport and 700 metres north-west of Kuskanax Creek.

2.0 Waste Received

2.1 Waste Generation and Landfilling

Historically, the quantity of waste received at the site was visually estimated by volume and recorded by the landfill attendant. A scale was installed in October 2016 and waste is now primarily tracked by weight. Material accepted for landfill disposal includes mixed waste, asbestos, construction, demolition, and renovation (CDR) waste, land clearing debris, noxious weeds, rubble (includes asphalt and concrete), bulky waste, and soil.

In 2025, approximately 1,787.3 tonnes of waste was landfilled at the Nakusp Landfill. The annual waste generation rate was calculated to be 642 kg/capita and the annual landfilling rate was 396 kg/capita. A summary of the waste data and rates is presented in Appendix B.

2.2 Recycling, Re-Purposing and Diversion

The RDCK has endorsed the concept of Zero Waste. This goal forms the cornerstone of the RDCK’s 2021 Resource Recovery Plan (RRP) which was approved by the Province in February 2023.

Approximately 1,073.7 tonnes of waste was diverted at the Nakusp Landfill in 2025, resulting in a wasteshed diversion rate of 37%. Appliances, yard and garden waste, scrap metal, used tires, automotive batteries, and propane tanks are diverted from the landfill. Contaminated soil acceptable under the Operational Certificate was re-purposed as daily or intermediate cover material. Tonnages are provided in Appendix B.

With the exception of yard and garden, soils, and wood waste, all diverted materials were temporarily stored on site before being transported to an end user. Upon closure, all diverted materials will be temporarily stored and transported to an end user.

In July 2020, the RDCK transitioned its recycling program to operate under the Recycle BC (RBC) stewardship program for collection and recycling of residential paper and packaging materials. Core depots for RBC recycling in the Nakusp landfill catchment area were established in Edgewood, New Denver, and Nakusp. The following materials are diverted through the RBC recycling program:

- Mixed paper and cardboard
- Glass bottles and jars
- Mixed containers
- Plastic bags and overwrap
- Other flexible plastic packaging
- White and coloured foam packaging

Additionally, the RDCK implemented a recycling program for cardboard generated by the industrial, commercial, and institutional (ICI) sector in 2020. Materials collected through the RBC and ICI cardboard recycling programs are not recycled on-site at the Nakusp landfill; however the amounts diverted by these programs for the area serviced by the Nakusp landfill are included in Appendix B for accurate calculation of waste generation and diversion rates.

A re-use shed provides a drop-off location for household items that are still in working condition that may be taken for free and re-used by others. Items for the re-use shed are charged at the mixed waste rate and are not included in recycled material statistics.

In September of 2025, a household hazardous waste (HHW) round-up event was held in the Village of Nakusp to provide an alternative disposal option for non-extended producer responsibility (EPR) HHW, as well as some EPR products, including batteries, lighting products, smoke and CO alarms, small appliances, as well as electronic waste. 242 residents participated in the Nakusp event, safely disposing of approximately 15.8 tonnes of HHW and EPR materials.

2.3 Stockpiling

In addition to the above materials, 33.9 tonnes of clean wood waste was collected and stockpiled at the site in 2025. Wood waste has historically been chipped and stockpiled for use for road maintenance in fill areas and for mixing with septic sludge; however the amount of wood waste received was far higher than what the landfill was able to re-purpose, resulting in large stockpiles of woodchips that present a fire hazard. As of spring 2025, only clean wood was diverted for grinding and all other waste wood was landfilled. The RDCK will continue to look for an economically viable higher end for contaminated wood waste with the goal of diverting this material from the landfill.

2.4 Septage

Approximately 1,113 m³ of septage (assuming a density of 1,000 kg/m³) was discharged at two on site septage drying beds in 2025.

3.0 Airspace Consumption and Remaining Site Life

The RDCK's RRP directs the discontinuation of daily fill activities at the Nakusp Landfill. In 2021, Wood Environment and Infrastructure Solutions (Wood) completed an update to their 2018 Update of Design & Operation plan for the Nakusp landfill to extend the life of the landfill to 2024. In November 2024, Sperling Hansen Associates (SHA) developed a Fill-to-Closure Plan guiding continued filling of the landfill to its expected closure in mid-2025. The Fill-to-Closure design figures are presented in Appendix C. SHA also developed a Closure Plan for the landfill, presented in Appendix D.

The landfill reached capacity in fall 2025, ceasing operations on November 30, 2025. After this date, waste received at the Nakusp transfer station was redirected to the Ootischenia Landfill near Castlegar for disposal. The Operational Certificate for the Nakusp Landfill will remain open for the near future while closure proceeds and further plans are developed.

4.0 Site Operations and Development

A site plan illustrating the existing conditions and authorized works of the site is presented as Figure 1. The landfill operated as a natural attenuation landfill. Waste received was recorded at the weigh scale by the landfill attendant. Refuse was placed and compacted, and daily cover was primarily provided through the Revelstoke Iron Grizzly (RIG) alternate cover system. Waste soil disposed and stockpiled at the landfill was re-purposed as supplementary daily and intermediate cover material. Additional cover material was provided by the site contractor from the neighbouring property.

Landfill gas and leachate are not collected or treated at the site; however monitoring for leachate-related impacts is conducted as part of the annual Environmental Monitoring Program (EMP) as described in Appendices E and F. Two septage drying beds were operated at the site. In 2018 one of the septage beds was partially de-commissioned. The new adjacent cell sites are slightly encroaching on the pit, however the remaining pit area serves as a reserve pit.

The entrance gate is locked when the site is closed to prevent unauthorized vehicle access and waste disposal. On site structures include the attendant scale house (located adjacent to the site entrance) and a re-use shed. Electrified fencing secures the limit of refuse and is operational between April 1 and November 1 each year.

4.1 Operational Problems and Corrective Actions

Inspections carried out in 2025 identified the following issues and corrective actions:

- The main gate at the landfill was broken and subsequently replaced with a stronger and more secure steel gate.
- The electric fence was found to be shorting out. After walking the perimeter a section of fence causing this was identified and repaired.
- Ongoing challenges with public scavenging. The landfill operator has attempted to mitigate this by using gravel piles to impede vehicles accessing the site around the entrance gate.

No other major problems or concerns requiring corrective action were identified in 2025.

4.2 2025 Operational Review

Activities carried out at the site in 2025 are summarized below:

- Development of a Closure Plan by SHA, submitted to the Ministry of Environment and Parks on November 26, 2025;
- Continued diversion activities, and storing recyclables from municipal, commercial and light industrial sources as specified in the Operational Certificate;
- Continued landfilling of refuse until November 30, at which point waste was collected at the transfer facility, constructed at the site in 2024, and hauled to Ootischenia landfill for disposal;
- Continued development of the site in accordance with the Design and Operations Plan till November 30, at which point intermediate cover was applied; and,
- Continued site inspections.

4.3 2026 Operational Plan

Site operations to be carried out during the next reporting period include:

- Final design and tendering for landfill closure works in accordance with the Closure Plan;
- Collection and hauling of refuse from the transfer station, as well as continued collection and storing of diversion materials at the site (includes wood, scrap metal, and recyclables from municipal, commercial and light industrial sources as specified in the Operational Certificate);
- Continued site inspections.

5.0 Changes from Approved Plans, Programs, and Reports

The 2008 D&O Plan includes the design for a natural attenuation landfill with four stages of development and progressive closure. In 2021, Wood completed an Update to the Design & Operations Plan. The update provided an airspace consumption analysis, including consumption rates, densities, and cover soil utilization (Wood, 2022). The update provided an updated filling plan with drainage outlined, design specifics for the final top of waste surface with the application of contractor supplied cover material. In late 2024, SHA developed a Fill-to-Closure Plan to guide filling of the landfill to its expected closure in mid-2025. Filling followed these plans until November 30, 2025 at which point the landfill was at capacity and intermediate cover was applied. Final landfill closure is expected to proceed in 2026-2027 as per the Closure Plan developed by SHA in 2025, pending approval from the Ministry of Environment and Parks.

The Environmental Monitoring Plan (EMP) for the Site was reviewed with Masse Environmental Consultants in early 2025. The format of the EMP summary table was updated to provide more clarity on the sampling schedule and consistency in the parameters analyzed (Appendix E). Groundwater and surface water sampling was conducted in general accordance with the EMP; any deviations are described in the report provided in Appendix F.

Analytical results from groundwater sampling indicate that leachate-related groundwater impacts generally attenuate with distance from the landfill, but that elevated levels of barium and lithium in exceedance of the background levels and applicable criteria persist just beyond the current site boundary (MW1-95). SLR recommended re-definition of the landfill site boundary to include Lot 13034 (currently owned by the RDCK) when the OC is next amended, such that the farthest down-gradient well MW17-07 is considered the down-gradient compliance well for the landfill. Concentrations of all parameters met the applicable criteria at this location.

The source monitoring well (MW4-06) has been dry since 2023; therefore samples have not been collected from this well. To ensure that leachate indicator parameters are monitored nearest the source (landfill), this well will be re-installed deeper as part of a region-wide drilling program planned for 2026.

6.0 Expenditures and Closure Fund

Operational and maintenance expenditures for the landfill were \$343,079 in 2024, and \$499,875 in Asset Retirement Obligation (ARO) was booked for the landfill. 2025 financials are not available by the deadline for this report and will be reported in the 2026 annual report.

7.0 Wildlife Observations

Mitigative measures to minimize the risk to landfill personnel, the public and the wildlife are carried out on an as-required basis. An electrified wildlife fence is energized and maintained throughout the active bear season to control wildlife access to the landfill area. Crows and wild turkeys continued to be present at the site in large numbers until landfiling ceased and intermediate cover was applied.

8.0 Landfill Operator Training

The Operation of the site was a contracted service and the training and certification were the responsibility of the Contractor.

9.0 Environmental Monitoring Program

The 2025 Annual Environmental Monitoring Program Report is included in Appendix F.

10.0 References

BC Ministry of Environment (MoE), 2016. Landfill Criteria for Municipal Solid Waste, Second Edition. June 2016.

Masse Environmental Consultants Inc., 2026. Annual Environmental Monitoring Program, Nakusp Landfill. March 2026.

Sperling Hansen Associates (SHA), 2025. Nakusp Landfill Closure Plan. August 2025.

Wood Environment & Infrastructure Solutions (Wood), 2018. Nakusp Landfill, Update of Design & Operation. April 2018.

Wood, 2022. Update to the Design and Operation Plan, Nakusp Landfill. January 2022.

FIGURES

Figure 1: Site Plan

Figure 2: Environmental Monitoring Plan Locations



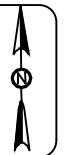
**REGIONAL DISTRICT OF
CENTRAL KOOTENAY
ENVIRONMENTAL SERVICES**
Box 590, 202 Lakeside Dr., Nelson BC, V1L 5R4
Tel: (250) 352-6665 Fax: (250) 352-9300
Web: www.rdc.bc.ca E-mail: rdck@rdck.gov.bc.ca

NAKUSP
RESOURCE RECOVERY
FACILITY

Figure 1
GENERAL SITE PLAN

VERIFY SCALE
BAR IS 12mm ON
ORIGINAL DRAWING.
0 12mm
IF NOT 12mm ON
THIS SHEET ADJUST
SCALES ACCORDINGLY.

LEGEND





APPENDICES

- Appendix A: Operational Certificate No. 16521
- Appendix B: 2025 Waste Stream Tonnage
- Appendix C: Airspace and Life Expectancy (Fill-to-Closure Plan)
- Appendix D: Nakusp Landfill Closure Plan
- Appendix E: Environmental Monitoring Program
- Appendix F: 2025 Annual Environmental Monitoring Program Report

APPENDIX A: OPERATIONAL CERTIFICATE NO. 16521



MINISTRY OF
ENVIRONMENT

OPERATIONAL CERTIFICATE

16521

Under the Provisions of the Environmental Management Act

REGIONAL DISTRICT OF CENTRAL KOOTENAY

BOX 590

202 LAKESIDE DRIVE

NELSON, BRITISH COLUMBIA

V1L 5R4

is authorized to manage waste and recyclable material from the Regional District of Central Kootenay and environs at the Nakusp landfill located near Nakusp, British Columbia, subject to the conditions listed below. Contravention of any of these conditions is a violation of the *Environmental Management Act* and may result in prosecution.

This Operational Certificate supersedes all previous versions of the Operational Certificate MR-16521 issued under the authority of the *Environmental Management Act*.

1. AUTHORIZED DISCHARGES

This authorization applies to the discharge of municipal solid waste, commercial and light industrial refuse to a sanitary landfill known as the Nakusp landfill. The site reference number for this discharge is E211814.

- 1.1 The authorized works are a sanitary landfill and related appurtenances approximately located as shown on Site Plan A.
- 1.2 The maximum quantity of waste discharges must not exceed the design capacity of the landfill as specified in the approved Design and Operations Plan. The final footprint and profile of the discharges waste must be within that specified in the Design and Operations Plan, and roughly as shown on the attached Site Plan A.

Date issued: November 29, 2000
Date amended: August 8, 2014
(most recent)

Sajid A. Barlas, Ph.D., P.Ag.
for Director, *Environmental Management Act*
Southern Interior Region - Kootenay

- 1.3 The authorized discharge is municipal solid waste as defined in the *Environmental Management Act* and other waste as may be authorized by the Director.
- 1.4 The legal description of the location of the authorized landfill facility is an unsurveyed part of District Lot 863, Kootenay District.
- 1.5 The site is located approximately 1.2 km northeast of the Nakusp Municipal Airport.

2. **DESIGN AND PERFORMANCE REQUIREMENTS**

2.1 **Design and Operating Plan**

The Operational Certificate holder must prepare and maintain a current Design and Operations Plan prepared by a qualified professional. The Plan must be reviewed and updated as needed at least once every five years. The Plan must address, but not be limited to, each of the subsections in the Landfill Criteria for Municipal Solid Waste including performance, siting, design, operational, closure and post-closure criteria. The facilities must be developed, operated and closed in accordance with the Plan. Should there be any inconsistency between this Operational Certificate and the Plan, this Operational Certificate must take precedence.

Written authorization from the Director must be obtained prior to implementing any changes to the approved plans. Based on any information obtained in connection with this facility, the Director may require revision of, or addition to, the design, operating and closure plans.

2.2 **Qualified Professionals**

All facilities and information, including works, plans, assessments, investigations, surveys, programs and reports, must be certified by Qualified Professionals.

2.3 **Maintenance of Works and Emergency Procedures**

The authorized works must be inspected regularly and maintained in good working order. In the event of an emergency or condition beyond the control of the Regional District of Central Kootenay including, but not limited to,

Date issued: November 29, 2000
Date amended: August 8, 2014
(most recent)



Sajid A. Barlas, Ph.D., P.Ag.
for Director, *Environmental Management Act*
Southern Interior Region - Kootenay

unauthorized fires arising from spontaneous combustion or other causes, or detection of leachate on the property, the Regional District of Central Kootenay must take appropriate remedial action and notify the Director immediately. The Director may reduce or suspend operations to protect the environment until the authorized works has been restored, and/or corrective steps taken to prevent unauthorized discharges.

2.4 Additional Facilities or Works

The Director may require investigations, surveys, and the construction of additional facilities or works. The Director may also amend any information requirements of this Operational Certificate including plans, programs, assessments and reports.

2.5 Public Health, Safety and Nuisance

The landfill must be operated in a manner such that it will not create a public nuisance or become a significant threat to public health or safety with respect to landfill gas, unauthorized access, roads, traffic, airport activity, noise, dust, litter, vectors, or wildlife attraction.

2.6 Ground and Surface Water Quality Impairment

The landfill must be operated in a manner such that ground or surface water quality does not decrease beyond that specified by the British Columbia Water Quality Guidelines, or other appropriate criteria as may be specified by the Director, at or beyond the landfill property boundary.

These measures include but are not limited to:

- a) Prohibiting the discharge of municipal solid waste into water.
- b) Ensuring that no new waste is landfilled within 1.2 m of the highest groundwater level.
- c) Ensuring that adequate surface water and groundwater diversion works are constructed and maintained to minimize surface water run-off and groundwater seepage from entering the landfill.
- d) Ensuring that the management systems for surface water that has not come

Date issued: November 29, 2000
Date amended: August 8, 2014
(most recent)



Sajid A. Barlas, Ph.D., P.Ag.
for Director, *Environmental Management Act*
Southern Interior Region - Kootenay

in contact with waste are hydraulically separate from those for managing impacted surface water.

- e) Ensuring that the landfill is operated in a manner that prevents the exceedance in surface water and groundwater of anticipated leachate indicators or parameters distinctive of leachate or those specified by the Director at the landfill boundary.
- f) Ensuring that the indicators in e) above, at specified groundwater monitoring wells within the property boundary are in accordance with those predicted by design and that suitable measures are taken to address the cause of any exceedances.
- g) Ensuring that the landfill is operated in accordance with a Design & Operations Plan which specifies measures to prevent decreases in groundwater and surface water quality at and beyond the property boundary.

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

2.7 Landfill Gas Management

The Landfill must not cause combustible gas concentrations to exceed the lower explosive limit in soils at the property boundary or 25% of the lower explosive limit at or in on-site or off-site structures.

The Operational Certificate holder must ensure that the facility is in compliance with the requirements of the Landfill Gas Management Regulation under the Greenhouse Gas Reduction (Emissions Standards) Statutes Amendment Act, 2008 on or before applicable dates specified in the regulation. The requirements of the regulation and its guideline documents must be incorporated by the Operational Certificate holder into the Design and Operation Plan revisions as they come into effect and as applicable.

Date issued: November 29, 2000
Date amended: August 8, 2014
(most recent)



Sajid A. Barlas, Ph.D., P.Ag.
for Director, *Environmental Management Act*
Southern Interior Region - Kootenay

2.8 **Buffer Zone**

No material must be landfilled within 50 metres of the property boundary.
Any new facilities or extension of the landfill will be subject to this revised buffer requirement.

3. **OPERATIONAL REQUIREMENTS**

3.1 **Waste Compaction and Coverage**

The Operational Certificate holder must ensure that waste deposition and compaction meets or exceeds the requirements of the BC Landfill Criteria or its most current version for daily, intermediate and final cover. Control must be exercised to ensure keeping freshly deposited refuse in a well defined and small / manageable working face.

3.2 **Prohibited Wastes**

The disposal of the following types of wastes is strictly prohibited:

- (a) Hazardous Wastes other than those specifically approved for disposal to authorized landfills in the Hazardous Waste Regulation under the Environmental Management Act.
- (b) Biomedical wastes as defined in the Guidelines for the Management of Biomedical Wastes in Canada (Canadian Council of Ministers of the Environment, February 1992),
- (c) Bulk liquids and semi-solid wastes, which contain free liquids, as determined by US EPA Method 90954 Paint Filter Liquids Test, Test Methods for Evaluating Solid Wastes-Physical/Chemical Methods (EPA Publication No. Sw-846),

Date issued: November 29, 2000
Date amended: August 8, 2014
(most recent)



Sajid A. Barlas, Ph.D., P.Ag.
for Director, *Environmental Management Act*
Southern Interior Region - Kootenay

- (d) Release of ozone depleting substances from the storage, handling and disposal of used appliances, equipment, or any material containing ozone depleting substances is prohibited in accordance with the requirements of the Ozone Depleting Substances Regulation. Onsite removal or evacuation of Ozone Depleting Substances (ODS) from appliances and the subsequent storage of appliances on site is permitted subject to both activities being in compliance with the Ozone Depleting Substances Regulation
- (e) Additional waste types may be deposited with the Director's approval.

3.3 Waste Asbestos

Waste asbestos is authorized for disposal subject to compliance with the requirements of section 40 of the Hazardous Waste Regulation and the following conditions:

- (a) The asbestos waste may not be mixed with any other hazardous waste.
- (b) The Regional District must approve the disposal before disposal takes place.
- (c) All other applicable requirements of the Hazardous Waste Regulation, including but limited to manifesting and waste record keeping, must also be complied with.

3.4 Contaminated Soil

Soil that contains contaminants in concentrations less than "hazardous waste" as defined by the Hazardous Waste Regulation may be disposed of at the landfill site. Disposal includes monofilling, co-disposal with other wastes, use as a refuse cell berm material and use as a refuse cell cover material. Disposal does not include use as final cover material.

3.5 Wildlife and Vector Control

Vectors (carriers capable of transmitting a pathogen from one organism to another

Date issued: November 29, 2000
Date amended: August 8, 2014
(most recent)



Sajid A. Barlas, Ph.D., P.Ag.
for Director, *Environmental Management Act*
Southern Interior Region - Kootenay

including, but not limited to flies and other insects, rodents, and birds) must be controlled by the application of cover material at the required frequency or by such additional methods as specified by the Director. Wildlife control fencing must be maintained around the perimeter of the landfill site and must be electrified for at least the active bear season of each year.

This landfill must be operated so as to minimize the attraction of wildlife such as bears and birds by applying cover at required frequencies and instituting a good housekeeping program.

3.6 Site Access and Supervision

A landfill operator that has received BC Qualified Landfill Operator training, is familiar with the requirements of the Operational Certificate and the specifications of the Design and Operations Plan, must be present at all times during operating hours.

Locking gates must be maintained at all access routes to the landfill site. Gates, perimeter fencing and/or barriers must be installed where necessary to prevent unauthorized access to the site by vehicles. Gates must be locked during non-operating hours.

3.7 Dust Control

Dust created within the landfill property must be controlled, using methods and materials acceptable to the Director, such that it does not cause a public nuisance.

3.8 Litter Control

The best practical means must be used to prevent the scatter of litter. Any litter scattered into the neighbouring property, along access roads, in drainage ditches, along litter-control fences, into surrounding trees or elsewhere on the landfill site must be cleaned up. The frequency of clean-up and other additional requirements for refuse scatter control must be determined by the Director.

3.9 Waste Reduction and Alternate Disposal

The Provincial Government has developed policies to promote the reduction,

Date issued: November 29, 2000
Date amended: August 8, 2014
(most recent)



Sajid A. Barlas, Ph.D., P.Ag.
for Director, *Environmental Management Act*
Southern Interior Region - Kootenay

reuse and recycling of wastes. The Operational Certificate holder is encouraged to segregate for recycling and reuse, where possible, materials destined for disposal at this site.

Public scavenging must not be permitted at the landfill. The controlled salvaging of waste by the landfill operator or persons authorized by the Operational Certificate holder is encouraged if areas or facilities for separation and storage of recyclable or reusable materials are provided.

In certain landfill environments, some construction and demolition debris or other wastes may create specific air and water quality concerns. If problems arise at this site that is attributable to specific wastes, the Director may require that alternate disposal/storage procedures be implemented

3.10 **Fire Prevention & Control**

The Operational Certificate holder must take all reasonable measures to prevent fires from occurring at the site and is responsible for complying with all local fire safety requirements. The Operational Certificate holder must provide and maintain firefighting equipment and materials as required for the site.

In the event of a landfill fire the following must be notified immediately:

- The Fire Department
- Provincial Emergency Program (PEP)
- The Regional Manager Environmental Protection

3.11 **Operations and Maintenance Manual**

The Operational Certificate holder must prepare an Operations and Maintenance Manual to be reviewed and updated annually.

3.12 **Sign Requirements**

A sign must be posted at each entrance gate with the following current information;

- a. Site name;
- b. Contact phone number and address for owner;
- c. Phone number in case of emergency;
- d. Hours and days of operation;
- e. Materials/waste accepted for landfill; and
- f. Tipping fees.

Date issued: November 29, 2000
Date amended: August 8, 2014
(most recent)



Sajid A. Barlas, Ph.D., P.Ag.
for Director, *Environmental Management Act*
Southern Interior Region - Kootenay

Additional signs which clearly indicate the directions to the active tipping face, public disposal area, recycling and waste separation areas, etc. should also be displayed within the landfill site as deemed necessary.

4. **MONITORING AND REPORTING REQUIREMENTS**

4.1 **Landfill Monitoring**

A monitoring program must be developed by a Qualified Professional and identify potential environmental impacts of the authorized facility and must address but not be limited to the Landfill Criteria for Municipal Solid Waste and Guidelines for Environmental Monitoring. The monitoring program must be submitted to the satisfaction of the Director. Monitoring must be conducted in accordance with the monitoring program.

The program must be designed to assess and identify:

- The design performance of the landfill as per the Design & Operations Plan including but not limited to compliance with water quality performance standards at the landfill boundary.
- Landfill leachate as a contaminant source.
- Residential well water quality.
- Surface water quality.

The Environmental Monitoring Program must take into consideration results from previous monitoring programs and any other investigations conducted at the site to ensure that early detection of potential impacts is possible.

4.2 **Sampling Techniques**

Sampling must be carried out in accordance with the procedures described in the most recent edition of the "British Columbia Field Sampling Manual for Continuous Monitoring Plus the Collection of Air, Air-Emission, Water, Wastewater, Soil, Sediment, and Biological Samples", or by suitable alternative procedures as authorized by the Director. A copy of the above manual may be purchased from the Queen's Printer Publications Centre, P.O. Box 9452, Stn. Prov. Gov't., Victoria, British Columbia, V8W 9V7.

4.3 **Analysis**

Analyses are to be carried out in accordance with procedures described in the

Date issued: November 29, 2000
Date amended: August 8, 2014
(most recent)



Sajid A. Barlas, Ph.D., P.Ag.
for Director, *Environmental Management Act*
Southern Interior Region - Kootenay

most recent edition of the "British Columbia Environmental Laboratory Manual for the Analysis of Water, Wastewater, Sediment and Biological Materials", or by suitable alternative procedures as authorized by the Director. A copy of the above manual may be purchased from the Queen's Printer Publication Centre, P.O. Box 9452, Stn. Prov. Govt., Victoria, British Columbia, V8W 9V7 (1-800-663-6105 or (250) 387-6409).

4.4 Quality Assurance

The Operational Certificate holder must produce, within 60 days on the request of the Regional Manager Environmental Protection, 'Field and Laboratory Quality Protocols and Quality Assurance Criteria' acceptable to the Director. The 'Laboratory Quality Protocols' must include the procedures used to assess precision, accuracy and blank quality, including frequency of application of those procedures, the procedures for sampling, handling (e.g. preservation, hold times) and corrective measures to be initiated when deficiencies are indicated. The 'Quality Assurance Criteria' must include the acceptance criteria for accuracy (based on recoveries for reference samples/spikes), for precision (based on deviation in field and lab duplicates) and method blanks (designed to indicate false positives).

5. LANDFILL REPORTING

5.1 Annual Report

The Operation Certificate holder must submit an Annual Report to the Director on or before April 30th each year for the previous calendar year. The report must contain at least the following information:

- (a) an executive summary;
- (b) the type and tonnage of waste received, recycled, stored on-site and discharged / landfilled for the year;
- (c) Any proposed changes to the Design and Operations Plan and the environmental monitoring program (EMP), with rationale for the changes; a description of unanticipated occurrences and any changes to the closure or post-closure plans and funds;
- (d) A review of the preceding year of operation or an operations update which summarizes landfill development work completed in the subject reporting

Date issued: November 29, 2000
Date amended: August 8, 2014
(most recent)



Sajid A. Barlas, Ph.D., P.Ag.
for Director, *Environmental Management Act*
Southern Interior Region - Kootenay

year and work planned for the subsequent year. A summary of any new information or changes to the facilities and plans, assessments, surveys, programs and reports;

- (e) Occurrences or observations of wildlife (medium and large carnivores) at the facility;
- (f) A statement regarding the facility's progress in reducing the regional solid waste stream being landfilled and the objectives of the Regional Solid Waste Management Plan;
- (g) An outline of the current Environmental Monitoring Program and a compendium of all environmental monitoring data in accordance with requirements specified in the most recent version of Guidelines for Environmental Monitoring at Municipal Solid Waste Landfills and Landfill Criteria for Municipal Solid Waste. The annual report must document any effect of the discharge on the quality of the receiving environment using appropriate statistical and graphical analysis. Trend analyses, as well as an evaluation of the impacts of the discharges on the receiving environment must be included;
- (h) A list of training programs completed for landfill operators during the previous year; and
- (i) Any additional information requested by the Director.

All reports must be submitted, suitably formatted and tabulated in both print and electronic format (portable document format).

5.2 Five Year Report

The Operation Certificate holder must submit a Five Year Report to the Director on or before April 30th on the five year anniversary of the last submission. The report must contain at least the following information:

- (a) An executive summary;
- (b) An updated Design and Operations Plan;
- (c) A detailed hydrogeological assessment;

Date issued: November 29, 2000
Date amended: August 8, 2014
(most recent)



Sajid A. Barlas, Ph.D., P.Ag.
for Director, *Environmental Management Act*
Southern Interior Region - Kootenay

- (d) The type and tonnage of waste received, recycled, stored on-site and discharged / landfilled for the year;
- (e) A current topographic map detailing airspace consumption, on-site borrow pit changes and future developments;
- (f) Volume and density analysis or an in-place material summary, updated estimates for the remaining capacity, site life, revised closure date (for the current phase or sequence and revised closure date for the current landfill footprint);
- (g) An outline of the current Environmental Monitoring Program and a compendium of all environmental monitoring data in accordance with requirements specified in the most recent version of Guidelines for Environmental Monitoring at Municipal Solid Waste Landfills and Landfill Criteria for Municipal Solid Waste. The annual report must document any effect of the discharge on the quality of the receiving environment using appropriate statistical and graphical analysis. Trend analyses, as well as an evaluation of the impacts of the discharges on the receiving environment must be included;
- (h) An update on the financial assurance mechanism including a statement of the current dollar value of the Closure Fund and the amount earmarked for the Landfill site; and
- (i) Any additional information requested by the Director.

6. **LANDFILL CLOSURE PLAN**

6.1 **Closure Plan and Post Closure**

The Operational Certificate holder must perform closure and post-closure care in accordance with all applicable requirements of the BC Landfill Criteria for Municipal Solid Waste. This Operational Certificate is issued on the condition that a Closure Plan and Final Cover Design that meets or exceeds the requirements of the criteria will be submitted to the Director during the operating life of the landfill. The Closure Plan must be reviewed every five years throughout the operating life of the landfill.

A certification by a Qualified Professional attesting that all closure works have

Date issued: November 29, 2000
Date amended: August 8, 2014
(most recent)



Sajid A. Barlas, Ph.D., P.Ag.
for Director, *Environmental Management Act*
Southern Interior Region - Kootenay

been completed in accordance with the Closure Plan and Final Cover Design is to be submitted to the Director no later than 60 days after the implementation of the Final Cover Design.

The Operational Certificate Holder must submit a Post Closure or Aftercare Plan to the Ministry at least one year prior to the anticipated closure date of the landfill.

6.2 Closure Fund

The Operational Certificate holder must provide for the funding of progressive closure operations, final closure and operations beyond closure by maintaining a closure fund. The value of the closure fund must meet or exceed the estimated closure and post-closure costs as established in the approved Design and Operations Plan and updated in the annual report, plus a reasonable contingency for any remediation which may be required. Reported costs must be adjusted for inflation annually. Alternately, a closure and post-closure financial security acceptable to the Director may be built over time.

The Operational Certificate holder must determine and ensure that the closure fund is adequate by preparing annually a financial statement of the fund which must be made available to the Director upon request. The financial statement must report the accrued capital, interest and additions to the fund for the previous year and review the sufficiency of the fund and the rate of accrual in consideration of the projected costs of closure and post-closure obligations.

6.3 Site Decommissioning

In accordance with Section 40 of the Environmental Management Act and Part 2 of the Contaminated Sites Regulation, the Operational Certificate holder must submit a site profile to the manager at least ten days prior to decommissioning the facilities authorized in Section 1.

Date issued: November 29, 2000
Date amended: August 8, 2014
(most recent)



Sajid A. Barlas, Ph.D., P.Ag.
for Director, *Environmental Management Act*
Southern Interior Region - Kootenay

6.4 Declaration of Landfill

Landfills sited on titled land must register a covenant that the property was used for the purpose of waste disposal as a charge against the title to the property as provided for under Section 215.1 of the Land Title Act. Landfills located on crown land are to have a “notation on file” registered that the property was used for the purpose of waste disposal.

The Operational Certificate holder must, upon closure of the landfill, register a charge against the property title, or provide other legal notification acceptable to the Director that the property described in Section 1 was used for the purpose of waste disposal. The Director must be notified of the charge or legal notification.

Date issued: November 29, 2000
Date amended: August 8, 2014
(most recent)



Sajid A. Barlas, Ph.D., P.Ag.
for Director, *Environmental Management Act*
Southern Interior Region - Kootenay

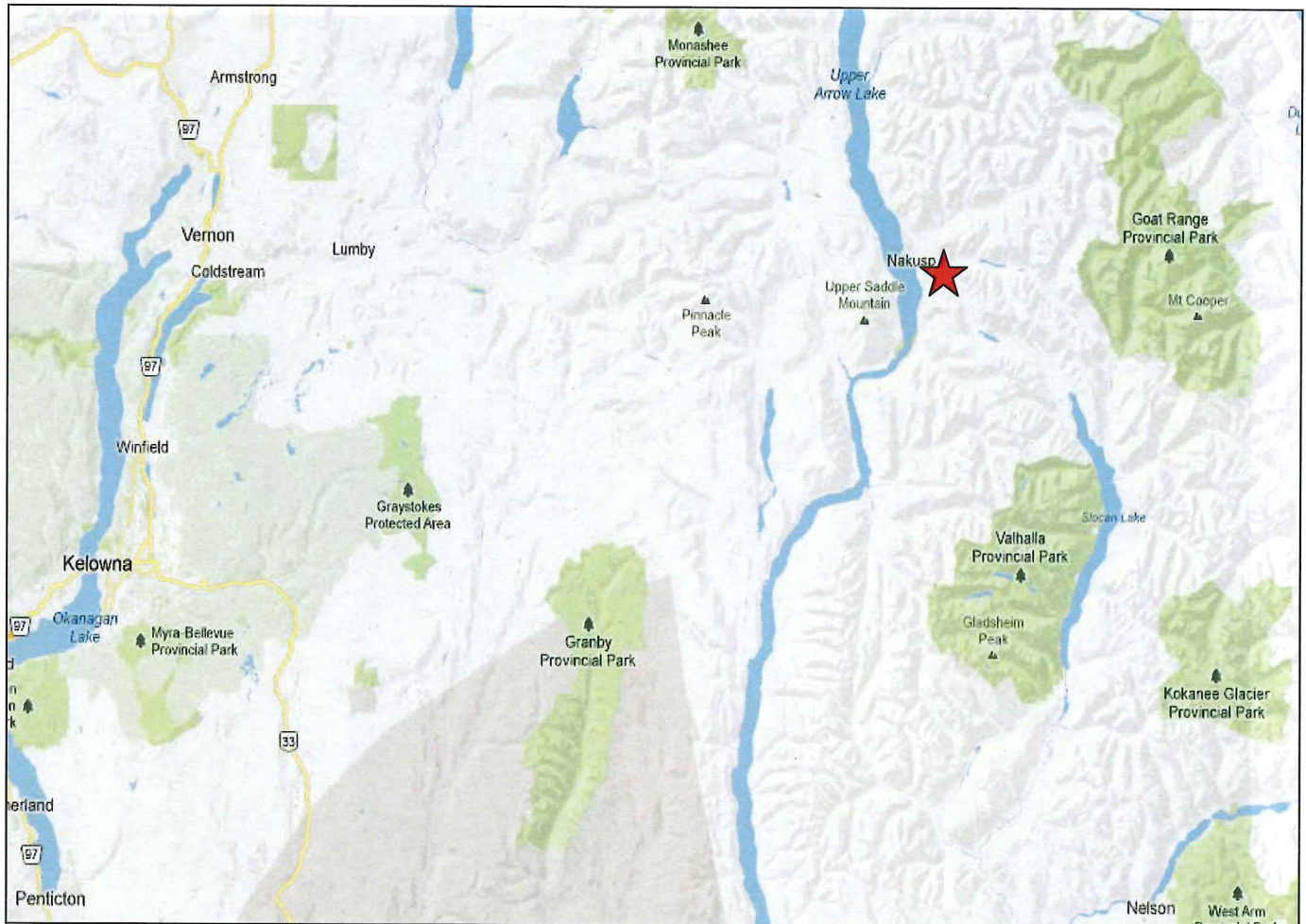
Site Plan A



Date issued: November 29, 2000
Date amended: August 8, 2014
(most recent)

Barlas
Sajid A. Barlas, Ph.D., P.Ag.
for Director, *Environmental Management Act*
Southern Interior Region - Kootenay

Location Map



Date issued:
Date amended:
(most recent)

November 29, 2000
August 8, 2014

Barlas

Sajid A. Barlas, Ph.D., P.Ag.
for Director, *Environmental Management Act*
Southern Interior Region - Kootenay

APPENDIX B: 2025 WASTE STREAM TONNAGE

WASTE STREAM TONNAGE

2025 Annual Operations and Monitoring Report Nakusp Landfill, Nakusp, BC

Waste Characterization	Units	2021	2022	2023	2024	2025
NON-RECYCLABLE WASTE						
Mixed Waste	tonnes	1,496.5	1,403.5	1,232.7	1,150.0	1457.9
Mixed Waste (transferred from Rosebery)	tonnes	493.2	138.0	-	-	-
Mixed Waste (transferred from Burton & Edgewood)	tonnes	109.5	110.1	149.2	131.9	165.9
Asbestos	tonnes	0.4	0.3	2.5	0.8	2.3
Bulky Waste	tonnes	0	0	1.6	4.3	2.1
Construction, Demolition, Renovation (CDR)	tonnes	63.2	11.6	26.1	131.1	123.5
Land-Clearing	tonnes	0	2.5	0.8	0.3	0.3
Noxious Weeds	tonnes	0.5	0.9	0	0.4	0.6
Rubble	tonnes	12.1	10.7	6.4	37.1	34.7
Total Waste Landfilled	tonnes	2,175.3	1,677.6	1,419.3	1,455.9	1,787.3
RECYCLING/RE-PURPOSED MATERIALS⁽¹⁾						
ODS Appliances (MARR program)	tonnes	30.2	22.7	24.2	9.0	12.9
Non-ODS Appliances (MARR program)	tonnes	-	-	-	5.3	16.0
Yard & Garden Waste	tonnes	109.3	132.5	220.4	187.6	194.1
Scrap Metal	tonnes	150.2	124.7	115.5	109.1	91.7
Soils (re-purposed as cover)	tonnes	271.3	0	16.2	432.2	617.8
Tires	tonnes	1.6	1.0	0.6	0.7	0.9
ICI Cardboard ⁽²⁾	tonnes	41.2	42.6	30.6	25.1	28.1
RecycleBC ⁽²⁾	tonnes	151.5	149.0	99.1	94.5	96.4
EPR Products and Non-EPR HHW	tonnes	-	-	-	23.7	15.8
Total Recycled/Re-purposed	tonnes	755.2	485.7	514.8	887.2	1,073.7
STOCKPILED MATERIALS						
Soils (stockpiled for closure)	tonnes	-	-	-	1,296.7	-
Wood	tonnes	193.3	127.2	195.7	166.8	33.9
Total Stockpiled	tonnes	193.3	127.2	195.7	1,463.5	33.9
TOTAL SOLID WASTE GENERATED	tonnes	3,123.9	2,290.5	2,129.8	3,806.6	2,894.9
SEPTAGE⁽³⁾	m³	647.3	444.4	282.0	501.1	1,113.0

Operational Statistics	Units	2021	2022	2023	2024	2025
Recycling/diversion rate ⁽⁴⁾	%	24	21	24	23	37
Total population served by landfill ⁽⁵⁾	persons	4,766	5,030	4,423	4,485	4,509
Average annual waste generated per person	kg/person/year	655	455	482	849	642
Average annual waste landfilled per person	kg/person/year	456	334	321	325	396

Notes:

Data was acquired from RDCK scale and ticket records for Nakusp landfill wasteshed, which includes Nakusp, Electoral Area K, 15% of Area H from 2023 forward (prior to that also included Silverton and New Denver).

⁽¹⁾ Not all materials collected go to the Nakusp landfill, but data from entire wasteshed is included for accurate calculation of waste generation and/or diversion rates.

⁽²⁾ RecycleBC and ICI cardboard collection programs started in mid-2020. Materials collected through these programs do not go to Nakusp landfill, but data is included for accurate calculation of waste generation and diversion rates

⁽³⁾ Assumed septage density is 1 tonne per cubic metre

⁽⁴⁾ 2020-2023 diversion rates have been updated from historical reports to reflect the change in material management for wood waste (stockpiled, not recycled or re-purposed).

⁽⁵⁾ 2021 population based on 2021 StatsCan census data, 2022-2025 population based on BC Stats

APPENDIX C: AIRSPACE AND LIFE EXPECTANCY (FILL-TO-CLOSURE PLAN)

PDF GENERATED by: Angus Tsang \ 12/5/2024 9:21 AM
X:\PRJ\PRJ24\PRJ24072 - NAKUSP LANDFILL FILL TO CLOSURE AND CLOSURE PLANNING\06_AUTOCAD DRAWINGS\01_PRODUCTION DRAWINGS\LIFT PLAN\FIG 1 - NOV.EG.DWG



Landfill Services Group
• Landfill Siting
• Design & Operations Plans
• Landfill Closure
• Environmental Monitoring
#8 - 1225 Keith Road East
North Vancouver, B.C. V7J 1J3
Phone: (604) 966-7723

LEGEND:

- (1m) EG MIN. CONT. - 2024 NOV 5
- (5m) EG. MAJ. CONT. - 2024 NOV 5
- (1m) DES. CLOSURE MIN. CONT.
- (5m) DES. CLOSURE MAJ. CONT.
- EXISTING ROAD
- PROPOSED ROAD
- PROPERTY LINE
- EXISTING FENCE

CLIENT:



PROJECT:

NAKUSP LANDFILL FILL TO CLOSURE AND
CLOSURE PLANNING

TITLE:

EXISTING TOPOGRAPHY
2024-11-05

SCALE: 1:750	DATE: 2024/12/03 yyyy/mm/dd	PROJECT NO: PRJ 24072
DESIGNED SG	SG	DRAWING NO: FIGURE 1
DRAWN AT	AT	
CHECKED SG	SG	

PDF GENERATED by: Angus Tsang \ 12/5/2024 9:21 AM
X:\PRJ\PRJ24\PRJ24072 - NAKUSP LANDFILL FILL TO CLOSURE AND CLOSURE PLANNING\06_AUTOCAD DRAWINGS\01_PRODUCTION DRAWINGS\LIFT PLAN\FIG 2 - FILLING AFTER NOV EG.DWG



Landfill Services Group
• Landfill Siting
• Design & Operations Plans
• Landfill Closure
• Environmental Monitoring
#8 - 1225 Keith Road East
North Vancouver, B.C. V7J 1J3
Phone: (604) 986-7723

- LEGEND:
- (1m) EG MIN. CONT. - 2024 NOV 5
 - (5m) EG. MAJ. CONT. - 2024 NOV 5
 - (1m) ESTIMATED EG MIN. CONT.
 - (5m) ESTIMATED EG. MAJ. CONT.
 - (1m) DES. CLOSURE MIN. CONT.
 - (5m) DES. CLOSURE MAJ. CONT.
 - EXISTING ROAD
 - PROPOSED ROAD
 - PROPERTY LINE
 - EXISTING FENCE
 - ESTIMATED TOPOGRAPHY AREA

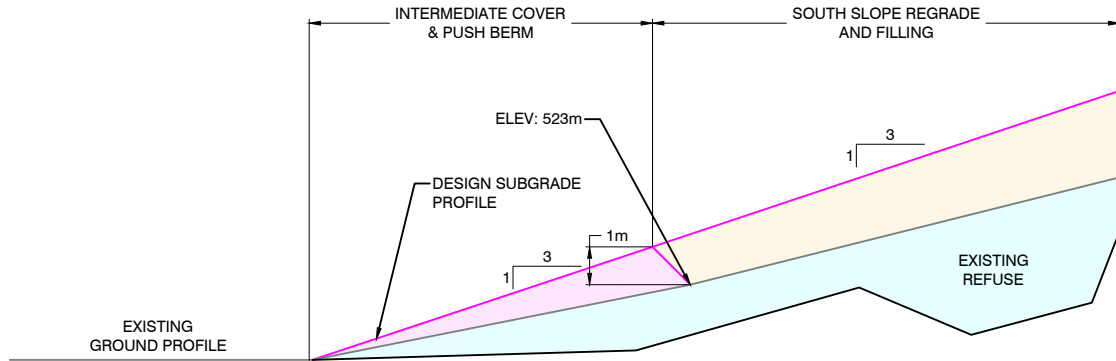
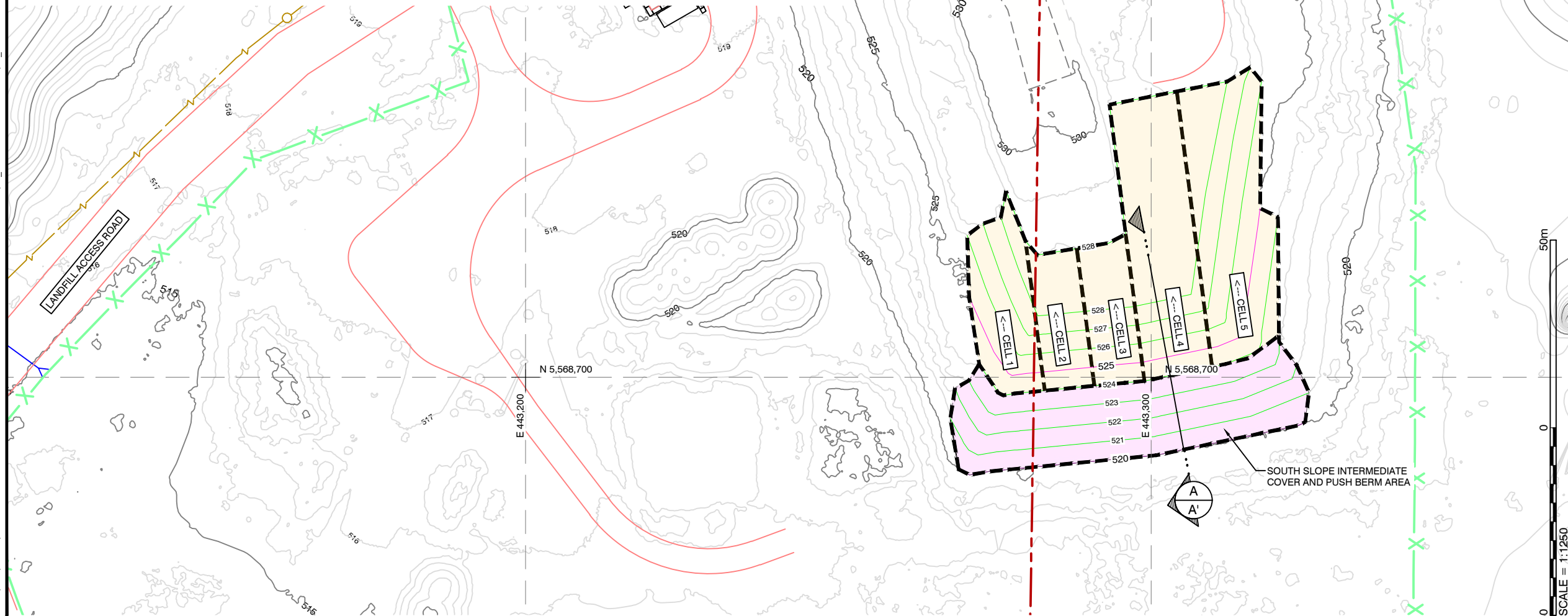


PROJECT:
NAKUSP LANDFILL FILL TO CLOSURE AND
CLOSURE PLANNING

TITLE:
ESTIMATED TOPOGRAPHY
SINCE 2024-11-05 SURVEY

SCALE: 1:750	DATE: 2024/12/03 yyyy/mm/dd	PROJECT NO: PRJ 24072
DESIGNED SG	DRAWING NO: FIGURE 2	
DRAWN AT		
CHECKED SG		

PDF GENERATED by: Angus Tsang \ 12/5/2024 9:21 AM
X:\PRJ\PRJ24\PRJ24072 - NAKUSP LANDFILL FILL TO CLOSURE AND CLOSURE PLANNING\06_AUTOCAD DRAWINGS\01_DRAWINGS\PRODUCTION DRAWINGS\LIFT PLAN\FIG 3 - SOUTH SOPE REGRADE.DWG



SECTION A-A'
SCALE NTS



SPERLING
HANSEN
ASSOCIATES

Landfill Services Group

- Landfill Siting
- Design & Operations Plans
- Landfill Closure
- Environmental Monitoring

#8 - 1225 Keith Road East
North Vancouver, B.C. V7J 1J3
Phone: (604) 986-7723

LEGEND:

- (1m) EG MIN. CONT. - 2024 NOV 5
- (5m) EG. MAJ. CONT. - 2024 NOV 5
- (1m) ESTIMATED EG MIN. CONT.
- (5m) ESTIMATED EG. MAJ. CONT.
- (1m) DES. CLOSURE MIN. CONT.
- (5m) DES. CLOSURE MAJ. CONT.
- EXISTING ROAD
- PROPOSED ROAD
- PROPERTY LINE
- EXISTING FENCE

CAPACITY: 1600 m³

CLIENT:



PROJECT:

NAKUSP LANDFILL FILL TO CLOSURE AND
CLOSURE PLANNING

TITLE:

**SOUTH SLOPE REGRADE
AND FILLING DESIGN SUBGRADE
(CELL 1 - 5)**

SCALE:

1:750

DATE:

2024/12/03
yyyy/mm/dd

PROJECT NO:

PRJ 24072

DESIGNED

SG

DRAWING NO:

DRAWN

AT

FIGURE 3

CHECKED

SG



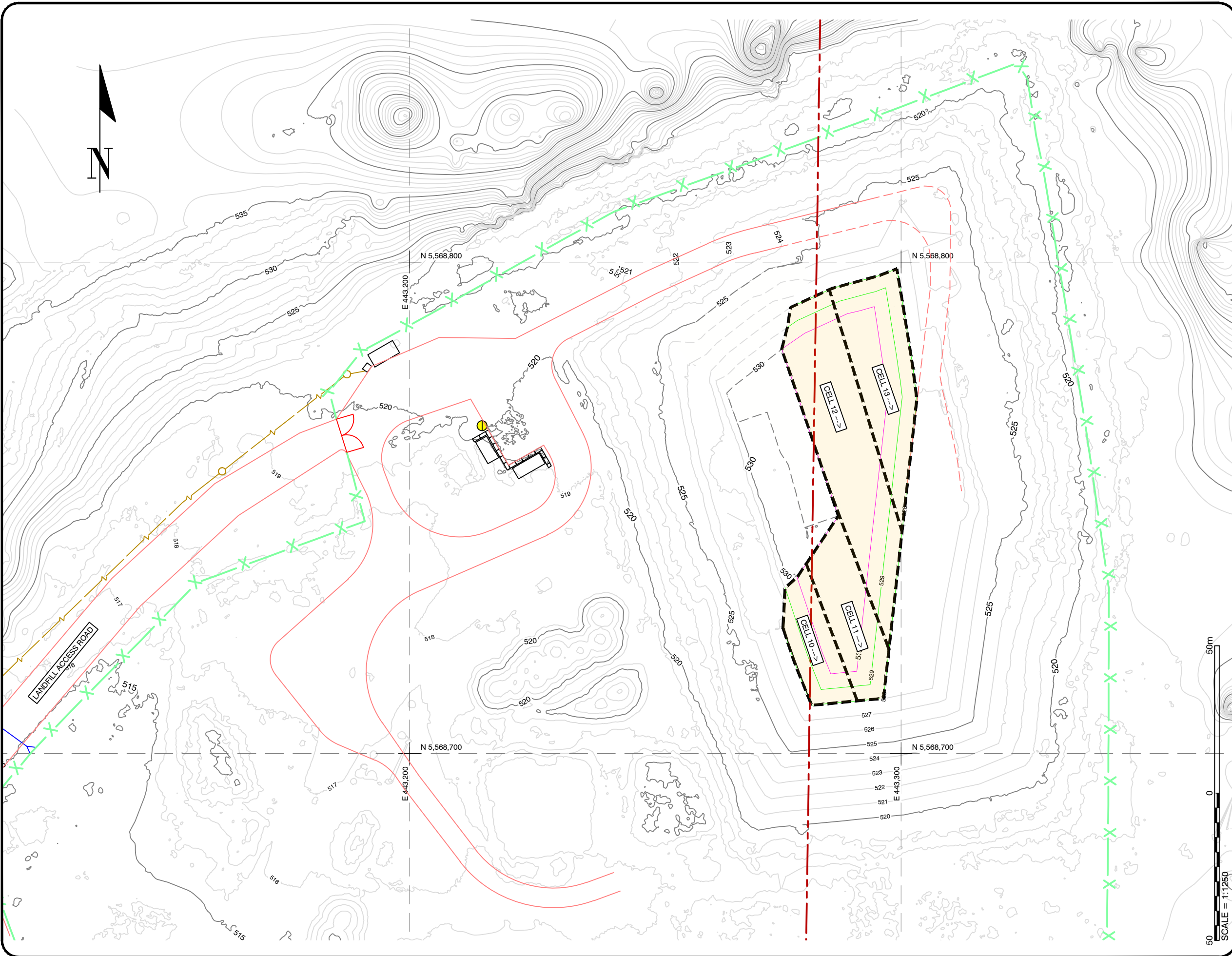
	(1m) EG + SOUTH SLOPE FILL MIN. CONT.
	(5m) EG + SOUTH SLOPE FILL MAJ. CONT.
	(1m) ESTIMATED EG MIN. CONT.
	(5m) ESTIMATED EG. MAJ. CONT.
	(1m) DES. CLOSURE MIN. CONT.
	(5m) DES. CLOSURE MAJ. CONT.
	EXISTING ROAD
	OPERATIONAL ROAD
	PROPOSED ROAD
	PROPERTY LINE
	EXISTING FENCE

CAPACITY: 500 m³

NAKUSP LANDFILL FILL TO CLOSURE AND CLOSURE PLANNING

CREST REGRADE
AND FILLING DESIGN SUBGRADE
(CELL 6 - 9)

SCALE: 1:750	DATE: 2024/12/03 yyyy/mm/dd	PROJECT NO: PRJ 24072
DESIGNED	SG	DRAWING NO: FIGURE 4
DRAWN	AT	
CHECKED	SG	



SPERLING
HANSEN
ASSOCIATES

Landfill Services Group

- Landfill Siting
- Design & Operations Plans
- Landfill Closure
- Environmental Monitoring

#8 - 1225 Keith Road East
North Vancouver, B.C. V7J 1J3
Phone: (604) 986-7723

LEGEND:

- LEGEND.
- | | |
|---|--|
| (1m) EG + SOUTH SLOPE FILL + CREST FILL (528m) MIN. CONT. | |
| (5m) EG + SOUTH SLOPE FILL + CREST FILL (528m) MAJ. CONT. | |
| (1m) ESTIMATED EG MIN. CONT. | |
| (5m) ESTIMATED EG. MAJ. CONT. | |
| (1m) DES. CLOSURE MIN. CONT. | |
| (5m) DES. CLOSURE MAJ. CONT. | |
| EXISTING ROAD | |
| OPERATIONAL ROAD | |
| PROPOSED ROAD | |
| PROPERTY LINE | |
| EXISTING FENCE | |

CAPACITY: 1,990 m³

CLIENT:



PROJECT:

NAKUSP LANDFILL FILL TO CLOSURE AND CLOSURE PLANNING

TITLE:

CREST REGRADE
AND FILLING DESIGN SUBGRADE
(CELL 11 - 14)

SCALE:

1:750

DATE:

2024/12/03

PROJECT NO:

PRJ 24072

DESIGNED

DRAWN

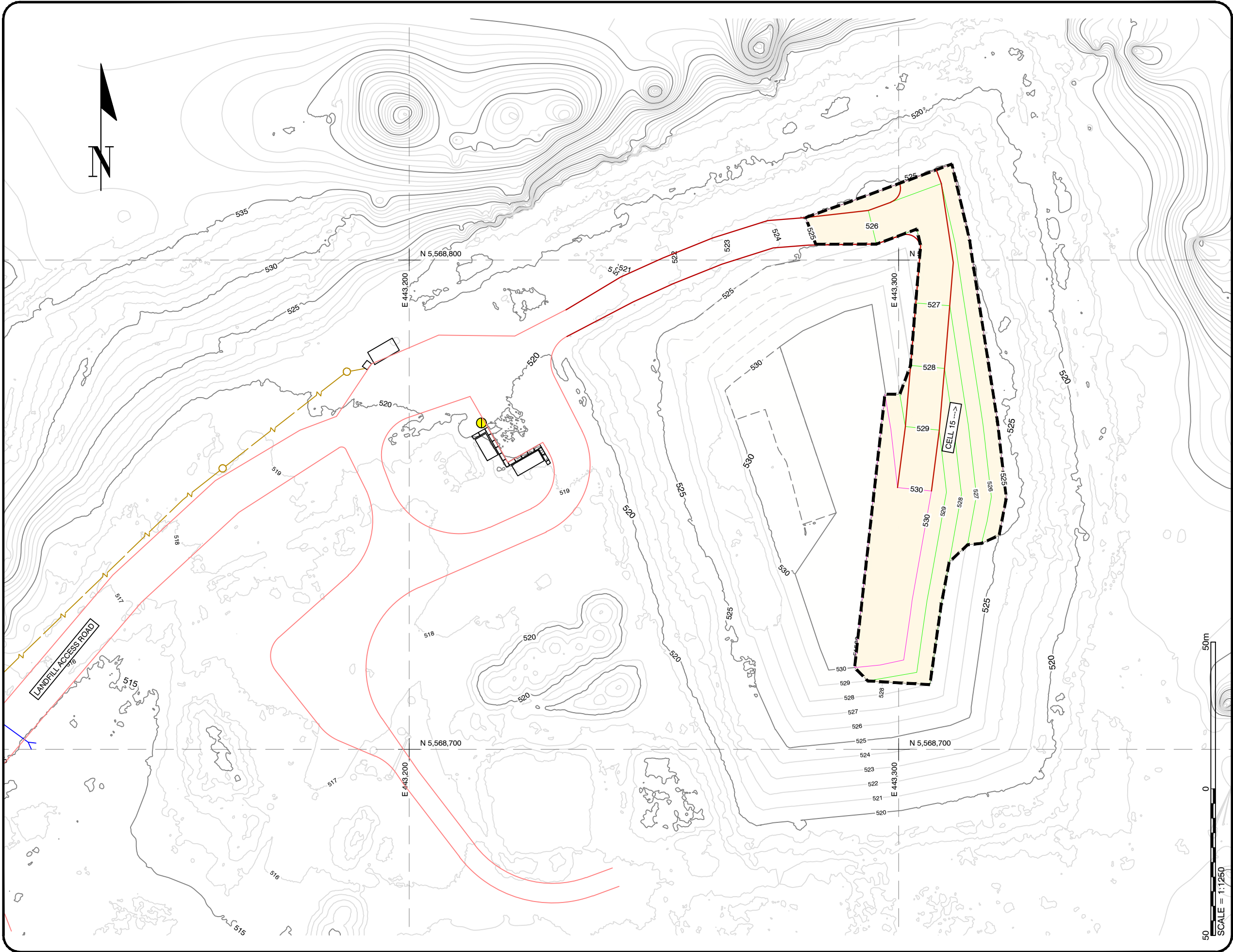
SG

AT

DRAWING NO:

FIGURE 5

PDF GENERATED by: Angus Tsang \ 12/5/2024 9:21 AM
X:\PRJ\PRJ24\PRJ24072 - NAKUSP LANDFILL FILL TO CLOSURE AND CLOSURE PLANNING\06_AUTOCAD DRAWINGS\01_PRODUCTION DRAWINGS\LIFT PLAN\FIG 6 - ROAD FILL DWG



Landfill Services Group
• Landfill Siting
• Design & Operations Plans
• Landfill Closure
• Environmental Monitoring
#8 - 1225 Keith Road East
North Vancouver, B.C. V7J 1J3
Phone: (604) 986-7723

LEGEND:

- (1m) EG + SOUTH SLOPE FILL + CREST FILL (530m) MIN. CONT.
- (5m) EG + SOUTH SLOPE FILL + CREST FILL (530m) MAJ. CONT.
- (1m) ESTIMATED EG MIN. CONT.
- (5m) ESTIMATED EG. MAJ. CONT.
- (1m) DES. CLOSURE MIN. CONT.
- (5m) DES. CLOSURE MAJ. CONT.
- EXISTING ROAD
- PROPOSED ROAD
- PROPERTY LINE
- EXISTING FENCE

CAPACITY: 1,390 m³

CLIENT:



PROJECT:

NAKUSP LANDFILL FILL TO CLOSURE AND CLOSURE PLANNING

TITLE:

ROAD REGRADE
AND FILLING DESIGN SUBGRADE
(CELL 15)

SCALE:

1:750

DATE:

2024/12/03
yyyy/mm/dd

PROJECT NO:

PRJ 24072

DESIGNED

SG

DRAWING NO:

DRAWN

AT

CHECKED

SG

FIGURE 6

APPENDIX D: NAKUSP LANDFILL CLOSURE PLAN

Nakusp Landfill Closure Plan



PREPARED FOR: REGIONAL DISTRICT OF CENTRAL KOOTENAY

PREPARED BY: SPERLING HANSEN ASSOCIATES

PRJ24072



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

CONFIDENTIALITY AND © COPYRIGHT

This document is for the sole use of the addressee and Sperling Hansen Associates Inc. The document contains proprietary and confidential information that shall not be reproduced in any manner or disclosed to or discussed with any other parties without the express written permission of Sperling Hansen Associates Inc. Information in the document is to be considered the intellectual property of Sperling Hansen Associates Inc. in accordance with Canadian copyright law.

This report was prepared by Sperling Hansen Associates Inc. for the account of District of Squamish. The material in it reflects the best judgment of Sperling Hansen Associates Inc. in the light of the information available to it, at the time of preparation. Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. Sperling Hansen Associates Inc. accepts no responsibility for damages, if any, suffered by third party as a result of decisions made or actions based on this report.



SPERLING HANSEN ASSOCIATES

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

August 6th, 2025

PRJ24072

Mr. Nathan Schilman
Environmental Technologist
Regional District of Central Kootenay
590 Lakeside Drive
Nelson, BC

Dear Mr. Schilman,

Re: Nakusp Landfill Closure Plan

Sperling Hansen Associates (SHA) is pleased to submit the final report for the *Nakusp Landfill Closure Plan*. As outlined in our proposal we have provided analysis and reporting on the Site Characterization, Regulatory Requirements, Grading Plan, Stormwater Management, Leachate Management, Landfill Gas Management, Landfill Closure Design, Environmental Monitoring, Cost Analysis, and Contaminating Lifespan.

We trust that the report will prove of value to the Regional District of Central Kootenay. We look forward to receiving comments and questions based on your review. At any time throughout your review, please do not hesitate to reach out for clarification.

Yours truly,

SPERLING HANSEN ASSOCIATES

Scott Garthwaite, ASCT
Director



EXECUTIVE SUMMARY

Introduction (Chapter 1): The Nakusp Landfill Closure Plan, prepared by Sperling Hansen Associates (SHA) for the Regional District of Central Kootenay (RDCK), outlines the strategy for closing and managing the Nakusp Landfill. The plan includes a review of current site conditions, regulatory requirements, environmental controls, and cost analysis for both closure and post-closure phases.

Objectives: The primary objective is to develop a Closure Plan that meets the Ministry of Environment and Climate Change Strategy's requirements and the BC Landfill Criteria for Municipal Solid Waste.

Site Characterization (Chapter 2): The landfill is located 3 kilometers north of Nakusp, BC, on Crown land. It covers approximately 11.6 hectares and has a varied climate with long, warm summers and cool, wet winters. The site geology consists of sedimentary rocks and glaciofluvial deposits, with groundwater generally flowing towards Upper Arrow Lake and Kuskanax Creek.

Regulatory Constraints & Design Objectives (Chapter 3): The plan adheres to several regulatory documents, including the BC Landfill Criteria for Municipal Solid Waste and the Contaminated Sites Regulation. Key design objectives include minimizing leachate production, managing landfill gas, and ensuring long-term environmental protection.

Grading Plan (Chapter 4): The final grading plan aims to develop the landfill in a way that protects human health and the environment. This includes placing a final cover layer to prevent waste exposure, control infiltration, and minimize erosion.

Environmental Control Systems (Chapter 5): Environmental control systems include surface water management, leachate management, and landfill gas management. The plan proposes a stormwater detention pond and a passive gas collection system to manage these aspects effectively.

Landfill Closure Design (Chapter 6): The recommended final cover design is a geomembrane cover system, which is most effective in minimizing long-term leachate production. The design includes a 150 mm topsoil layer, a 450 mm subsoil layer, and a 40 mil LLDPE geomembrane barrier. A compacted soil cap may also be used as an alternative barrier layer if the RDCK is able to secure a low permeability soil source with a hydraulic conductivity of 1×10^{-7} cm/s.



Environmental Monitoring Plan (Chapter 7): Post-closure monitoring will include groundwater, surface water, and landfill gas monitoring. The plan outlines a comprehensive Environmental Monitoring Plan (EMP) to ensure ongoing environmental protection.

Cost Analysis (Chapter 8): The estimated closure cost is approximately \$1,454,976, including engineering and contingency costs. Post-closure costs are estimated at \$40,000 per year, covering maintenance, monitoring, and reporting.

This executive summary provides an overview of the key elements of the Nakusp Landfill Closure Plan, ensuring that the closure and post-closure phases are managed effectively to protect the environment and public health.



TABLE OF CONTENTS

1. INTRODUCTION

1.1 Background	1-1
1.2 Objective	1-1
1.3 Project Scope	1-1

2. SITE CHARACTERIZATION

2.1 Location	2-1
2.2 Site History	2-1
2.3 Climate	2-3
2.4 Geology	2-4
2.5 Hydrogeology.....	2-4
2.6 Groundwater Quality	2-5
2.7 LFG Monitoring	2-7

3. REGULATORY CONSTRAINTS AND DESIGN OBJECTIVES

3.1 Regulatory Requirements	3-1
-----------------------------------	-----

4. GRADING PLAN

4.1 Intended End Use Plan.....	4-1
4.2 Grading Plan for Intended End Use	4-1

5. ENVIRONMENTAL CONTROL SYSTEMS

5.1 Surface Water Management Plan	5-1
5.2 Leachate Management Plan	5-3
5.3 Landfill Gas Management Plan	5-5



6. FINAL CLOSURE DESIGN

6.1	Design Objectives	6-2
6.2	HELP Modelling and Final Cover Design	6-3
6.3	Topsoil and Vegetation	6-5
6.4	Erosion Control	6-7

7. ENVIRONMENTAL MONITORING PLAN

7.1	Post Closure Monitoring.....	7-1
7.2	Post Closure Period	7-9

8. COST ANALYSIS

8.1	Introduction	8-1
8.2	Closure Cost Estimates for the Nakusp Landfill	8-1
8.3	Post Closure Costs	8-2

9. LIMITATIONS

10. REFERENCES

LIST OF FIGURES

Figure 2-1	Site Plan and Existing Topography (Novembre 5, 2024)
Figure 2-2	Nakusp Landfill Location Map
Figure 4-1	Final Design Contours
Figure 4-2	Cut-Fill Final Design Contours vs. Existing Topography
Figure 5-1	Surface Water Management Plan
Figure 5-2	Landfill Gas Management Plan
Figure 5-3	Landfill Gas Details
Figure 5-4	Surface Water Management Details
Figure 6-1	Recommended Cover System Option 2
Figure 7-1	Post-Closure Monitoring Locations



LIST OF TABLES

Table 2-1	Climate Data for the Nakusp Climate Station
Table 2-2	Groundwater Level Monitoring Data (March 2016 and September 2023)
Table 5-1	Leachate Generation Estimate Summary
Table 6-1	HELP Model Profiles
Table 6-2	HELP Model Results
Table 6-3	An example of a seed mix applied at the Skway Landfill in Chilliwack, BC
Table 7-1	Recommended Post-Closure Groundwater Monitoring Program
Table 7-2	Recommended Post-Closure Surface Water Monitoring Program
Table 7-3	Data Acceptance Criteria
Table 8-2	Estimate of Closure Costs
Table 8-3	Summary of Closure Costs
Table 8-4	Estimated Annual Post Closure Costs

APPENDICES

Appendix A	Operational Certificate
Appendix B	Contaminating Lifespan Assessment



1. INTRODUCTION

Sperling Hansen Associates (SHA) was engaged by the Regional District of Central Kootenay (RDCK) to develop a comprehensive Closure Plan for the Nakusp Landfill (Landfill). The Closure Plan includes a review of the current site conditions, along with SHA's strategy for landfill closure and post-closure management. Additionally, the plan provides a cost analysis to estimate both closure and post-closure expenses.

1.1 Background

Landfill operations at the site began in 1977 under Permit No. PR 4308, issued to the RDCK as a natural attenuation landfill. This permit was later replaced by Operational Certificate MR-16521, issued on November 29, 2000, and amended on August 8, 2014 under the Environmental Management Act. The site continues to function under this certificate as a natural attenuation landfill and is expected to reach filling capacity in 2025. A copy of the operational certificate is included in Appendix A.

The Landfill accepts municipal solid waste, asbestos, asphalt, concrete, construction and demolition (C&D) waste, land clearing debris, noxious weeds, rubble, soil and animal carcasses. Refuse was historically managed across the 7.2 ha area. The most current disposal rate is approximately 3,500 m³/year and is typically covered with local pit run material.

1.2 Objective

The key objective of this report is to prepare a Closure Plan to address the Ministry of Environment and Climate Change Strategy's (ENV) requirements for the Nakusp Landfill as per OC MR-16521 and the BC Landfill Criteria for Municipal Solid Waste, Second Edition (the "Criteria").

1.3 Project Scope

In order to incorporate the aforementioned information into the Closure Plan, the Closure Plan is organized into the following chapters.

- Chapter 1: Introduction
- Chapter 2: Site Characterization
- Chapter 3: Regulatory Constraints and Design Objectives
- Chapter 4: Grading Plan
- Chapter 5: Environmental Controls
- Chapter 6: Final Closure Design
- Chapter 7: Environmental Monitoring Plan
- Chapter 8: Cost Analysis
- Chapter 9: Limitations
- Chapter 10: References

2. SITE CHARACTERIZATION

2.1 Location

The Nakusp landfill, operated by the RDCK, is located approximately 3 kilometers north of the Village of Nakusp, British Columbia. The site, shown in Figure 2-1, is situated on Crown land leased to the RDCK and covers approximately 11.6 hectares. The property to the south is owned by the RDCK, while the properties to the north, east, and west are Crown provincial land. The landfill is accessed via Hot Springs Road and is located about 1.2 kilometers northeast of the Nakusp Airport and 700 meters northwest of Kuskanax Creek. The legal description of the location is an unsurveyed part of District Lot 863, Kootenay District.

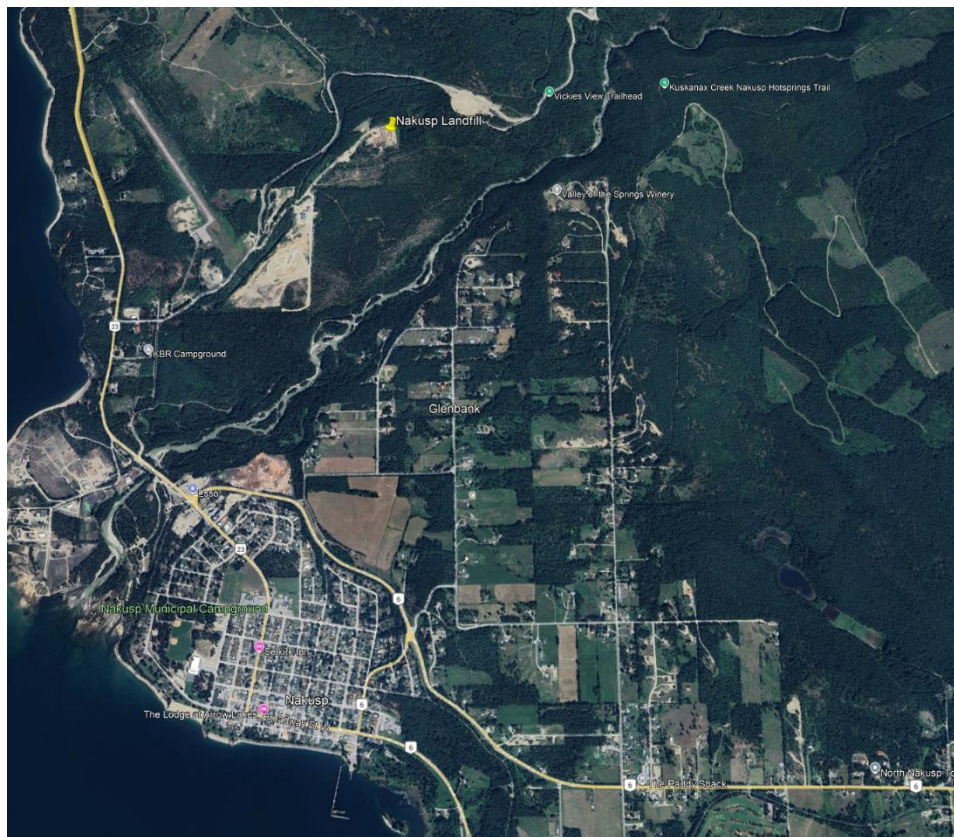


Figure 2-1: Nakusp Landfill Location Map

2.2 Site History

The RDCK began landfill operations in 1977 under Permit No. 4308, which was later replaced by Operational Certificate MR-16521. Several 'refuse pockets' exist at the site, created when waste was disposed of in pits or trenches during historical operations. In 2006, two septage drying beds and a soil bioremediation facility were constructed.

Before October 2016, the landfill attendant estimated waste quantities received by volume. In October 2016, a weigh scale was installed, and waste has since been tracked by weight. According to RDCK data, 1,677 tonnes of waste were landfilled in 2022, equating to approximately 2,875 m³/year. The estimated cumulative waste tonnage at the end of 2023 was 65,000 tonnes (RDCK 2024). The calculated waste density is approximately 0.58 tonnes/m³ (580 kg/m³) with a 2.4:1 waste-to-soil cover ratio (Wood, 2022). As per the Operational Certificate, the maximum quantity of waste discharged must not exceed the landfill's design capacity, as specified in the approved Design and Operations Plan (CRA 2008). The 2008 Design and Operations Plan notes a volume capacity of 174,900 m³ with a final waste elevation of 532 meters above mean sea level (AMSL). Currently, the site is used for landfilling and has approximately 5,500 m³ of air space remaining according to SHA's 2025 Fill to Closure Plan.

In the summer of 2024, a new waste transfer station was constructed to accept local waste for transfer to the RDCK Ootischenia Landfill once the Nakusp landfill reaches capacity. The transfer station is located south of the landfill waste footprint and is constructed on native material. Additionally, the recycling area was expanded to accommodate more bins and improve traffic flow. An operations road was also constructed, connecting the transfer station to the landfill area, allowing residents to access the wood, metal, white goods, and tire storage areas. These diversion materials are managed within the landfill permit area but are not included in closure planning. The new transfer station is shown in Photo 2-1 below.



Photo 2-1: 2024 Nakusp Transfer Station Construction



2.3 Climate

The Landfill is situated at an elevation of approximately 520 m AMSL. The regional climate is characterized by long, warm summers and cool, wet winters, influenced by predominantly easterly flowing air masses. This results in a varied climate throughout the region. The surrounding mountain ranges cause moist Pacific air masses to rise, leading to increased precipitation on the western slopes and drier conditions in the rain shadow of the mountains.

Environment Canada climate data normals (1971 – 2000) from the Nakusp Climate Station (ID: 1145300) were used to describe the local climate. The Nakusp Climate Station, which is presently inactive, is located approximately 0.5 km west of the site at an elevation of 457 m AMSL. The Nakusp CS Climate Station (ID: 1145297) is located approximately 2 kilometers south of the site at an elevation of 512.1 meters AMSL and is presently the closest active climate station to the site; however, there is not sufficient precipitation data for January or December to rely on this climate station.

The mean annual temperature recorded at the Nakusp Climate Station is approximately 7.4°C. During the summer months (June, July, and August), the mean temperature is 17.3°C, while in the winter months (January, February, and December), the mean temperature drops to -2.1°C. The Nakusp area is one of the drier valleys in the region, with a local mean annual precipitation of approximately 842.1 mm, compared to 1,000 to 1,100 mm in the major valleys of the region. About a quarter of the precipitation occurs as snowfall, primarily from November to March, with peak rainfall observed in June. Climate data for the Nakusp area is presented in Table 2-1 below.

Table 2-1: Climate Data for the Nakusp Climate Station

	Average (1970-2000 - ID 1145300)		Extreme (1970- 2000 - ID 1145300)	
Month	Temp (°C)	Precipitation (mm)	Temp (°C)	Precipitation (mm)
Jan	-3	101.2	-5.9	177.3
Feb	-1.1	74.7	-4.4	74.9
Mar	2.5	52.3	-3.2	71.1
Apr	7.2	51.1	1	50.3
May	12.1	61.9	5.7	66.5
Jun	15.8	77.5	9.3	124.2
Jul	18.3	59.3	10.9	28.4
Aug	17.9	58.3	12.1	42.4
Sep	12.4	56.5	6.6	71.9
Oct	6.8	56.8	3.2	101.9
Nov	1.7	88.6	-0.4	83.8
Dec	-2.1	103.9	-7.4	209.6
	7.38	842.1	2.29	1102.3



2.4 Geology

The Nakusp Landfill is situated on sedimentary rocks of the Slocan Group, which include phyllites, limestones, slates, and argillites. These rocks have been intruded by the Kaskanax Batholith, composed of monzonites and basaltic volcanic rocks. Bedrock has not been encountered in boreholes drilled on-site to depths of up to 39 meters below ground surface (mbgs).

The regional surficial geology consists of glaciofluvial deposits from the last ice age and modern alluvial deposits. Glaciofluvial deposits are characterized by sandy loam, loamy till, and glaciofluvial sands and gravels. Alluvial deposits, identified by their rounded particles, are found southeast of the steep embankment on the property.

The landfill's stratigraphy includes layers of sand, gravel, and silt overlying bedrock of unknown depth. Test pits and monitoring wells have revealed materials such as sand, gravelly sand, boulders, cobbles, and minor silt layers. Historical refuse pits filled with sawdust and native material were also encountered.

2.5 Hydrogeology

Groundwater at the landfill generally flows in a southwesterly direction towards Upper Arrow Lake and Kuskanax Creek. The groundwater table is typically encountered at depths of 31 to 39 meters below ground surface. Water levels in monitoring wells show seasonal variations, with higher levels in wet seasons and lower levels in dry periods.

Hydraulic conductivity tests indicate that the landfill's aquifer is composed of sand and gravel, with high hydraulic conductivity values ranging from 3×10^{-4} to 9×10^{-4} m/s with an overall geometric mean of 5×10^{-4} m/s.

The average groundwater flow velocity is calculated to be approximately 3 m/day, or 1,100 m/year for the site.

The landfill is situated on a plateau, with surface water mainly flowing towards Kuskanax Creek. The topographic contours indicate that surface water flow north and northeast of the landfill is diverted towards Upper Arrow Lake.

The Chambord Spring is located hydraulically upgradient of the landfill within 1 km.

2.5.1 Environmental Monitoring and Analysis

Environmental monitoring at the site is managed under an Environmental Monitoring Plan (EMP), which was updated in 2017 by Amec Foster Wheeler. The monitoring network includes six groundwater monitoring wells, all of which are screened within a deep, unconfined sand aquifer beneath the site.



The EMP mandates biannual monitoring of the wells, which includes water level monitoring, headspace gas monitoring, and water quality sampling. Each biannual event involves measuring specific field parameters and conducting laboratory analyses for general chemistry, nutrients, and metals. Additionally, volatile organic compounds (VOCs) are analyzed every second sampling event at select wells.

Currently, Masse Environmental Consultants Ltd. conducts the monitoring on behalf of the RDCK, with laboratory analyses performed by ALS Canada Ltd. Chloride, sodium, and lithium are selected as leachate impact indicators based on historical sampling results. MW4-06 is the source characterization well, and shows high concentrations of leachate indicators, with a general trend towards increasing leachate potency. This is due to its close proximity to the landfill footprint and historic septage area.

Table 2-2: Groundwater Level Monitoring Data (March 2016 and September, 2023)

Well #	Ground Elevation	Well Depth	March 2016 Groundwater Depth	September 2023 Groundwater Depth
	(masl)	(mbgs)	(mbgs)	(m)
MW1-95	515.16	35.37	32.03	32.91
MW2-95	517.31	35.37	33.15	34.32
MW3-95	519.39	35.59	35.03	36.16
MW4-06	519.50	35.98	35.32	36.45
MW5-06	520.50	38.72	36.12	37.53
MW17-17	504.36	32.00	No Data	30.90

2.5.2 Background Water Quality

Upgradient monitoring well MW5-06 represents background water quality, showing relatively low concentrations of leachate indicators. MW2-95 and MW3-95 were initially considered background wells but are found to be impacted by the landfill. Downgradient Monitoring Wells MW1-95, MW2-95, MW17-7, show improvement in water quality due to natural attenuation, but some concerns remain with elevated barium and lithium levels.

2.6 Groundwater Quality

The landfill must operate such that water quality does not decrease beyond the BC Water Quality Guidelines (BC WQG) at or beyond the landfill property boundary. Evaluating the site water quality under the BC Contaminated Site Regulation (CSR) standards is recommended, particularly for Drinking Water (DW) and Aquatic Life (AW) criteria. Health Canada Guidelines for Canadian Drinking Water is used for assessing downgradient drinking water quality.



2.6.1 Water Quality Criteria Exceedances

Results were compared against the British Columbia Approved Water Quality Guidelines and Guidelines for Canadian Drinking Water Quality.

BC Water Quality Guideline: Majority of exceedances include pH, temperature, total organic carbon, nitrite, sulphate, beryllium, chromium, copper, mercury, nickel, phosphorus, uranium, and zinc.

BC CSR DW: Water samples showed exceedances for nitrate, barium, cobalt, and lithium, particularly at source well MW4-06 and downgradient.

Health Canada Guidelines for Canadian Drinking Water: Exceedances for manganese at MW4-06 and MW17-7, and several aesthetic objectives reported for turbidity, iron, manganese, and sodium.

Most exceedances are not considered significant due to inconsistencies or minor deviations.

2.6.2 Temporal and Spatial Trends

Monitoring Well MW4-06 consistently was the most impacted, showing increased metal and mineral leaching, higher groundwater temperatures, lower pH values, and higher total organic carbon (TOC). Laboratory pH values increased from late 2013, likely due to carbon dioxide degassing and calcite precipitation. Iron concentrations in MW4-06 increased from 2010 to 2014, peaking in September 2014, then decreasing in 2015. Chloride and sulphate concentrations in MW4-06 increased over the study period.

- **Ammonia:** Historically low concentrations (<0.5 mg/L) at all wells with no obvious trends. Slight elevation in wells MW4-06 and MW5-06 from 2013 to 2015, but consistently below 0.05 mg/L since then.
- **Chloride and Sodium:** Low and consistent historical concentrations at all wells except MW4-06, where both show notable increasing trends post 2012 with significant annual variation.
- **Dissolved Iron:** Generally low and consistent at all wells except MW4-06 and MW5-06. Higher concentrations observed from late 2009 to mid-2015 with seasonal variation. Recent results show stabilization below criteria at MW5-06.
- **Dissolved Manganese:** Low and consistent at all wells except MW4-06, where concentrations spiked from September 2011 to July 2015 but remained below 400 µg/L since then. Declining trends at MW5-06 were observed since early 2007, stabilizing around DW criteria since 2015. A similar declining trend at MW17-7 was observed since June 2017, stabilizing around 2 µg/L.



2.7 LFG Monitoring

Gas composition in the headspace of groundwater monitoring wells was measured using a Landtec GEM 5000 Plus landfill gas analyzer. The instrument intake PVC tubing was threaded into the monitoring well, and the top was sealed with plastic during analysis.

May 2022 Results:

- **Methane:** 0.7% by volume detected at well MW4-06, the highest reading to date but below the hazardous condition limit of 1.25% methane by volume (BC MoE 1996). The explosive limit for methane is 5% by volume in air.
- **Hydrogen Sulfide (H₂S):** 2 ppm detected at well MW17-7, the first detection of H₂S at the Nakusp landfill by Masse Environmental.

October 2022 Results:

- No methane or H₂S detected at any of the wells.

PDF GENERATED by: Angus Tsang | 2/19/2025 11:40 AM
X:\PRJ\PRJ24\PRJ24072 - NAKUSP LANDFILL FILL TO CLOSURE AND CLOSURE PLANNING\06_AUTOCAD DRAWINGS\01_DRAWINGS\PRODUCTION DRAWINGS\CLOSURE CONCEPT\FIG 2-1 EG.DWG



Landfill Services Group

- Landfill Siting
- Design & Operations Plans
- Landfill Closure
- Environmental Monitoring

#8 - 1225 Keith Road East
North Vancouver, B.C. V7J 1J3
Phone: (604) 966-7723

- LEGEND:
- (1m) EG MIN. CONT. - 2024 NOV 5
 - (5m) EX. MAJ. CONT. - 2024 NOV 5
 - EXISTING ROAD
 - PROPERTY LINE
 - EXISTING ELECTRIC FENCE
 - PROPOSED ROAD



PROJECT:

NAKUSP LANDFILL FILL TO CLOSURE AND CLOSURE PLANNING

TITLE:

EXISTING TOPOGRAPHY
5 NOV 2024 AND SITE
FEATURES

SCALE:	DATE:	PROJECT NO:
1:1250	2025/02/04 yyyy/mm/dd	PRJ 24072
DESIGNED	SG/BH	DRAWING NO: FIGURE 2-1
DRAWN	AT	
CHECKED	SG	



3. REGULATORY CONSTRAINTS AND DESIGN OBJECTIVES

This Chapter describes the regulatory constraints and design objectives of the Closure Plan for the Nakusp Landfill (Landfill).

3.1 Regulatory Requirements

The following documents and/or regulations apply to the site:

- Operational Certificate OC – 16521 for the Nakusp Landfill;
- BC Landfill Criteria for Municipal Solid Waste, 2nd Edition, as a supplemental guidance document; and
- Contaminated Sites Regulations

3.1.1 Operational Certificate

The most recent amendment of the Operational Certificate was issued on August 8th, 2014 and supersedes all previous versions. The Operational Certificate notes the holder must follow the BC Landfill Criteria for Municipal Solid Waste for closure and post-closure care. The holder must also submit a Closure Plan and Final Cover Design to the Director during the landfill's operating life, with reviews of the plan every five years. A Qualified Professional must certify that closure works are completed as per the plan and submit this certification within 60 days of implementing the Final Cover Design. Additionally, a Post Closure or Aftercare Plan must be submitted to the Ministry at least one year before the landfill's anticipated closure date.

3.1.2 Landfill Criteria for Municipal Solid Waste

The Provincial Government issued the *Landfill Criteria for Municipal Solid Waste, Second Edition* in June 2016. The Criteria provides guidelines for development, operation and closure of landfills in British Columbia. The Criteria are not regulations; rather, they are guidelines to be used by Regional Waste Managers as standards in permits, waste management plans and operational certificates issued under the Waste Management Act.

The most important criteria which are applicable to the closure of the Landfill are summarized below:

- *Service Life and Contaminating Lifespan*: The landfill site is to be designed such that the service life of the facility exceeds the contaminating lifespan.
- *Site Layout*: A buffer zone of 50 m is to be maintained between the landfill footprint and the property boundary of which the 30 m closest to the landfill site boundary shall be reserved for landscape screening and 20 m closest to the landfill footprint should be used for access roads, firebreaks, leachate and LFG management and monitoring works, as required.
- *Surface Water Management Works*: All components of a surface water management system are to be designed in a manner such that surface water runoff is directed away from the active operation area within the landfill footprint and is discharged as clean water, as well

as, to minimize potential for on-site erosion and sediment loading to downstream water courses. Surface water ditches and retention ponds are to be designed for the control and retention of a 1:100-year, 24-hour storm event and the design shall make allowances for additional water that may result from snow melt and from prolonged multi-day precipitation events. All ditches are to be armored with appropriate protection and to maintain a minimum 1% grade.

- *LFG Management Works:* The LFG Management Regulations apply to landfills that have accepted MSW on or after January 1st, 2009. The regulation requires that if the quantity of waste in place is equal to or greater than 100,000 tonnes or if the annual quantity of waste received exceeds 10,000 tonnes/year before January 1, 2009, a LFG generation assessment report had to be submitted to the Ministry by January 1st, 2011. Landfills that are determined to produce more than 1,000 tonnes of methane per year in the assessment are required to develop a LFG facility design plan within one year of submitting the initial LFG assessment. As per the LFG Management Regulation, the LFG management facilities are to be designed, constructed, and operated in accordance with the BC LFG Management Facilities Design Guideline.
- *Final Cover Design:* The minimum final cover is to consist of a barrier layer, providing a maximum hydraulic conductivity of 1×10^{-7} cm/s for non-arid regions and 1×10^{-5} cm/s for arid regions. The final cover barrier layer shall have a minimum compacted thickness of 0.6 m measured perpendicular to the slope with a minimum 0.15 m topsoil layer capable of establishment and sustained growth of the vegetative cover. A lower permeability barrier layer or the addition of a geomembrane, may be required to control leachate generation rates.
- *Final Contours:* Final contours of the landfill are to be constructed at grades not steeper than 3H:1V (33 %). The recommended design criteria for the top plateau of the landfill is a slope not less than 10H:1V (10 %) for cover systems using a soil barrier layer. The grade for the top plateau can be reduced up to 2.5H:1V (4%) for cover systems using a durable geomembrane or composite barrier layer with an overlying drainage layer above the final landfill side slope.
- *Site Security and Fencing:* Fencing is required around the perimeter of the landfill. Security fencing is to be established around the entire perimeter of the operational footprint of the landfill. The minimum size fence shall be a 1.2 m high post and page wire fence. Along the landfill site boundary where vehicle access can be achieved from the outside a minimum 2 m chain link fence is recommended. All access points are to have locking gates.
- *Access Roads:* An appropriately constructed and maintained access road to the landfill site and a road system within the landfill site capable of supporting all vehicles hauling waste are required during the operating life of the landfill. The following design criteria should be adopted in designing an access road:

-
- Access road traffic surface to be minimum 4 m wide for one lane and 7 m for two lanes;
 - Roads for public and commercial traffic should not exceed 8 percent grade;
 - Roads for construction / internal off-road equipment traffic should not exceed 15 percent grade; and,
 - All roads sloped steeper than 2 percent should have armoured ditches.
- *Vector and Wildlife Management:* Landfills are to be operated to minimize the attraction of vectors and wildlife, such as flies, bears and birds, by applying cover at required frequencies and instituting a good housekeeping program. Further control measures, such as bear control fences, and bird control programs, may be required on a site-specific basis.
 - *Contaminating Lifespan:* Section 8.3 of the Criteria requires that technical analysis is undertaken by a Qualified Professional to determine the contaminating lifespan in order to estimate the post closure period. In the absence of a contaminating lifespan analysis, a lifespan of 50 years shall be used for landfills with less than 100,000 tonnes of waste in place, 100 years shall be used for landfills with less than 1,000,000 tonnes of waste in place and 200 years shall be used as the default for landfills with more than 1,000,000 tonnes of waste in place. The technical analysis to determine the contaminating lifespan for the landfill may potentially result in a shorter post-closure period but not less than 30 years which is the minimum.
 - *Monitoring:* A detailed Environmental Monitoring Plan (EMP) for leachate, groundwater, surface water, and landfill gas must be prepared and implemented during landfill construction and landfill operation, closure and post-closure. The post-closure operation and maintenance program as well as an environmental monitoring program are required to be conducted during the contaminating lifespan of a landfill.

A Closure Plan must document how the facility will be operated and maintained post- closure to ensure that all required environmental control systems will continue to function and all performance criteria will be met.

The post-closure operation and maintenance program shall include:

- Maintenance of the final cover including vegetation and the repair of damage due to erosion, leachate breakouts, slope failures, settlement and burrowing animals;
- Where applicable, operation and maintenance of surface water management works, including repairs required due to settlement;
- General site maintenance including maintenance of access roads and fencing;
- Where applicable, operation and maintenance of leachate collection and on-site leachate treatment facility or leachate haulage program;

-
- Where applicable, operation and maintenance of landfill gas management facilities, including repairs to infrastructure damaged by settlement;
 - An environmental monitoring program to be carried out during the contaminating lifespan;
 - Practical and implementable contingency measures to address any failure of the works or non-compliance with the performance criteria. Contingency measures may include the following measures:
 - Extraction and treatment of groundwater downgradient of the landfill site;
 - Establishment of monitored attenuation zones;
 - Repair and/or installation of shallow leachate collection system; and
 - Installation of landfill gas collection or barrier systems.

3.1.3 Contaminated Sites Regulation

Municipal Solid Waste landfills are listed as one of the activities in Schedule 2 of the Contaminated Sites Regulations (CSR).

The contaminated site statutes in the Province of British Columbia are regulated by the *Environmental Management Act* (EMA), and the *Contaminated Sites Regulation* 1997 (CSR) as amended November 1st 2017. This legislation includes a comprehensive framework for environmental investigation.

The CSR sets numeric concentration limits for numerous substances to protect receiving environments in British Columbia. For soil, generic numerical standards are established for some parameters, while matrix numerical standards are set for others. Different standards apply based on land use, such as industrial (IL), commercial (CL), residential (RL), urban park (PL), agricultural (AL), or wildlands (WL), to safeguard environmentally sensitive organisms or human health.

In water, generic numerical standards are established to protect specific groundwater uses, including aquatic life (AW), irrigation (IW), livestock watering (LW), and drinking water (DW). If contaminant concentrations exceed the applicable numeric standards, corrective or remedial action is required. This action can either reduce the concentration of contaminants to below the numeric standard or mitigate the risk to human health and the environment using specific engineered or administrative controls.



4. GRADING PLAN

This chapter presents the grading plan which represents the final cover topography as shown on Figure 4-1.

4.1 Intended End Use Plan

The intention is to develop the Landfill in a way that protects human health and the environment. This is achieved by placing a final cover layer over the waste footprint that prevents exposure to waste, controls infiltration of precipitation, minimizes methane release, limits erosion and controls odors.

The crest area and side slopes of the landfill should be vegetated to help stabilize the soil, reducing erosion caused by wind and water. This is crucial for maintaining the integrity of the landfill cover and preventing the exposure of waste materials. Vegetation can also help manage water infiltration by absorbing rainfall and reducing surface runoff. This minimizes the amount of water that percolates through the landfill, reducing the generation of leachate, which can contaminate groundwater.

The flatter topography within the fenced landfill area (elevation 520 to 515) is currently used to temporarily stockpile diversion materials to be transferred offsite. Material piles consist of brush wood, clean wood, chipped wood, metal, tires, propane tanks and white goods. Two septic pits exist adjacent to the SW corner of the landfill with the expectation that one will be decommissioned as part of the landfill closure. There are also historical waste pits and trenches, (which are considered closed) around the material piles that have been well capped with local soils as well as approximately 300 mm of wood chips in order to maintain adequate public access. An existing transfer station with 2 bins is located adjacent to the tire pile which will be converted to asbestos bins to be hauled offsite as needed.

It should be noted that the future use of the site can not include buildings or heavy structures without a detailed geotechnical investigation. Development of commercial / light industrial structures on the property should include measures to isolate the waste, ensure that landfill gas and soil vapours are not migrating into structures, and foundations are designed to accommodate future settlement. These issues should be addressed by a Qualified Professional before a building permit is issued.

4.2 Grading Plan for Intended End Use

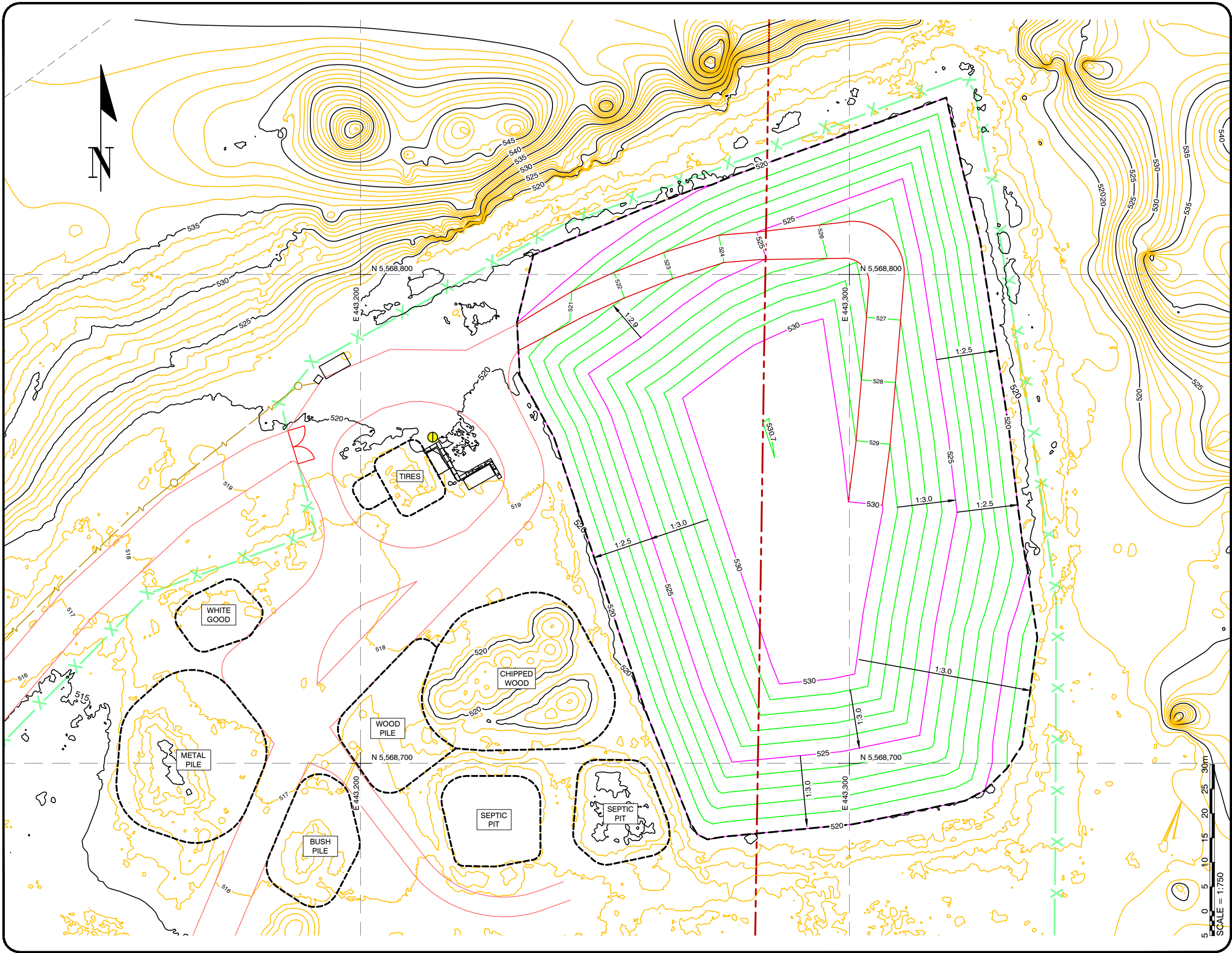
The grading plan and final subgrade design for the landfill are presented in Figure 4-1, while the existing topography is shown in Figure 2-1. As indicated in Figure 4-1, the final design elevation of the landfill will be a maximum of 530.7 meters above sea level (masl). The final contour geometry includes outside slopes ranging from 2.5H:1V to 3H:1V and a crest slope of 5% to facilitate surface water shedding. Grades slightly steep than 3H:1V are proposed along the base of the landfill to preserve transfer station operational and infrastructure. As shown in Figure 4-2, a net volume of 4,610 m³ of fill remains for waste and operational cover materials.



The cut and fill for re-grading, as well as the actual area to be closed, should be adjusted and refined during detailed design.

The access road, depicted in Figures 4-1 and 4-2, will start at the northwest corner of the landfill to provide access to the crest.

PDF GENERATED by: Angus Tsang | 2/19/2025 11:40 AM
X:\PRJ\PRJ24\PRJ24072 - NAKUSP LANDFILL FILL TO CLOSURE AND CLOSURE PLANNING\06_AUTOCAD DRAWINGS\01_PRODUCTION DRAWINGS\CLOSURE CONCEPT\FIG 4-1 CLOSURE DESIGN.DWG



Sperling Hansen Associates
Landfill Services Group
• Landfill Siting
• Design & Operations Plans
• Landfill Closure
• Environmental Monitoring
#8 - 1225 Keith Road East
North Vancouver, B.C. V7J 1J3
Phone: (604) 966-7723

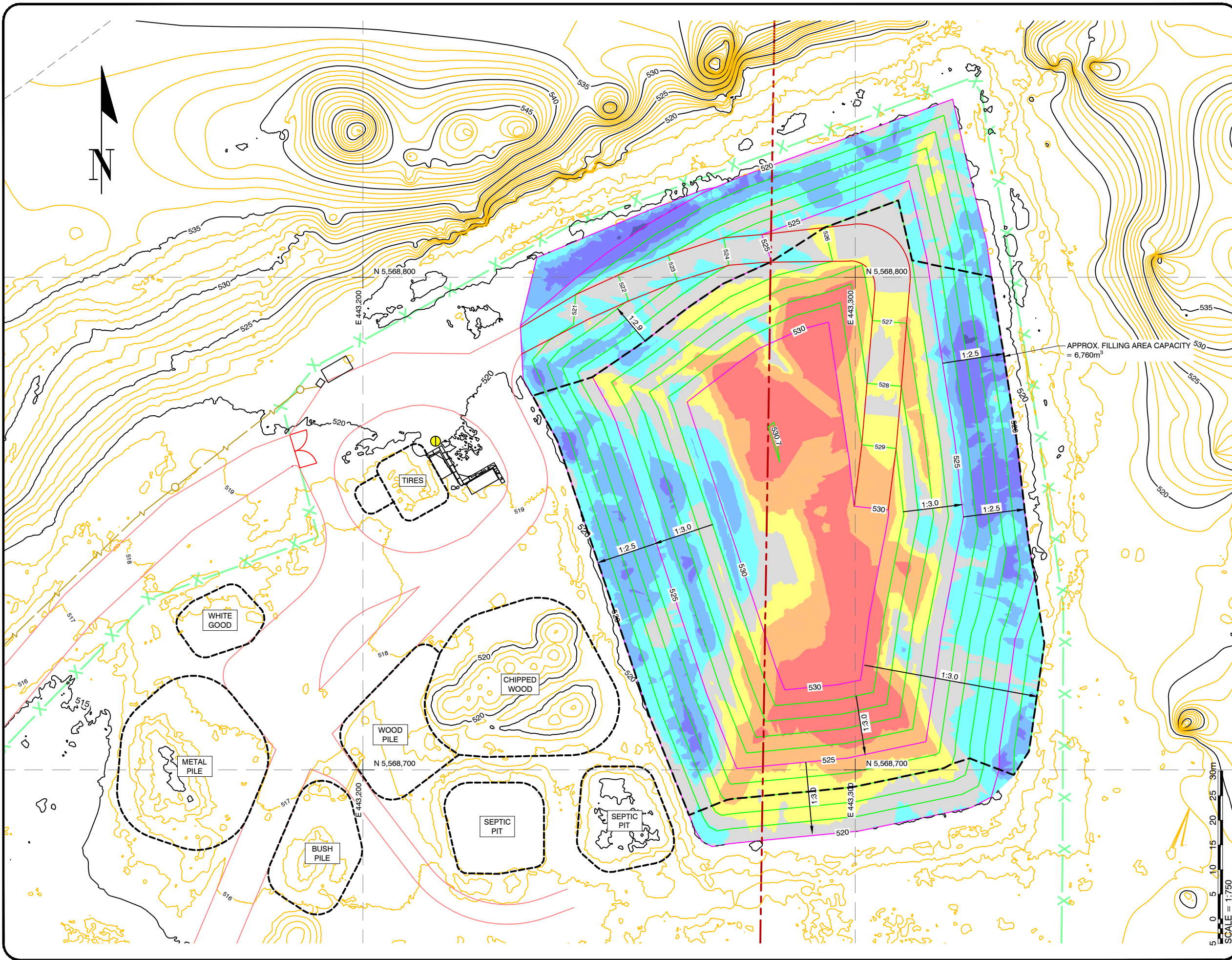
- LEGEND:**
- (1m) EG MIN. CONT. - 2024 NOV 5
 - (5m) EX. MAJ. CONT. - 2024 NOV 5
 - (1m) DES. CLOSURE MIN. CONT.
 - (5m) DES. CLOSURE MAJ. CONT.
 - EXISTING ROAD
 - PROPOSED ROAD
 - PROPERTY LINE
 - EXISTING ELECTRIC FENCE



PROJECT:
NAKUSP LANDFILL FILL TO CLOSURE AND CLOSURE PLANNING

TITLE:
FINAL DESIGN CONTOURS

SCALE: 1:750	DATE: 2025/02/04 yyyy/mm/dd	PROJECT NO: PRJ 24072
DESIGNED	SG/BH	DRAWING NO: FIGURE 4-1
DRAWN	AT	
CHECKED	SG	



Landfill Services Group

- Landfill Siting
- Design & Operations Plans
- Landfill Closure
- Environmental Monitoring

#8 - 1225 Keith Road East
North Vancouver, B.C. V7J 1J3
Phone: (604) 986-7723

LEGEND:

- (1m) EG MIN. CONT. - 2024 NOV 5
- (5m) EX. MAJ. CONT. - 2024 NOV 5
- (1m) DES. CLOSURE MIN. CONT.
- (5m) DES. CLOSURE MAJ. CONT.
- EXISTING ROAD
- PROPOSED ROAD
- PROPERTY LINE
- EXISTING ELECTRIC FENCE

Elevations Table

MIN. ELEVATION	MAX. ELEVATION	COLOUR
-2.3m	-2.0m	
-2.0m	-1.0m	
-1.0m	-0.5m	
-0.5m	0.0m	
0.0m	0.5m	
0.5m	1.0m	
1.0m	2.0m	
2.0m	4.0m	

OVERALL VOLUMETRIC ANALYSIS
CUT&FILL

BASE: NAKUSP LF 2024-11-05 EG
COMPARISON: NAKUSP LF
CLOSURE DESIGN CONCEPT
CUT: 2,500m³
FILL: 7,110m³
NET: 4,610m³

CLIENT:



PROJECT:

NAKUSP LANDFILL FILL TO CLOSURE AND
CLOSURE PLANNING

TITLE:

CUT-FILL FINAL DESIGN
CONTOURS VS EXISTING
TOPOGRAPHY

SCALE:

1:750

DATE:

2025/02/04
yyyy/mm/dd

PROJECT NO:

PRJ 24072

DESIGNED

SG/BH

DRAWING NO:

DRAWN

AT

FIGURE 4-2

CHECKED

SG



5. ENVIRONMENTAL CONTROL SYSTEMS

Environmental control systems for Landfill closure are shown on Figures 5-1 to 5-4.

5.1 Surface Water Management Plan

The primary objectives of the surface water management plan for the Nakusp Landfill are to:

- Keep clean water clean
- Prevent erosion of the final cover system
- Minimize percolation through the top surface of the landfill
- Prevent ponding of surface water on the cover system
- Manage suspended sediments
- Minimize leachate production
- Control surface water in a manner compatible with the proposed end-uses

This chapter reviews the background information on existing conditions and provides recommendations on runoff diversion, ditch sizing, stormwater control and runoff controls during construction.

5.1.1 Run-On Diversion

The terrain to the north and east of the landfill is characterized by a mountainous landscape with sharp inclines and significant elevation changes that direct drainage towards the landfill. However, existing channels intercept stormwater and divert flows around the landfill to the west and south. The existing run-on diversion channels should be reviewed as part of the detailed design and upgraded as necessary.

In contrast, the topography to the south and west of the landfill is flat with gentle slopes trending southwest. The ground in these areas is pervious, allowing most water to infiltrate into the soil with minimal overland flow.

5.1.2 Storm Water Routing

Upon closure of the Nakusp Landfill, clean run-off from the final cover system needs to be diverted away from the waste footprint. Figure 5-1 shows proposed ditch locations for closure including a ditch along the crest access road. The landfill crest will have grades between 4% and 10% for drainage depending on the cover system used, and side slopes should be graded at 3H:1V, though some existing slopes at 2.5H:1V are acceptable.

Run-off should be diverted to the perimeter ditch around the landfill toe, which discharges to the storm water detention pond. Peak flows should be analyzed to ensure ditches are adequately sized.

SHA recommends ditches with a triangular cross section, 0.75m depth and 2.0H:1V side slopes armoured with riprap to protect against expected flow velocities. Figure 5-4 shows a conceptual surface water ditch for the Nakusp Landfill.

5.1.3 Storm Water Detention Pond

The primary purpose of a detention pond is to temporarily store excess stormwater runoff during heavy rain events and release it gradually to prevent downstream flooding. By regulating the release rate, it helps mitigate erosion in downstream areas. Additionally, detention ponds aid in settling out sediments and pollutants from the runoff, improving water quality.

A stormwater detention pond, designed to retain the 1-in-100-year, 24-hour storm event, should be constructed at the location shown in Figure 5-1, provided there is no buried waste in this area. It is recommended to dig test holes to verify the absence of buried waste. According to a figure from Ray Johnson and Associates Surveyors and Engineers (Photo 5-1), the approximate limit of refuse at the landfill shows no waste buried in the southeast corner. This information needs to be verified. If waste is present, an alternative location for the storm pond must be selected where there is no buried waste. The alternate location is further south, past the fence line, which is lower in elevation and outside the waste footprint.

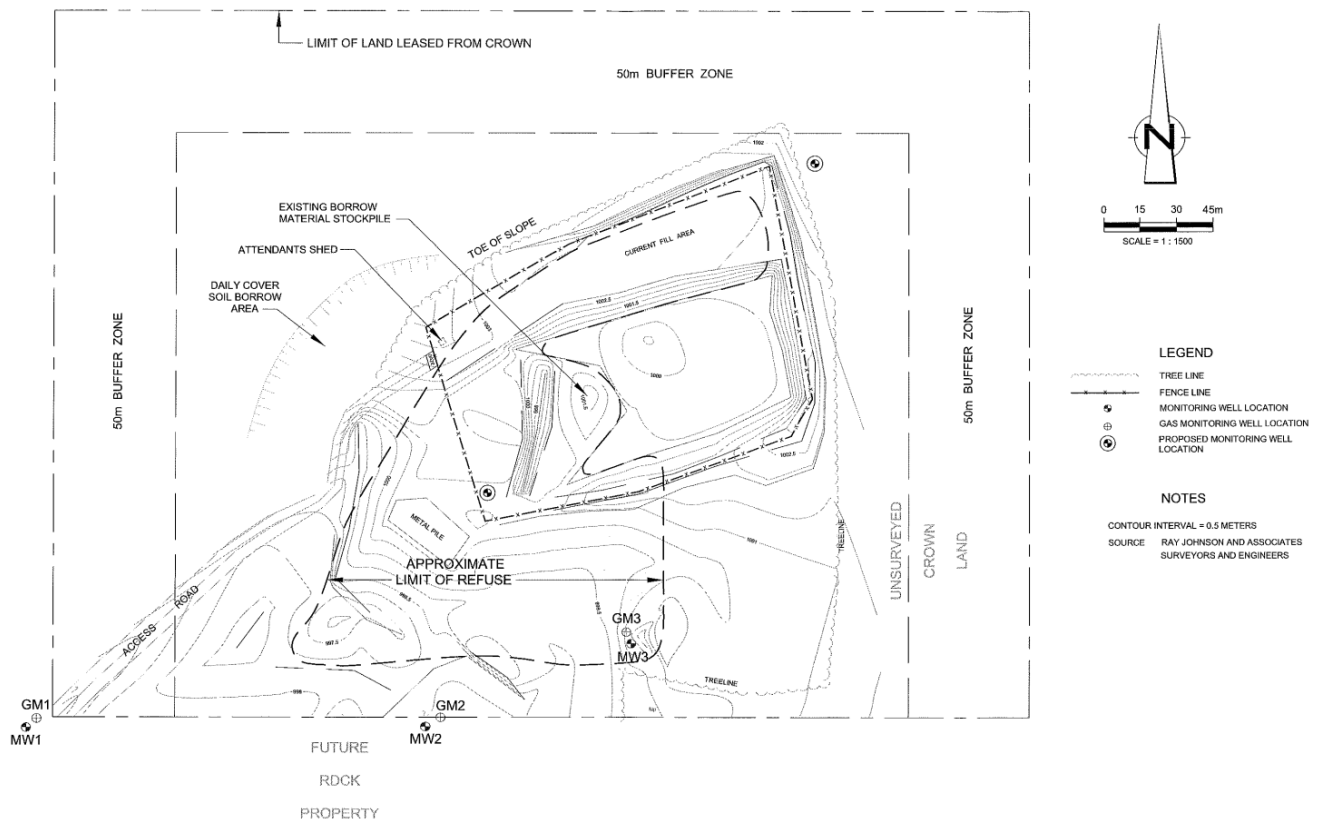


Photo 5-1: Approximate Limits of Historic Refuse

The capacity of the pond should be approximately 600 m³ in order to store 100% of run-off expected from the 1.3 ha closure area during the design storm event plus average snow melt and multi-day precipitation. Additional volume will be considered for climate change. Pond storage calculations and details will be refined during detail design. The pond will not be lined with a synthetic liner and will act as an infiltration pond to help recharge groundwater and reduce surface runoff.

SHA has designed several retention and detention ponds in BC. Photo 5-2 shows a retention pond at Delta Shake and Shingle (DSS) Landfill at Delta,



Photo 5-2: Retention Pond at DSS Landfill

5.2 Leachate Management Plan

Landfill leachate is generated when precipitation filters through the soil cover into the underlying refuse layer, and from moisture within the waste itself, which drains by gravity and is squeezed out by the compaction from the weight of overlying solid waste. The volume of leachate produced depends on several factors, with the most significant being climate, the surface area



of the landfill cells, and the effectiveness of the final cover cap, such as a geomembrane or soil barrier.

5.2.1 Leachate Generation

To estimate the current and future leachate generation, SHA performed a water balance analysis for the site using the Hydrological Evaluation of Landfill Performance (HELP) model.

The water balance examines the relationship between precipitation and evapotranspiration, which involves the return of water to the atmosphere through evaporation and transpiration by vegetation. During winter months, precipitation typically exceeds evapotranspiration, resulting in a moisture surplus. Conversely, during summer months, precipitation rates are lower than evapotranspiration rates, leading to a moisture deficit. A moisture surplus causes water to flow over the landfill surface as runoff, be retained in storage (e.g., snow or soil moisture), or infiltrate and generate leachate. During a moisture deficit, water is drawn out of surface soils, decreasing soil moisture content.

A 50-year simulation of leachate production at the site was conducted using the HELP model, with results presented in Chapter 6, Table 6-2. The simulation indicates that, under open conditions, the majority of precipitation becomes leachate.

SHA estimated leachate generation for both average and extreme weather conditions. With a final geomembrane cover installed, the total annual volume of leachate generated at the site is projected to decrease to approximately 88 m³ under average conditions and 85 m³ under extreme conditions. The engineered geosynthetic closure system will effectively and significantly minimize leachate generation. The results are summarized in Table 5-1 below.

Table 5-1: Leachate Generation Estimate Summary

Location	Area (m ²)	Average		Extreme	
		Leachate generation (mm/year)	Leachate Quantity (m ³ /year)	Leachate generation (mm/year)	Leachate Quantity (m ³ /year)
Current Condition					
Crest and Slope	11,660	291	3,398	311	3,621
After Closure					
Crest and Slope	11,660	8	88	7	85



5.2.2 Existing Leachate Control

The landfill was designed as a natural attenuation site, meaning there are no existing leachate controls in place. Importantly, there are no signs of significant leachate seepage or breakouts observed anywhere on the site.

5.2.3 Proposed Leachate Management Strategy

The proposed leachate management strategy will prioritize source control by minimizing infiltration. The closed surface of the landfill will generate increased stormwater runoff, which will be directed to the stormwater detention pond. This pond will help dilute any leachate impacts that may migrate from the attenuation landfill.

5.3 Landfill Gas Management Plan

5.3.1 Introduction

Landfill gas (LFG) emissions are a significant concern due to potential health and safety issues, nuisance odors, and their contribution to global climate change. If LFG is not properly vented, gas pressures can build up beneath the final cover, potentially leading to uplift of the cover system. Additionally, gas can migrate from the site to nearby properties and structures if it is prevented from venting directly to the atmosphere or if there is a preferential pathway for the gas to travel off-site.

LFG is a by-product of the natural decomposition of organic materials in landfills. The most common form of LFG, produced during biological anaerobic decomposition, consists primarily of equal parts methane (CH_4) and carbon dioxide (CO_2). Other trace constituents include over 166 different Non-Methane Organic Compounds (NMOCs), nitrogen (N_2), and oxygen (O_2).

Methane is a potent greenhouse gas (GHG) with a global warming potential (GWP) 28 to 36 times higher than CO_2 over a 100-year timeframe. Methane, at concentrations between 5% to 15% by volume in air, can cause an explosion if it encounters an ignition source. The lower end of this range (5%) is referred to as the lower explosive limit (LEL). Combustible gases are a concern in relation to LFG migration issues.

Carbon dioxide, another major component of LFG, is found at low concentrations in atmospheric air. The main danger posed by CO_2 is that it can displace atmospheric air in confined structures such as manholes and wells, potentially causing asphyxiation for anyone entering such a structure without properly checking the atmospheric conditions.

LFG may also contain hydrogen sulfide (H_2S), which originates from the biological degradation of gypsum drywall, sulfur-containing industrial wastes, and biosolids from municipal wastewater treatment plants. Hydrogen sulfide emissions can be problematic at a landfill as they can cause odor issues, impact surrounding communities, damage LFG collection and energy utilization components, and contribute to the formation of explosive conditions. Normally, H_2S can be detected by humans at concentrations as low as 0.05 parts per million (ppm), and by 3 ppm, a



distinctive odor of rotten eggs is noted. At concentrations between 10 and 50 ppm, most people experience headaches and nausea. This gas is highly toxic at concentrations above 50 ppm, and prolonged exposure can decrease the ability to smell the gas.

Besides the obvious benefits of LFG control in reducing climate change, there are several other factors that highlight the importance of having a proper LFG management system. The most important of these factors are:

- Methane is a flammable gas and explosive within a specific concentration range.
- LFG contains trace amounts of Hazardous Air Pollutants (HAPs), Volatile Organic Compounds (VOCs), and other odorous compounds.
- Excessive concentrations of LFG in work areas can pose serious health and safety risks to workers.
- Capturing LFG can produce renewable energy and/or green fuel, substituting fossil fuels and providing an additional revenue stream for the landfill project, as well as local and global environmental benefits.

5.3.2 Applicable Regulations and Guidelines

The BC Ministry of Environment and Climate Change Strategy (ENV) regulates landfill gas management in British Columbia through the LFG Management Regulation and the BC Landfill Criteria for Municipal Solid Waste guidelines.

Landfill Gas Management Regulation:

The Landfill Gas Management Regulation (LFG Regulation) applies to landfill sites that (i) accepted municipal solid waste (MSW) for disposal on or after January 1, 2009, and (ii) have 100,000 tonnes or more of MSW in place or receive more than 10,000 tonnes of MSW per year in any calendar year. Regulated landfills are required to complete an LFG generation assessment. If a landfill is determined to generate 1,000 tonnes or more of methane per year, it must install an active LFG management system. This system is designed to actively collect LFG and reduce methane emissions through flaring (thermal combustion) or other methods that achieve equivalent emission reductions. The active LFG management facility must operate continuously until the methane generation rate at the facility falls below 500 tonnes per year.

Since the Nakusp Landfill has less than 100,000 tonnes of municipal solid waste (MSW) in place (with an estimated cumulative waste tonnage of 65,000 tonnes by the end of 2023) and does not receive more than 10,000 tonnes of MSW per year, the Landfill Gas Management Regulation does not apply to this site.



BC Landfill Criteria for Municipal Solid Waste:

The second edition of the Landfill Criteria for Municipal Solid Waste was issued in June 2016. This document outlines specific criteria that should be satisfied during design, operations and closure of MSW landfills in BC.

According to the criteria:

- soil gas concentrations at the landfill site boundary must not exceed 100% LEL (i.e. 5% methane by volume) at any time,
- combustible gas concentrations measured in on-site buildings must not exceed 20% LEL (i.e. 1% methane by volume) at any time,
- LFG must also be managed in accordance with all migration and health and safety requirements. Resources include WorkSafe BC and the Landfill Gas Management Facilities Design Guidelines (Section 8.0 LFG Migration Assessment and Control; Section 9.0 Health and Safety),
- LFG emissions must be managed such that all federal, provincial, and local ambient air quality objectives and standards are met.

5.3.3 Landfill Gas Generation Estimate

At the end of 2023, the landfill had approximately 65,000 tonnes of waste in place (RDCK 2024). In 2024, approximately 1,455 tonnes of waste was landfilled, 887 tonnes of materials were diverted and 1,464 tonnes of soil and wood were stockpiled. SHA estimates that the landfill's cumulative waste tonnage is approximately 67,000 tonnes as of January 2025.

In 2023, the RDCK submitted a Landfill Gas Survey to Environment and Climate Change Canada, noting that the total annual methane generation for 2022 was 79 tonnes/year, as estimated using the draft Environment and Climate Change Canada (ECCC) model. Consequently, SHA anticipates that the amount of LFG generated from the site is minimal, and less than 1,000 tonnes of methane per year.

5.3.4 LFG Management System

Landfill gas consists primarily of equal parts methane (CH_4) and carbon dioxide (CO_2). Methane is a potent greenhouse gas with a global warming potential 28 to 36 times higher than CO_2 over a 100-year timeframe. Therefore, LFG management at municipal solid waste (MSW) landfills in BC is regulated.

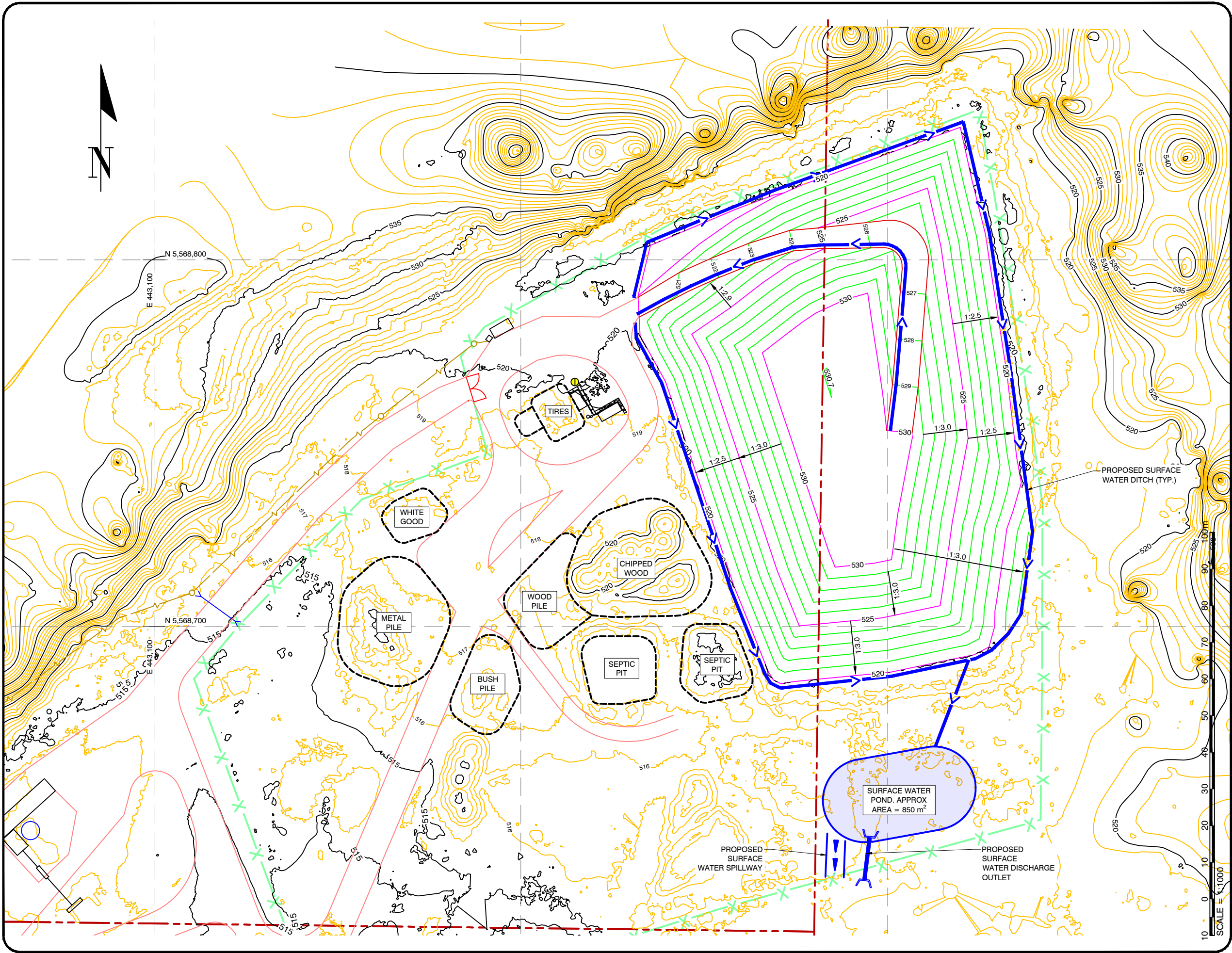
The Nakusp Landfill is not mandated to install and operate an active LFG management facility because it is not regulated, and the quantity of CH_4 generated at this site does not exceed the regulation threshold of 1,000 tonnes per year. However, once the closure system is implemented, a passive gas collection system will need to be installed as part of the closure system. This will allow LFG, that is generated below the cover system, to be collected and



vented to the atmosphere without damaging the cover system and minimizing the potential for migration.

The LFG layout plan for the passive collection system is presented in Figure 5-2, and the system details are shown in Figure 5-3. As illustrated in Figure 5-2, landfill gas will be passively collected via perforated pipes installed below the geomembrane on the landfill crest. These perforated pipes will be connected to a series of LFG vents located on the outer edges of the crest, which will vent the collected LFG to the atmosphere (Figure 5-3).

PDF GENERATED by: Angus Tsang | 2/19/2025 11:42 AM
X:\PRJ\PRJ24\PRJ24072 - NAKUSP LANDFILL FILL TO CLOSURE AND CLOSURE PLANNING\06_AUTOCAD DRAWINGS\01_DRAWINGS\PRODUCTION DRAWINGS\CLOSURE CONCEPT\FIG 5-1 SW PLAN.DWG



Landfill Services Group
• Landfill Siting
• Design & Operations Plans
• Landfill Closure
• Environmental Monitoring
#8 - 1225 Keith Road East
North Vancouver, B.C. V7J 1J3
Phone: (604) 986-7723

LEGEND:

- (1m) EG MIN. CONT. - 2024 NOV 5
- (5m) EX. MAJ. CONT. - 2024 NOV 5
- (1m) DES. CLOSURE MIN. CONT.
- (5m) DES. CLOSURE MAJ. CONT.
- EXISTING ROAD
- PROPOSED ROAD
- PROPERTY LINE
- EXISTING ELECTRIC FENCE
- PROPOSED S.W DITCH
- PROPOSED S.W CULVERT
- PROPOSED S.W POND

CLIENT:



PROJECT:

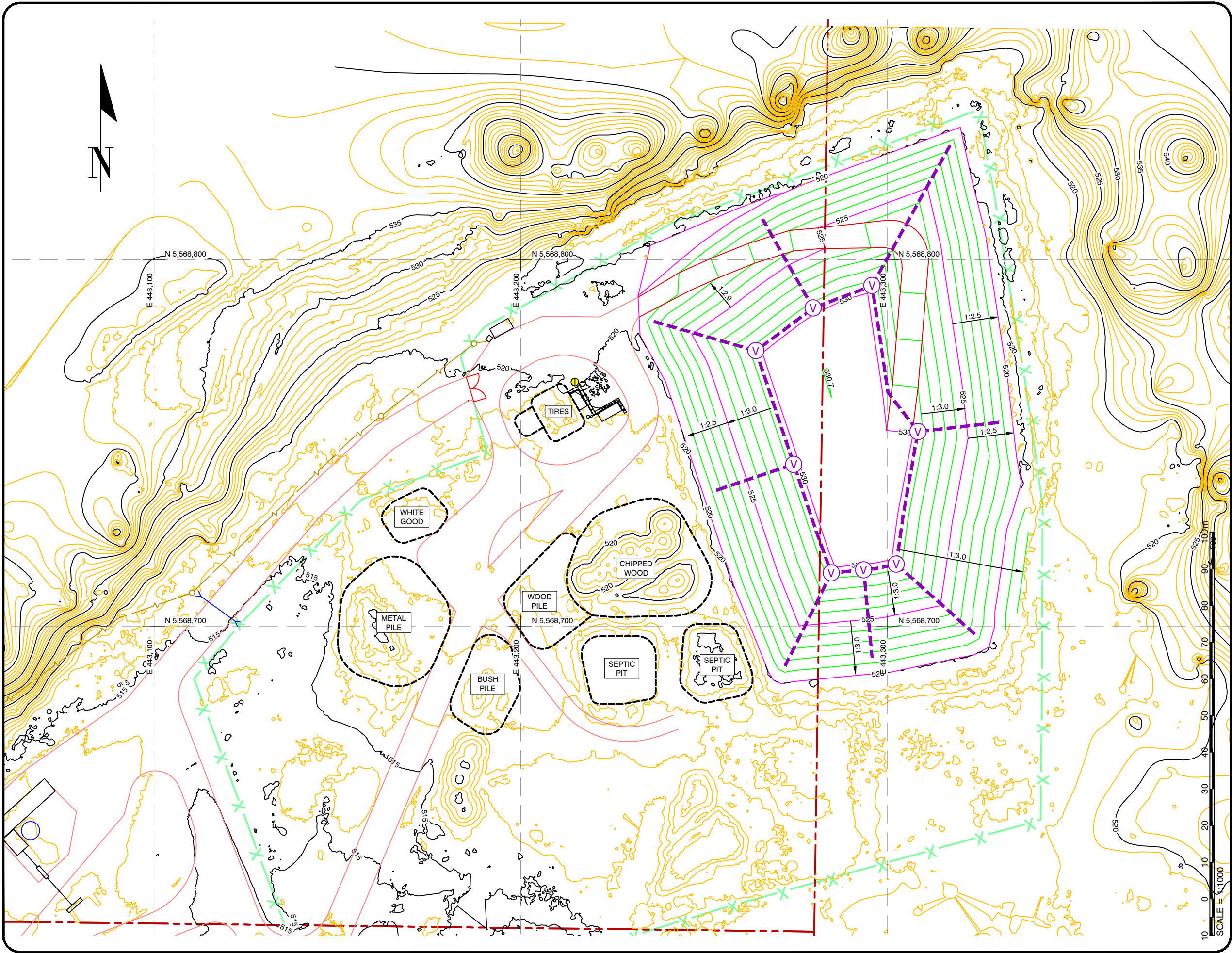
NAKUSP LANDFILL FILL TO CLOSURE AND CLOSURE PLANNING

TITLE:

SURFACE WATER MANAGEMENT PLAN

SCALE: 1:1000	DATE: 2025/02/04 yyyy/mm/dd	PROJECT NO: PRJ 24072
DESIGNED	SG/BH	DRAWING NO:
DRAWN	AT	FIGURE 5-1
CHECKED	SG	

PDF GENERATED by: Angus Tsang | 2/19/2025 11:42 AM
X:\PRJ\PRJ24\PRJ24072 - NAKUSP LANDFILL FILL TO CLOSURE AND CLOSURE PLANNING\06_AUTOCAD DRAWINGS\01_DRAWINGS\PRODUCTION DRAWINGS\CLOSURE CONCEPT\FIG 5-2 LFG PLAN.DWG



Landfill Services Group

- Landfill Siting
- Design & Operations Plans
- Landfill Closure
- Environmental Monitoring

#8 - 1225 Keith Road East
North Vancouver, B.C. V7J 1J3
Phone: (604) 986-7723

- LEGEND:
- (1m) EG MIN. CONT. - 2024 NOV 5
 - (5m) EX. MAJ. CONT. - 2024 NOV 5
 - (1m) DES. CLOSURE MIN. CONT.
 - (5m) DES. CLOSURE MAJ. CONT.
 - EXISTING ROAD
 - PROPOSED ROAD
 - PROPERTY LINE
 - EXISTING ELECTRIC FENCE
 - PROPOSED LFG VENT
 - PROPOSED PERF. HDPE LFG PIPE



PROJECT:

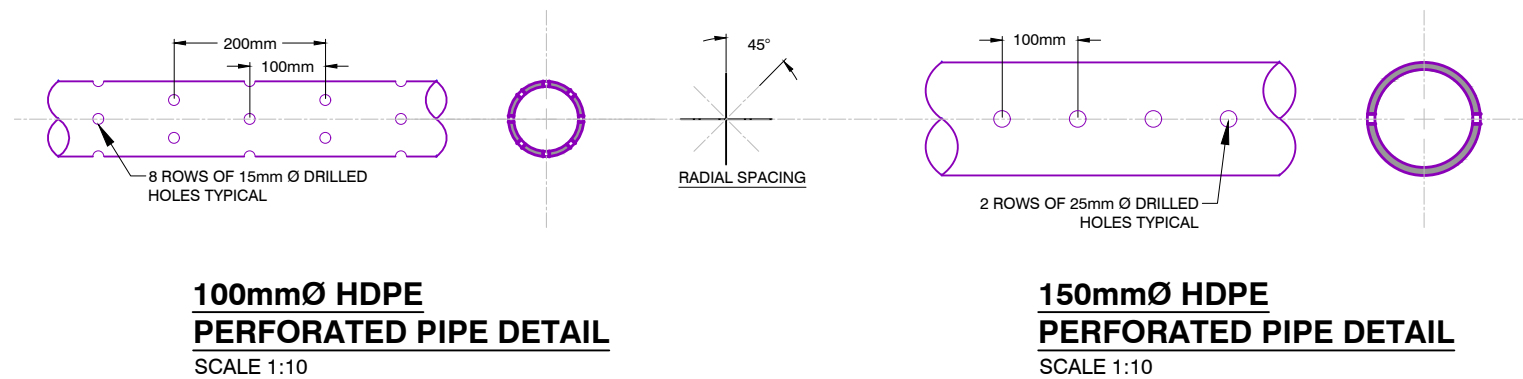
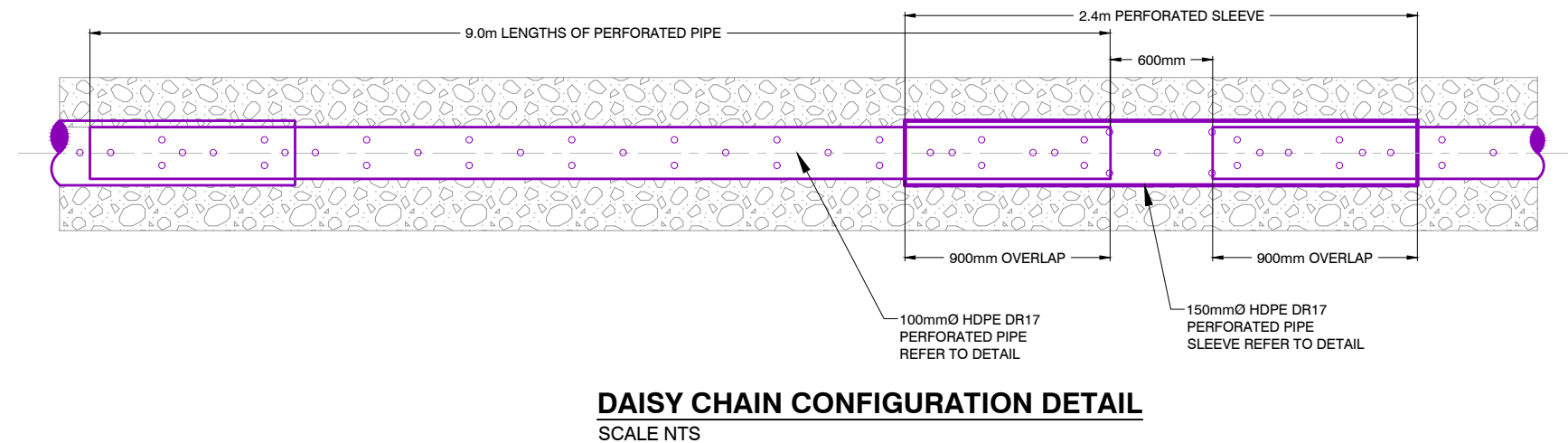
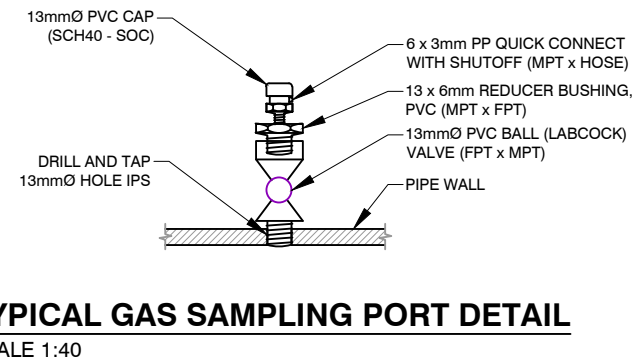
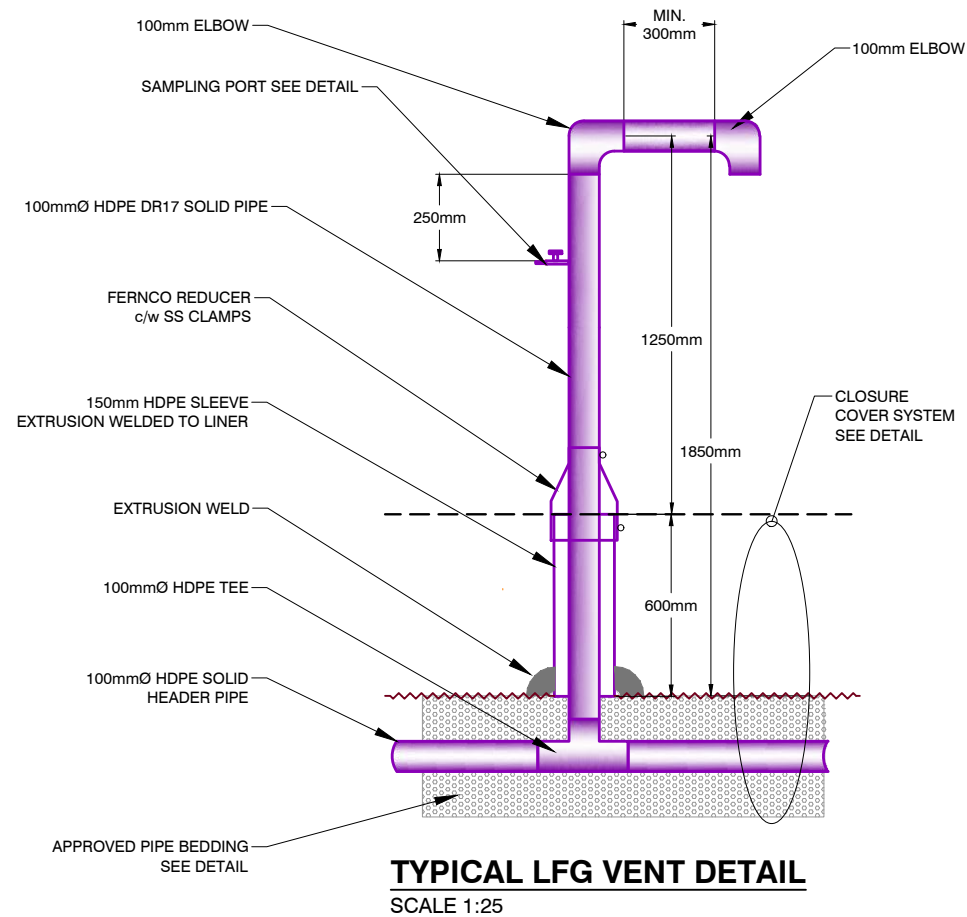
NAKUSP LANDFILL FILL TO CLOSURE AND CLOSURE PLANNING

TITLE:

LANDFILL GAS MANAGEMENT PLAN

SCALE:	DATE:	PROJECT NO:
1:1000	2025/02/04 yyyy/mm/dd	PRJ 24072
DESIGNED	SG/BH	DRAWING NO: FIGURE 5-2
DRAWN	AT	
CHECKED	SG	

PDF GENERATED by: Angus Tsang | 2/19/2025 11:42 AM
X:\PRJ\PRJ24\PRJ24072 - NAKUSP LANDFILL FILL TO CLOSURE AND CLOSURE PLANNING\06_AUTOCAD DRAWINGS\01_DRAWINGS\PRODUCTION DRAWINGS\CLOSURE CONCEPT\FIG 5-3 LFG DETAILS.DWG



Landfill Services Group

- Landfill Siting
- Design & Operations Plans
- Landfill Closure
- Environmental Monitoring

#8 - 1225 Keith Road East
North Vancouver, B.C. V7J 1J3
Phone: (604) 986-7723

LEGEND:

CLIENT:



PROJECT:

NAKUSP LANDFILL FILL TO CLOSURE AND
CLOSURE PLANNING

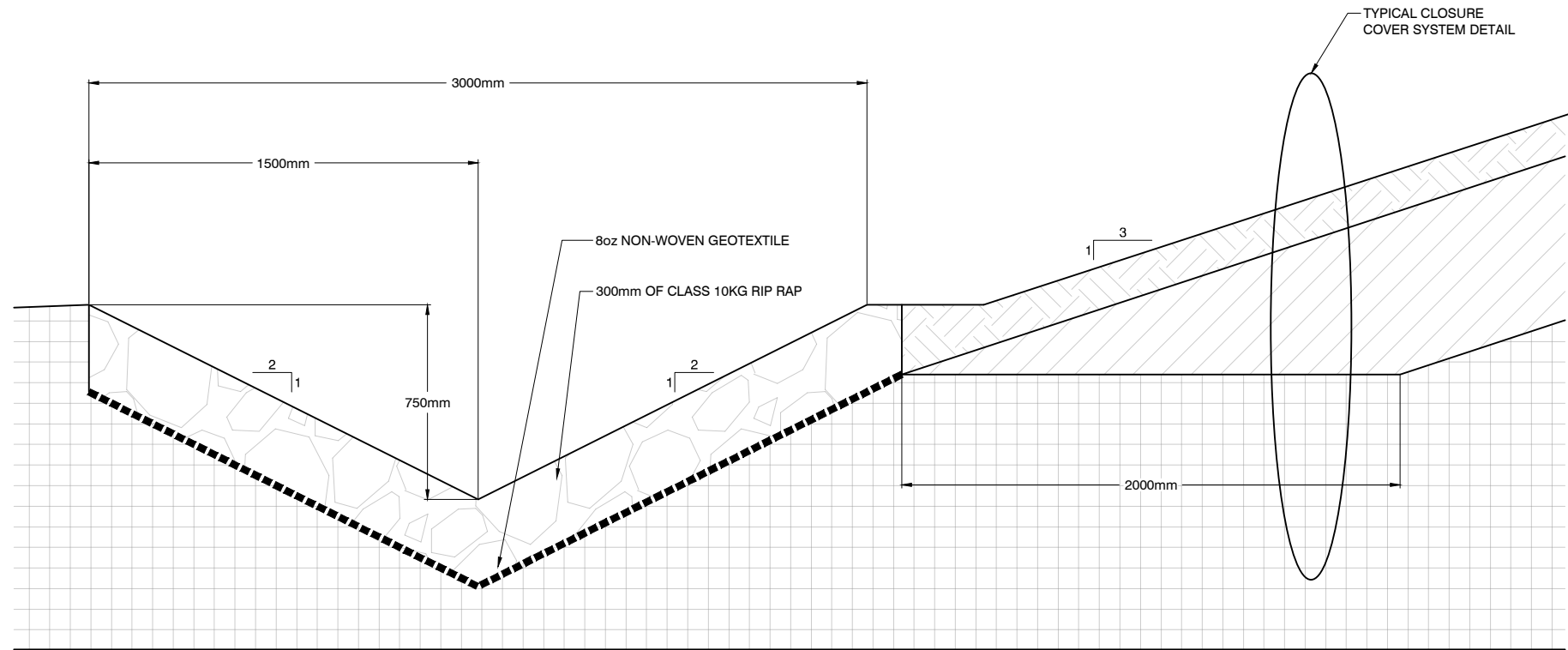
TITLE:

LANDFILL GAS DETAILS

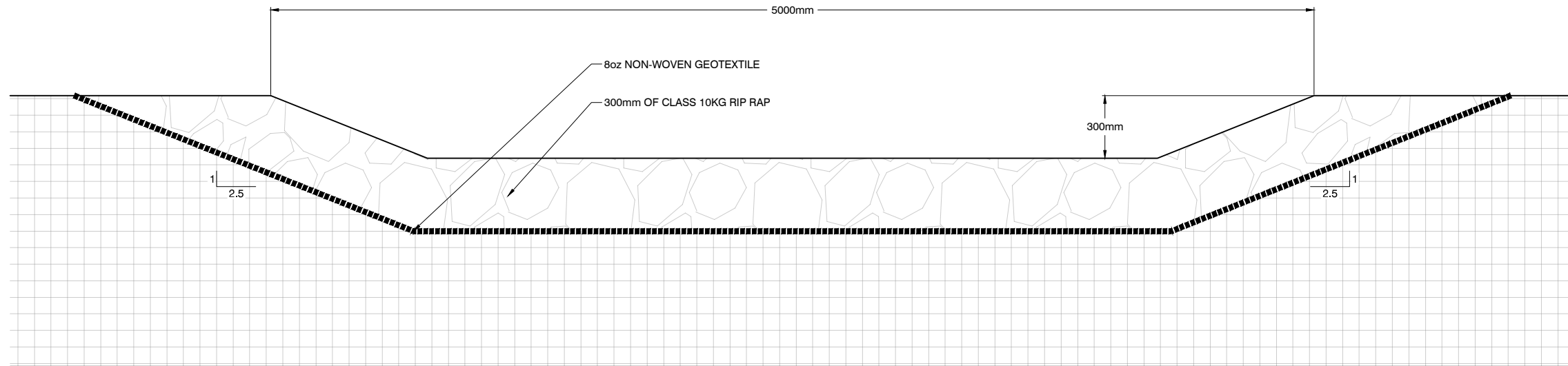
SCALE: AS SHOWN	DATE: 2025/02/04 yyyy/mm/dd	PROJECT NO: PRJ 24072
DESIGNED	SG/BH	DRAWING NO:
DRAWN	AT	FIGURE 5-3
CHECKED	SG	

PDF GENERATED by: X:\PRJ\PRJ24\PRJ24072 - NAKUSP LANDFILL FILL TO CLOSURE AND CLOSURE PLANNING\06_AUTOCAD DRAWINGS\01_DRAWINGS\PRODUCTION DRAWINGS\CLOSURE CONCEPT\FIG 5-4 SW DETAILS.DWG

Angus Tsang | 2/19/2025 11:42 AM



SURFACE WATER DITCH DETAIL
SCALE 1:25



EMERGENCY SPILLWAY AND RIPRAP OVERLAND INLET DETAIL
SCALE 1:25



**Sperling
Hansen
Associates**

Landfill Services Group
• Landfill Siting
• Design & Operations Plans
• Landfill Closure
• Environmental Monitoring

#8 - 1225 Keith Road East
North Vancouver, B.C. V7J 1J3
Phone: (604) 986-7723

LEGEND:

CLIENT:



PROJECT:

NAKUSP LANDFILL FILL TO CLOSURE AND
CLOSURE PLANNING

TITLE:

**SURFACE WATER
MANAGEMENT DETAILS**

SCALE: AS SHOWN	DATE: 2025/02/04 yyyy/mm/dd	PROJECT NO: PRJ 24072
DESIGNED	SG/BH	DRAWING NO: FIGURE 5-4
DRAWN	AT	
CHECKED	SG	

6. FINAL CLOSURE DESIGN

This chapter presents the final closure design options and the recommended conceptual final cover design for the Nakusp Landfill. The conceptual design aligns with the BC Landfill Criteria for Municipal Solid Waste – 2nd Edition (the Criteria). Detailed analysis is provided in Table 6-1 and Table 6-2 at the end of this chapter.

In British Columbia, four basic types of cover systems are used:

1. Compacted Soil Cover
2. Geosynthetic Cover
3. Composite Cover
4. Evapotranspirative Cover

Based on the current Design, Operations, and Closure Plan (DOCP) initially prepared by CRA in 2008 and updated by Wood in 2022, the anticipated closure strategy involves using native material from the northwest embankment, previously utilized for borrow cover material. However, SHA has identified a potential issue: the hydraulic conductivity of the native embankment soil, as indicated in the 2008 DOCP, is likely too high for effective use as capping material. This means that the material will not adequately prevent water infiltration into the waste mass, as precipitation will percolate through the sandy capping material.

For the purpose of final closure design, the site has been divided into two areas based on landfilling practices.

Area 1: This is the active face and surrounding area, characterized by a mounded waste mass with approximately 3:1 side slopes, varying in elevation from 520 masl to 530 masl. Covering roughly 1.3 hectares, this area requires a final cover design.

Area 2: This area is flatter and contains sporadic waste pits and trenches. It is currently used to store material piles for offsite transfer. Spanning approximately 2.3 hectares, Area 2 is believed to contain significantly less waste than Area 1. Groundwater monitoring results from the SLR Hydrogeology and Hydrology Characterization Report (2024) indicate that the environmental impact from Area 2 is considerably lower. Sampling results from MW4-06 (northwest of the septic pits) confirm leachate production and associated water quality impairment near the landfill. However, downgradient sampling near the site boundary at MW1-95 shows improved water quality, suggesting that natural attenuation effectively mitigates impacts to downgradient receptors.

Given these findings, it has been decided that Area 2 does not require a final cover design at this time. Instead, it will be monitored according to the environmental monitoring plan outlined in Chapter 7. If water quality trends at MW1-95 continue to improve due to natural attenuation, a final cover system will not be necessary for Area 2.

In this chapter, SHA will evaluate the potential effectiveness of two alternative solutions for Area 1: a geosynthetic cover system and an imported clay cover system. The goal is to identify the most suitable conceptual option for the landfill closure.

6.1 Design Objectives

The purpose of constructing a landfill final closure system is to implement essential environmental control measures to effectively manage leachate, landfill gas, stormwater, and settlement. A well-designed closure system should provide the following benefits:

- Isolation of refuse to prevent direct contact with humans and vectors.
- Minimize infiltration and resulting leachate production by diverting and managing precipitation runoff.
- Prevention of leachate breakouts at the landfill toe and on side slopes.
- Protection of the cover system from erosion through the maintenance of a sustainable vegetative cover layer.
- Enhancement of passive landfill gas collection by controlling the upward venting of landfill gas and preventing the downward intrusion of atmospheric oxygen.
- Reduction of odour release.
- Minimize oxygen infiltration to reduce the risk of fires.
- Provision of habitat for methanotrophic bacteria in the vegetative cover system to enhance the oxidation of methane emissions.

In developing the final cover design to meet these objectives, local site conditions and intended end use were carefully considered. The selection of soil types, thicknesses, and other materials for the cover was guided by both regulatory guidelines and site-specific conditions and design goals. Key elements considered in the final cover design include:

- The final cover barrier layer shall consist of at least 600 mm of low permeability soil. To achieve leachate minimization objectives, this barrier layer should have a hydraulic conductivity (K) of less than 1×10^{-7} cm/s for non-arid environments, or alternatively, an impermeable geomembrane barrier can be used. This barrier layer shall be protected with a minimum of 150 mm of topsoil, capable of supporting the establishment and sustained growth of a healthy vegetative cover.
- The final cover shall be sloped at a minimum of 4% to promote surface water runoff, with a maximum slope of 33%. The top crest shall have a minimum slope of 10% for soil barrier layer covers, and 4% for durable geomembrane or composite barrier layers with an overlying drainage layer.



6.2 HELP Modelling and Final Cover Design

A variety of final cover system options were evaluated in this study to determine the most suitable solution for the landfill. The three different cover system design options considered are described below and detailed in Table 6-1:

1. Option 1 (ENV Recommended Clay Barrier): involves a 150 mm topsoil horizon ($k = 1 \times 10^{-4}$ cm/s), and a 600 mm clay barrier layer ($k = 1 \times 10^{-7}$ cm/s).
2. Option 2 (ENV Recommended Geomembrane Barrier): involves a 150 mm topsoil horizon ($k = 1 \times 10^{-4}$ cm/s), a 450 mm subsoil layer ($k = 1 \times 10^{-4}$ cm/s), and a 40 mil LLDPE geomembrane barrier ($k = 4 \times 10^{-13}$ cm/s).
3. Option 3 (Native Silty Sand Barrier): involves a 150 mm topsoil horizon ($k = 1 \times 10^{-4}$ cm/s), and a 600 mm native silty sand barrier layer ($k = 1 \times 10^{-5}$ cm/s).

The model scenarios were constructed and analyzed using the HELP (Hydrologic Evaluation of Landfill Performance) model (Schroeder et al., 1994). Table 6-1 provides the HELP modeling profiles and input details for the different scenarios, while the results are presented in Table 6-2.

All scenarios utilized a geologic profile representative of average site conditions. It was estimated that the typical average refuse thickness at the landfill is 10 m. Based on SHA's previous experience, the average hydraulic conductivity (K) for the refuse was estimated to be 5×10^{-4} cm/s. The average hydraulic conductivity for the intermediate cover was estimated to be 1×10^{-3} cm/s.

For this project, all cover option profiles were assessed using a 50-year simulation based on climate patterns from the Nakusp Climate Station. The average monthly precipitation rate and temperature, derived from Environment Canada Climatic Normal Data (1970 to 2000), were input into the model. Unfortunately, more recent data (1981-2010) is not available for this climate station.

The HELP model estimated an average annual precipitation of 802.91 mm/year. However, the actual average annual precipitation recorded at the Nakusp Climate Station is higher, at 842.0 mm/year. This discrepancy arises from the artificial parameters used by the HELP model to simulate weather conditions. Additionally, SHA ran the model using extreme year precipitation data. Based on the input parameters, the model estimates that extreme precipitation would be 1,023.0 mm/year.

6.2.1 HELP Modelling Results

As shown in Table 6-2, the model results vary for each closure system option. The HELP model was also run for the existing conditions.

A summary of the results under average climate conditions is presented below:

Open - Existing Conditions: Results in a leachate production rate of 291.4 mm/year, which translates to 36.3% of the annual precipitation.

Closed - Option 1: ENV Recommended Clay Barrier on the Crest: Results in a leachate production rate of 26.0 mm/year, translating to 3.2% of annual precipitation under average conditions, and 26.4 mm/year, translating to 2.6% of annual precipitation under extreme conditions.

Closed - Option 2: ENV Recommended Geomembrane Barrier: Results in a leachate production rate of 7.5 mm/year, translating to 0.9% of annual precipitation under average conditions, and 7.3 mm/year, translating to 0.7% of annual precipitation under extreme conditions.

Closed - Option 3: 600mm Native Silty Sand Barrier: Results in a leachate production rate of 231.9 mm/year, translating to 28.9% of annual precipitation under average conditions, and 224.9 mm/year, translating to 22.0% of annual precipitation under extreme conditions. The model was also run using a 2,000 mm thick native barrier, resulting in a leachate generation of 230.68 mm/year, translating to 28.7%, which is an insignificant reduction.

6.2.2 Recommended Final Cover Design

Based on the results of this analysis, SHA concludes that the most effective cover system for minimizing long-term leachate production is a geomembrane cover system. Specifically, SHA recommends 'Option 2 – ENV Recommended Geomembrane Barrier' for both the landfill crest and side slopes. Figure 6-1 below illustrates the recommended geomembrane cover system concept (Option 2) for the Nakusp landfill closure.

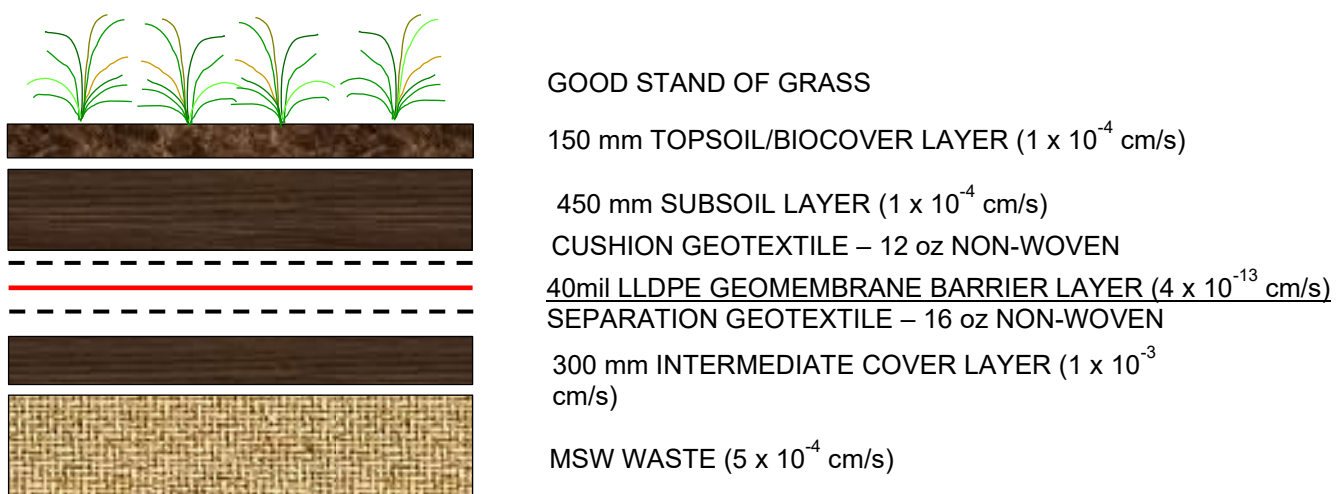


Figure 6-1. Cover System Option 2



Alternatively, if the RDCK is able to procure a low permeability soil source that meets the specifications outlined in Option 1 above (barrier layer ($k = 1 \times 10^{-7}$ cm/s), and the source is within the vicinity of Nakusp, it should be a viable option to use in lieu of a geomembrane cover system.

6.3 Topsoil and Vegetation

This section outlines the elements of the closure plan designed to establish a vibrant ecosystem on the crest and sloped areas of the landfill. The plan includes procedures for creating soil horizons conducive to plant growth and planting native grass, shrub, and tree species that will thrive in the environment.

The objectives of the soil and vegetation activities are to:

- Utilize native trees, shrubs, and grasses.
- Provide effective erosion control through shallow-rooted and fast-growing plant species.
- Maximize evapotranspiration of moisture from the soil cover material.
- Reduce percolation through the final cover.
- Enhance the aesthetics of the site.
- Create a low-maintenance, self-sustaining ecosystem.

The current conceptual closure design recommends using locally available topsoil of suitable quality to sustain plant growth, spread uniformly at a depth of 150 mm. The quality of the topsoil has not yet been determined. As part of the final design activities, this soil should be analyzed for standard physical and chemical parameters. Typically, stockpiled or imported soil requires amendments (either inorganic or chemical fertilizers or organic soil amendments) to create an optimal growing medium. Preliminary investigations into soil quality may reveal opportunities to use local organic "wastes" as soil amendments, recycling these materials to develop a soil that will sustain a diverse plant community.

The designed soil depth is adequate for establishing a variety of grasses. With an appropriate seed mixture and application rate, germination and establishment should be rapid, resulting in a dense community of grasses and legumes. Once established, this grass community should minimize the survival of tree seedlings germinating from the seedbank or neighboring trees through competition for light. However, the proposed 150 mm topsoil layer is insufficient for tree establishment on the landfill. An increased soil depth would be required to provide adequate water-holding capacity for trees.

Species selection for the vegetative community on the landfill should focus on plants with extensive fibrous root systems to assist in soil stability. The aboveground portions of these plants should facilitate water interception and mitigate the erosive action of precipitation on the soil surface. Vegetation without a large standing dry biomass during the summer moisture deficit period will minimize fuel loading for accidental ignition.

The final formulations for the fabricated topsoil should be determined in consultation with a Professional Agrologist. The soil and/or soil amendments should be stored to minimize runoff



and other pollution sources. The soil must be moist (25% to 75% of field capacity) but not frozen or wet when placed. It should be spread in a consistent thickness to eliminate rough spots and humps, and manually spread around any obstacles. Care should be taken to avoid compaction of the topsoil before seeding.

Seed application will be done by hydroseeding the topsoil layer with a light wood fiber mulch application. The hydroseeding seed blend will include both warm and cool season native species. Selecting native species specific to the region is crucial to ensure the highest possible plant survival rate, while choosing both warm and cool season species will maximize plant-water uptake and transpiration throughout the year.

Generally, when hydroseeding, a combination of seed mixture, fertilizer blend, tackifier, and wood fiber mulch should be applied. The ratio of this mixture and the specific additive requirements are seasonally dependent. A typical hydroseeding application blend includes:

- 80 kg/ha seed mixture
- 160 kg/ha fertilizer blend (18-18-18)
- 50 kg/ha guar gum tackifier
- 200 kg/ha wood fiber mulch

An example of a seed mix applied at the Skway Landfill (Chilliwack, BC) is presented in Table 6-3. In addition to the seed mix, Fall Rye was applied as a cover crop. The hydroseed mixture should be confirmed by a certified agrologist before application.

Table 6-3: An example of a seed mix applied at the Skway Landfill in Chilliwack, BC

	% by Weight	Seeds/ lb	% by Seed Count
Agrostis gigantea, Red Top	1.24	4,990,000	12.80
Dactylis glomerata, Orchardgrass	6.17	520,000	6.64
Elymus dauricus, Dahurian Wildrye	8.64	86,180	1.54
Elymus trachycaulus, Slender Wheatgrass	6.17	145,000	1.85
Festuca rubra var. rubra, Creeping Red Fescue	16.05	455,000	15.11
Festuca trachyphylla, Hard Fescue	9.88	590,000	12.06
Lolium perenne, Perennial Ryegrass (Diploid)	30.86	247,000	15.77
Phleum pratense, Timothy	3.7	1,230,000	9.41
Poa compressa, Canada Bluegrass	2.47	2,400,000	12.26
Trifolium hybridum, Alsike Clover	3.70	680,040	5.20
Trifolium pratense, Single Cut Red Clover	9.88	275,000	5.62
Trifolium repens, White Clover	1.24	680,000	1.74
	100.000		100.00

6.4 Erosion Control

During final cover construction, the RDCK may consider protecting the topsoil with a biodegradable erosion control mat while the grass cover is becoming established. Alternatively, applying a hydroseed mix with additional mulch on the slopes can help establish a vegetative cover and control erosion.

Erosion control in the ditches is also beneficial. To mitigate erosion, the ditches should be lined with riprap or a similar material. The riprap is designed to reduce erosion caused by high flows that can occur within the ditches.



Table 6-1: HELP Model Profiles

Layers	Vegetation	Open	Closed		
		Open	Option 1 - 150 mm Topsoil with 600 mm Clay Barrier - ENV	Option 2 - 150 mm Topsoil and 450 mm Subsoil Layer with Geomembrane Barrier	Option 3 - 150mm Topsoil with 600 mm Native Subsoil Layer
		Poor Stand of Grass	Good Stand of Grass	Good Stand of Grass	
		Evaporative Zone Depth = 20cm	Evaporative Zone Depth= 51 cm	Evaporative Zone Depth= 51 cm	Evaporative Zone Depth= 51 cm
Layer 1	Material Function Thickness (mm) K Value (cm/s)	Intermediate Cover Vertical Percolation Layer 300 1x10 ⁻³	Topsoil/Biocover Vertical Percolation Layer 150 1x10 ⁻⁴	Topsoil/Biocover Vertical Percolation Layer 150 1x10 ⁻⁴	Topsoil/Biocover Vertical Percolation Layer 150 1x10 ⁻⁴
Layer 2	Material Function Thickness (mm) K Value (cm/s)	Refuse Vertical Percolation Layer 10000 5x10 ⁻⁴	Clay Barrier Layer 600 1x10 ⁻⁷	Subsoil Vertical Percolation Layer 450 1x10 ⁻⁴	Clay Barrier Layer 600 1x10 ⁻⁵
Layer 3	Material Function Thickness (mm) K Value (cm/s)		Intermediate Cover Vertical Percolation Layer 300 1x10 ⁻³	LLDPE Geomembrane Barrier Layer 40 mil 4x10 ⁻¹³	Intermediate Cover Vertical Percolation Layer 300 1x10 ⁻³
Layer 4	Material Function Thickness (mm) K Value (cm/s)		Refuse Vertical Percolation Layer 10000 5x10 ⁻⁴	Intermediate Cover Vertical Percolation Layer 300 1x10 ⁻³	Refuse Vertical Percolation Layer 10000 5x10 ⁻⁴
Layer 5	Material Function Thickness (mm) K Value (cm/s)			Refuse Vertical Percolation Layer 10000 5x10 ⁻⁴	





Table 6-2: HELP Model Results

Scenarios		Evapotranspiration (mm/yr)	Evapotranspiration as % of P	Runoff (mm/yr)	Runoff as % of P	Lateral Drainage (mm/yr)	Lateral Drainage %	Percolation to leachate (mm/yr)	Percolation to Leachate % of P	Lateral Drainage in Leachate Collection Layer (mm/yr)	Lateral Drainage in Leachate Collection Layer %	Change in water storage (mm/yr)	Change in water storage as % of P	Leakage through Bottom Layer	Leakage through Bottom Layer as % of P	Leachate Produced (mm/yr)	Leachate Produced as % of P	Precipitation (mm/yr)
	Scenario Modelled																	
I.D	4% Slope																	
	Average																	
	Open - Existing	312.5	38.9%	195.8	24.4%	N/A	N/A	291.4	36.3%	N/A	N/A	3.2	0.4%	291.4	36.3%	291.4	36.3%	802.91
Option 1	Closed - 150 mm Topsoil with 600 mm Clay Barrier - ENV (K=1x10-7 cm/s)	388.6	48.4%	385.0	48.0%	N/A	N/A	26.0	3.2%	N/A	N/A	3.3	0.4%	26.0	3.2%	26.0	3.2%	802.91
Option 2	Closed- 150 mm Topsoil and 450 mm Subsoil Layer with Geomembrane Barrier	528.3	65.8%	263.6	32.8%	N/A	N/A	7.5	0.9%	N/A	N/A	3.5	0.4%	7.5	0.9%	7.5	0.9%	802.91
Option 3	Closed - 150 mm Topsoil with 600 mm Clay Barrier Site Clay - ENV(K=1x10-5 cm/s)	317.8	39.6%	250.2	31.2%	N/A	N/A	232.2	28.9%	N/A	N/A	3.1	0.4%	231.9	28.9%	231.9	28.9%	802.91
	Extreme																	
	Open - Existing	256.7	25.1%	451.1	44.1%	N/A	N/A	310.6	30.4%	N/A	N/A	4.7	0.5%	310.6	30.4%	310.6	30.4%	1,023.04
Option 1	Closed - 150 mm Topsoil with 600 mm Clay Barrier - ENV(K=1x10-7 cm/s)	316.9	31.0%	673.0	65.8%	N/A	N/A	26.4	2.6%	N/A	N/A	6.8	0.7%	26.4	2.6%	26.4	2.6%	1,023.04
Option 2	Closed- 150 mm Topsoil and 450 mm Subsoil Layer with Geomembrane Barrier	438.4	42.9%	572.7	56.0%	N/A	N/A	7.3	0.7%	N/A	N/A	4.6	0.4%	7.3	0.7%	7.3	0.7%	1,023.04
Option 3	Closed - 150 mm Topsoil with 600 mm Clay Barrier Site Clay - ENV(K=1x10-5 cm/s)	263.6	25.8%	530.0	51.8%	N/A	N/A	222.7	21.8%	N/A	N/A	4.6	0.5%	224.9	22.0%	224.9	22.0%	1,023.04





7. ENVIRONMENTAL MONITORING PLAN

The following chapter details a comprehensive Environmental Monitoring Plan (EMP) for groundwater, surface water, leachate, and landfill gas, to be implemented post-closure. It also discusses the post-closure period and the contaminating lifespan assessment.

7.1 Post Closure Monitoring

7.1.1 Groundwater Monitoring

Semiannual groundwater sampling has been conducted in general accordance with the revised EMP produced by AMEC Foster Wheeler in their 2017 Hydrogeology Review (AMEC 2017). SHA recommends the ongoing monitoring of wells MW1-95, MW2-95, MW3-95, MW4-06 & MW5-06 for the same parameters listed in the EMP as summarized in Table 7-1 below. The locations of the post-closure groundwater monitoring wells are shown on Figure 7-1.

Table 7-1: Recommended Post-Closure Groundwater Monitoring Program

Monitoring Wells	Frequency	
MW1-95 MW2-95 MW3-95 MW4-06 MW5-06	Field Measurements	Semiannual – temperature, pH, specific conductance, water level, reduction-oxidation potential (ORP) and turbidity
	Lab	Semiannual – speciated alkalinity, anions, ammonia, nitrate, nitrite, hardness (dissolved), pH, sulphate, sulphide, total organic carbon, dissolved metals, specific conductance, dissolved organic carbon (DOC) and ion balance
MW1-95 MW4-06	Lab	Annually – Volatile Organic Compounds (VOCs), Volatile Organic Compounds (BTEX)
Field Blanks	One blank sample should be submitted per year	
Duplicates	One duplicate sample should be submitted during each event	
Reporting	Annual monitoring report	

* The program should be expanded as necessary to test for any emerging pollutants of concern, following industry best practices or recommendations from the ENV or the qualified professional of record.

The BC Landfill Criteria for Municipal Solid Waste - 2nd Edition (ENV, 2016) requires that a Qualified Professional evaluate the identified uses of groundwater and surface water. Based on this evaluation, they should recommend the appropriate water quality criteria, compliance locations, and provide a rationale and justification for their choices. The selection of criteria typically depends on the intended receptor of the water from the site, such as livestock, wildlife, fish, or human consumption.

The landfill is situated approximately 700 meters from Kuskanax Creek and is elevated by about 30 meters. It is also located within 1.85 kilometers of Upper Arrow Lake, with an elevation



difference of around 60 meters. Additionally, the landfill is within 500 meters of existing water well(s) designated for private domestic use. Consequently, standards and guidelines for freshwater aquatic life and drinking water should be applied.

The analytical results for groundwater should be interpreted using the most appropriate water quality criteria. Currently, these are the BC Contaminated Sites Regulation (CSR) standards for the protection of freshwater aquatic life (AW) and drinking water (DW).

The analytical results from the downgradient groundwater monitoring wells should be compared to the results from the upgradient groundwater monitoring well to detect any leachate impact on the groundwater. The results from monitoring wells should also be compared to historical data from these wells to assess if there are any changes in groundwater quality that can be traced to the landfill.

Every five years, the monitoring data should be reviewed to determine if modifications to the sampling frequency or the parameters tested are warranted. Any proposed changes to the monitoring program will require approval from the ENV.

7.1.2 Surface Water Monitoring

SHA recommends establishing a new surface water monitoring location at the discharge point of the proposed stormwater pond. All landfill surface water will be diverted to this detention pond before being discharged into the surrounding environment. The infrastructure for the discharge outlet should be designed during the detailed design stage of the closure to ensure that outlet rates are limited to predevelopment flow conditions.

The surface water monitoring location is illustrated in Figure 7-1, and the recommended post-closure surface water monitoring program is detailed in Table 7-2.

Table 7-2: Recommended Post-Closure Surface Water Monitoring Program

Monitoring Locations	Frequency	
SW1-25 (Detention Pond discharge)	Field Measurements	Semi-annually – Temperature, pH, conductivity, dissolved oxygen, turbidity
	Lab	Semi-annually – alkalinity, ammonia, COD, chloride, fluoride, ammonia, nitrate, nitrite, conductivity, hardness, pH, total suspended solids, sulphate, sulphide, total organic carbon, total metals, and DOC Annually - LEPH/HEPH/PAH
Field Blanks	One blank sample should be submitted per year	
Duplicates	One duplicate sample should be submitted for every ten samples collected	
Reporting	Annual monitoring report	



-
- * The program should be expanded as necessary to test for any emerging pollutants of concern, following industry best practices or recommendations from the ENV or the qualified professional of record.

The analytical results should be interpreted using the most appropriate water quality criteria. Currently, these are the B.C. Approved and Working Water Quality Guidelines for the protection of aquatic life (AW) and drinking water (DW).

Every five years, the monitoring data should be reviewed to determine if modifications to the sampling frequency or the parameters tested are warranted. Any proposed changes to the monitoring program will require approval from the ENV.

7.1.3 Landfill Gas Monitoring

The Landfill Criteria outlines recommended practices for design, operations and closure of MSW landfills in BC. According to the Criteria:

- Soil gas concentrations at the landfill site boundary must not exceed the lower explosive limit (LEL) of methane (5% methane by volume, or 100% LEL) at any time.
- Combustible gas concentrations measured in on-site buildings must not exceed 20% LEL (1% methane by volume) at any time.
- Landfill gas (LFG) must be managed in accordance with all migration and health and safety requirements. Resources include WorkSafe BC and the Landfill Gas Management Facilities Design Guidelines (the "Guideline") (Section 8.0 LFG Migration Assessment and Control; Section 9.0 Health and Safety).
- LFG emissions must be managed to ensure that all federal, provincial, and local ambient air quality objectives and standards are not exceeded.

According to the Guideline, all buildings on the landfill site must have continuous combustible gas measurement equipment. However, buildings that are elevated and not in direct contact with the soil do not require monitoring for combustible gas concentrations; instead, vents should be installed in these buildings.

Landfill gas (LFG) at the property boundaries can be monitored by measuring pressure and methane concentration in perimeter gas monitoring probes (GMP). A sensitive manometer and a calibrated gas analyzer can be used for this purpose. If positive pressure is observed in the GMPs, or if methane concentration exceeds the recommended performance criteria (i.e., 5% CH₄ or 100% LEL) at property boundaries, a more detailed assessment of landfill gas migration should be conducted to determine if corrective actions are necessary.

Probe installation generally involves drilling 100 mm to 150 mm diameter bores and inserting perforated or slotted 25 mm diameter pipes with screen sections extending from 1 meter below ground to the water table. The perforated section of the pipe should be surrounded by coarse sand or pea gravel, with the last 0.5 to 1 meter of the bore filled with compacted clay or a bentonite seal.



According to the Guideline, landfill gas sampling should be conducted regularly. The Guidelines for Environmental Monitoring at MSW Landfills recommend monthly sampling, but considering the site location and surrounding properties, SHA recommends quarterly monitoring of soil gas at property boundaries unless exceedances are observed during any monitoring events. Following each monitoring event, the collected data should be reviewed to:

- Verify unusual and/or erroneous readings.
- Identify problems and initiate remedial action if necessary.
- Notify individuals responsible for detailed assessment and contingency plans of readings that may indicate gas presence.
- Identify the occurrence of LFG migration.
- Develop remedial actions if warranted.
- Assess the effectiveness of any actions taken.

A more detailed evaluation of the data should be performed annually.

Continuous monitoring is advisable for any buildings constructed on-site that do not have a vented foundation. Monitoring and alarm devices for methane should be installed within, beneath, and immediately adjacent to structures, as well as in any associated utility service conduits and trenches. Any reported problems with LFG odors should be noted and investigated by a Qualified Professional.

Both the LFG Management Facilities Design Guideline and Guidelines for Environmental Monitoring at MSW Landfills should be followed during LFG probe installation and monitoring.

7.1.4 Quality Assurance/Quality Control

SHA recommends incorporating a quality assurance/quality control (QA/QC) program into the monitoring program. A QA/QC program is a system of procedures, checks, audits, and corrective actions that ensure the highest achievable quality of data collected in the field and analyzed in the laboratory. This is crucial, as the monitoring data will form the basis for all conclusions regarding the landfill's impact on the surrounding environment. As a first step in the QA/QC program, we recommend ensuring that sampling is conducted by a qualified person following the BC Field Sampling Manual, and that all samples are submitted to an analytical laboratory certified by the Canadian Association of Environmental Laboratories.

The primary purpose of the QA/QC program is not to check up on the environmental laboratory conducting the analyses, but to demonstrate the reproducibility of the analytical data. Reproducibility ensures that the data is of high quality, and that the conclusions drawn from the data have a high level of confidence.

There are two main types of laboratory QA/QC samples: internal and external. Internal QA/QC refers to the routine procedures that laboratories perform daily or on a "batch" basis to ensure



that nothing inside the laboratory influences the analytical results. These should be reviewed by the Qualified Professional (QP) conducting the analysis. External QA/QC refers to blind and duplicate QC samples submitted to the laboratory to determine whether the sampling methodology contaminated the samples, to assess the laboratory's analytical precision and accuracy, and to evaluate sampling variability.

7.1.5 Internal QA/QC

As discussed, internal QA/QC consists of routine checks and procedures undertaken by the laboratory on a daily or batch basis. Typically, laboratories have their own internal QC program, which may include, but is not limited to:

- Standard methods for cleaning sample bottles, utensils, and analytical equipment.
- Standard procedures for method blanks, spike samples, lab duplicates, reference samples, surrogate recoveries, etc.
- Storage, handling, and quality of internal QC samples.
- Sample storage procedures.
- Sample documentation (e.g., analytical technician, analytical technique, control charts, and other information).
- Storage, handling, and quality of cleaning agents, reagents, acids, distilled or deionized water.
- QA/QC training and certification of staff.

Laboratories certified by the Canadian Association of Environmental Laboratories also undergo a bi-annual audit to ensure that their standard operating procedures meet the minimum standards and that all technical staff are certified.

7.1.6 External QA/QC

External QA/QC involves submitting blind QC samples as part of a sampling suite. These blind samples usually consist of a combination of blank, duplicate, reference, and spike samples. Each type of external QC sample is discussed below, as per the Guidelines for Environmental Monitoring at MSW Landfills:

Duplicate Samples: Used to determine the analytical precision of the laboratory and assess sample variability. Field duplicates are two samples collected from the same sampling point, either sequentially or by splitting one large sample into two sub-samples. The samples are submitted separately.

Reference Samples: Used to determine a laboratory's analytical accuracy. These commercially available samples have a known composition and are submitted to the laboratory. The results are then checked against the known "ingredient list" once analysis is complete.



Spiked Samples: Similar to reference samples, spiked samples are used to determine the analytical accuracy of a laboratory. They contain only one or two dissolved parameters of known concentration, rather than a full suite of parameters. Spiked samples are typically used for VOCs, hydrocarbons, or other organic parameters, rather than inorganic parameters.

Blank Samples: Used to determine whether any systematic sampling contamination is affecting the samples. Field blanks typically consist of commercially available de-ionized or distilled water taken with the field staff during a sampling event. The blanks are treated identically to all other samples, being poured into a sample bottle, undergoing any routine filtration or acidification in the field, and being submitted to the laboratory as a discrete sample. Field blanks should be used for environmental samples and for monitoring effluent parameters with low permit limits.

7.1.7 Field QA/QC

Recommendations for Field Quality Assurance / Quality Control (QA/QC) measures applicable to this site are as follows:

- **Field Equipment:** Ensure all field equipment is cleaned, calibrated, and maintained in good working condition. Equipment used in the field should be cleaned between each sampling location.
- **Gloves:** Use new nitrile gloves for each sample collected.
- **Sample Containers:** All sample containers should be provided by the laboratory, pre-cleaned, and pre-sterilized. Containers should be labeled with their respective sampling location and date.
- **Sample Storage:** Keep samples cool by storing and transporting them in a cooler with ice. When required, add preservatives to the sample containers for certain parameters to maintain sample integrity.
- **Chain of Custody:** Prepare a chain of custody to detail the sample number, sample description, and chemical parameters being analyzed. The completed chain of custody should be sent with the samples to an independent Canadian Association of Laboratory Accreditation Inc. (CALA) accredited laboratory. Follow chain-of-custody procedures (i.e., sign-off between parties when the samples change custody) when transporting the samples.
- **Duplicate Samples:** Analyze duplicate samples at a minimum rate of one for every ten samples analyzed per analysis batch. Matching duplicate samples should be analyzed to calculate the Relative Percent Difference (RPD). The RPD procedure is summarized in the next section.

7.1.7.1 Relative Percent Difference

Relative Percent Difference (RPD) should be calculated to compare the differences between a sample and its duplicate. RPD quantifies the reproducibility or precision of the data. It is calculated by taking the absolute value of the difference between the sample and the duplicate, dividing it by the average of the sample and duplicate, and then multiplying by 100 to obtain a percentage.



$$RPD = \frac{|\text{Sample Concentration} - \text{Duplicate Concentration}|}{\left(\frac{\text{Sample Concentration} + \text{Duplicate Concentration}}{2}\right)} * 100\%$$

The BC Environmental Laboratory Manual (2015) (BCELM) recommends further review for RPD values greater than those listed in Table 7-3. However, if the concentration of the analyte is less than five times the method detection limit, or if the analyte is a metal in soil, an RPD greater than 35% may be reasonable. If the RPD exceeds 50% in soil or groundwater, it is generally necessary to determine the cause and assess how it affects the investigation's findings. For soil vapor, although the BCELM does not provide a specific recommendation, further review is advised when RPD values exceed 100%.

Table 7-3: Data Acceptance Criteria

Parameter Category	Recommended RPD for Concentrations Exceeding five (5) times the Mean Detection Limit (MDL)
Organics in Solids • PAHs • Volatile Organics (including VPH) • EPH	50% 40% 40%
Organics in Water	30%
Metals in Solids	30%
Metals in Water	20%
General Inorganics Solids	30%
General Inorganics in Water	20%

The QA/QC protocols for the site should be reviewed by the client, the Qualified Professional preparing the annual report, and the ENV. The QA/QC protocol should include procedures for sampling, calibration of field instruments, chain of custody reports, and the use of blank, reference, and duplicate samples. All sampling should be conducted by properly trained and certified personnel. The protocol should also specify the QA/QC procedures that the selected laboratory will use.

7.1.8 Annual Inspection

A geotechnical inspection and landfill settlement monitoring are required annually during the post-closure phase, as per the Criteria. The RDCK should conduct the geotechnical inspection to assess both active and inactive areas of the landfill footprint. This includes checking the cover for potential issues such as cracking, erosion (especially during snowmelt), or slumping, and evaluating the condition of any infrastructure that does not receive regular inspection or maintenance. If geotechnical concerns are identified, a Qualified Professional should be retained to review and address any problems.



Additional inspections should be carried out to detect ditch clogging and blow-outs, sediment accumulation, leachate break-outs and seeps, and to assess the overall effectiveness of fencing.

7.1.9 Annual Reporting

All monitoring data should be compiled annually into a comprehensive Annual Environmental Monitoring Report. Annual reporting is a useful way to ensure that all necessary monitoring is being completed. It is required that the monitoring report be developed and/or signed off by a Qualified Professional.

As per the Landfill Criteria, the Annual Environmental Monitoring Report should include:

- Results of the monitoring program.
- Data tabulation, comparison to performance criteria, interpretation, graphs, and trends.
- Identification of non-compliance and anticipated future non-compliance.
- Conclusions, recommendations, and proposed changes to the monitoring program.

7.2 Post Closure Period

The post-closure period is defined as the time from when a landfill stops receiving waste to the end of its contaminating lifespan, with a minimum duration of 30 years. After landfill closure, the facility will continue receiving waste at the waste transfer station area, which is considered separate from the landfill and will not extend the post-closure period. Section 8.3 of the Landfill Criteria requires a technical analysis by a Qualified Professional to determine the contaminating lifespan. In the absence of such an analysis, default lifespans are used: 50 years for landfills with less than 100,000 tonnes of waste, 100 years for landfills with less than 1,000,000 tonnes of waste, and 200 years for landfills with more than 1,000,000 tonnes of waste.

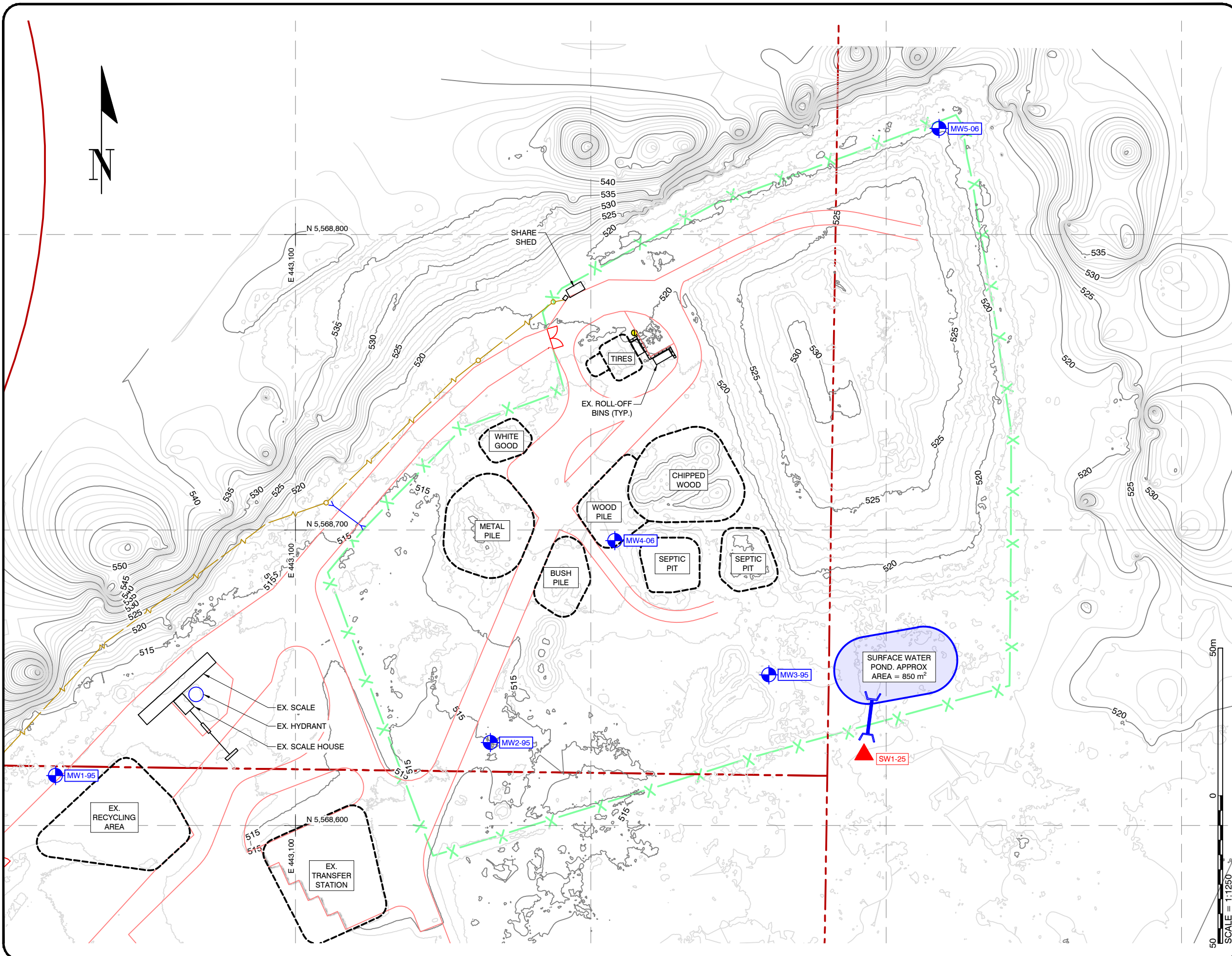
The Nakusp Landfill currently contains less than 100,000 tonnes of waste and will remain below this limit at closure. Therefore, the default contaminating lifespan for the Nakusp Landfill is 50 years.

The purpose of the assessment is to determine the post-closure period during which post-closure maintenance of the landfill should be performed. The Criteria also recommend that landfill sites be designed so that the service life of the facilities exceeds the contaminating lifespan.

7.2.1 Contaminating Lifespan Assessment

SHA completed a contaminating lifespan assessment which is included in Appendix B. Based on the modelling and the continued support of a post closure maintenance plan, a 30 year post closure period is recommended.

PDF GENERATED by: Angus Tsang | 2/19/2025 11:42 AM
X:\PRJ\PRJ24\PRJ24072 - NAKUSP LANDFILL FILL TO CLOSURE AND CLOSURE PLANNING\06_AUTOCAD DRAWINGS\01_DRAWINGS\PRODUCTION DRAWINGS\CLOSURE CONCEPT\FIG 7-1 MW.DWG



Landfill Services Group

- Landfill Siting
- Design & Operations Plans
- Landfill Closure
- Environmental Monitoring

#8 - 1225 Keith Road East
North Vancouver, B.C. V7J 1J3
Phone: (604) 986-7723

LEGEND:

- (1m) EG MIN. CONT. - 2024 NOV 5
- (5m) EX. MAJ. CONT. - 2024 NOV 5
- EXISTING ROAD
- PROPERTY LINE
- EXISTING ELECTRIC FENCE
- PROPOSED ROAD
- POST CLOSURE GROUNDWATER MONITORING LOCATIONS
- POST CLOSURE SURFACE WATER MONITORING LOCATIONS

CLIENT:



PROJECT:

NAKUSP LANDFILL FILL TO CLOSURE AND CLOSURE PLANNING

TITLE:

POST CLOSURE MONITORING LOCATIONS

SCALE:

1:1250

DATE:

2025/02/04
yyyy/mm/dd

PROJECT NO:

PRJ 24072

DESIGNED

SG/BH

DRAWING NO:

DRAWN

AT

FIGURE 7-1

CHECKED

SG



8. COST ANALYSIS

8.1 Introduction

This chapter outlines the estimated closure and post-closure costs for the landfill. These estimates encompass all capital expenses, including engineering and construction. The construction unit costs are derived from SHA's extensive experience with closure projects across British Columbia. The cost estimates provided below reflect the average unit costs observed during actual landfill construction projects in BC, as well as industry-standard rates for similar work.

8.2 Closure Cost Estimates for the Nakusp Landfill

Closure cost estimates have been developed for the Landfill for the cost of construction and engineering services. Engineering costs are estimated at 15% of the cost of construction. A 20% contingency has also been included at this stage, which will be reduced to 10% following detailed design.

Capital costs for closure have been itemized and priced and are included in Table 8-2 at the end of this Chapter. A summary of closure costs is presented below in Table 8-3. The construction closure cost for the Landfill, excluding engineering and contingency costs, is estimated at \$1,077,760 excluding GST. The calculated unit rate for closure construction over a closure area of 13,000 m² is approximately \$83/m². The project will require engineering services and an appropriate contingency amount for dealing with unexpected extras that may be encountered. Contingency costs for engineering and construction have been included at 15% and 20%, respectively. SHA does not foresee engineering costs for detailed design and construction QAQC ultimately being 15% of the overall costs, but recommends the RDCK carry the allowances in their budgeting in the event there are changes to the scheduling or to make sure funds are available for unforeseen events.

Table 8-3: Summary of Closure Costs

Item	Total Cost
Closure Area = 30,390 m²	(\$)
Road and Ditch Works	\$120,760
Landfill Closure Site Regrading	\$130,000
Storm Water Pond Construction	\$63,000
Cover System	\$650,000
Landfill Gas System	\$114,000
Total Construction	\$1,077,760
Engineering (estimated @15%)	\$161,164
Contingency (estimated @20%)	\$215,552
Total Cost for Closure Including Engineering and Contingency	\$1,454,976



8.3 Post Closure Costs

Post-closure costs generally include maintenance of the landfill final cover, operation and maintenance of leachate management facilities if applicable, operation and maintenance of landfill gas management facilities, operation and maintenance of site infrastructure including surface water control works, roads, fences, and annual environmental monitoring and reporting. Estimated annual post closure costs for the Landfill \$40,000 /year excluding contingency and GST and are summarized in Table 8-4. The calculated closure unit cost over the closure area of 13,000 m² is approximately \$3/m².

Table 8-4 Estimated Annual Post Closure Costs					
Item	Quantity	Units	Unit Cost	Sub-Cost	Total Cost
Closure Area = 13,000 m²			(\$)	(\$)	(\$)
Maintenance					\$12,000
Cover system maintenance	1	LS	\$5,000	\$5,000	
Passive Gas Vent System Maintenance	1	LS	\$2,000	\$2,000	
Storm Water Pond and Ditch Maintenance	1	LS	\$5,000	\$5,000	
Monitoring and Reporting					\$18,000
Annual Water Quality Monitoring	1	LS	\$7,500	\$12,000	
Annual Settlement Survey	1	LS	\$1,000	\$1,000	
Annual Reporting	1	LS	\$5,000	\$5,000	
Administration					\$10,000
Local Staff	1	LS	\$10,000	\$10,000	
TOTAL excluding GST					\$40,000
Total excluding GST with Contingency (10%)					\$44,000
			Unit Cost (per m²) = \$3.08		

It is important to note that over the post-closure period, due to inflation, the cost for monitoring will inevitably increase. Please note that inflation has not been accounted for in our projections.

As outlined in Chapter 7, the post closure period for which post-closure care will be required is determined based on the contaminating lifespan of the landfill. Based on the model results, SHA recommends 30 years of intensive post-closure monitoring following final closure of the site, defined as the day at which the site stops receiving waste (i.e. 2025). Therefore, post closure monitoring of this site should be conducted until 2055.



TABLE 8-2 - Estimate of Closure Costs					
Item	Quantity	Units	Unit Cost	Sub-Cost	Total Cost
Closure Area = 13,000 m²			(\$)	(\$)	(\$)
Road and Ditch Works					\$120,760
Granular Road Base	144	m3	\$40	\$5,760	
Surface Water Ditches inc. excavatioin and armoring	450	m	\$250	\$112,500	
Culverts	1	LS	\$2,500	\$2,500	
Landfill Closure Site Regrading (Cover Material excluded)					\$130,000
Re-grading: cut and fill earthworks to achieve design grades	13,000	m2	\$8.00	\$104,000	
Site Grading; smoothing and proof rolling	13,000	m2	\$2.00	\$26,000	
Surface Water Pond Construction					\$63,000
Excavate Pond Geometry	2500	m3	\$20	\$50,000	
Construct Spillway	1	LS	\$5,000	\$5,000	
Construct Outlet Structure	1	LS	\$8,000	\$8,000	
Cover System					\$650,000
8 Oz Non-Woven Geotextile	13,000	m2	\$7	\$91,000	
Double Textured 40 mil LLDPE Membrane	13,000	m2	\$19	\$247,000	
8 Oz Non-Woven Geotextile	13,000	m2	\$7	\$91,000	
Subsoil / Pit Run - 450mm	5,850	m3	\$25	\$146,250	
Topsoil	1,950	m3	\$25	\$48,750	
Seeding	13,000	m3	\$2	\$26,000	
Landfill Gas System					\$114,000
Passive Gas Collection Piping and Venting	13,000	m2	\$8	\$104,000	
Perimeter LFG Probes	1	LS	\$10,000	\$10,000	
Total Construction					\$1,077,760
Engineering (estimated @15%)					\$161,664
Contingency (estimated @20%)					\$215,552
Total Cost for Closure Including Engineering and Contingency					\$1,454,976



9. LIMITATIONS

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

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

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

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

We appreciate the opportunity to work with the RDCK on this project. Please do not hesitate to contact the undersigned if you have any questions.

Sincerely,

SPERLING HANSEN ASSOCIATES

EGBC Permit Number 1003066

Report prepared by:

Bryan Houle, P.Eng.
Project Engineer

Dr. Iqbal Bhuiyan, P. Eng.
Senior Environmental Engineer





Report reviewed by:

A handwritten signature in black ink, appearing to read "S. Garthwaite".

Scott Garthwaite, ASCT
Sr. Landfill Consultant / Director

APPENDICES

APPENDIX A
OPERATIONAL CERTIFICATE 16521



MINISTRY OF
ENVIRONMENT

OPERATIONAL CERTIFICATE

16521

Under the Provisions of the Environmental Management Act

REGIONAL DISTRICT OF CENTRAL KOOTENAY

BOX 590

202 LAKESIDE DRIVE

NELSON, BRITISH COLUMBIA

V1L 5R4

is authorized to manage waste and recyclable material from the Regional District of Central Kootenay and environs at the Nakusp landfill located near Nakusp, British Columbia, subject to the conditions listed below. Contravention of any of these conditions is a violation of the *Environmental Management Act* and may result in prosecution.

This Operational Certificate supersedes all previous versions of the Operational Certificate MR-16521 issued under the authority of the *Environmental Management Act*.

1. **AUTHORIZED DISCHARGES**

This authorization applies to the discharge of municipal solid waste, commercial and light industrial refuse to a sanitary landfill known as the Nakusp landfill. The site reference number for this discharge is E211814.

- 1.1 The authorized works are a sanitary landfill and related appurtenances approximately located as shown on Site Plan A.
- 1.2 The maximum quantity of waste discharges must not exceed the design capacity of the landfill as specified in the approved Design and Operations Plan. The final footprint and profile of the discharges waste must be within that specified in the Design and Operations Plan, and roughly as shown on the attached Site Plan A.

Date issued: November 29, 2000
Date amended: August 8, 2014
(most recent)

Sajid A. Barlas, Ph.D., P.Ag.
for Director, *Environmental Management Act*
Southern Interior Region - Kootenay

- 1.3 The authorized discharge is municipal solid waste as defined in the *Environmental Management Act* and other waste as may be authorized by the Director.
- 1.4 The legal description of the location of the authorized landfill facility is an unsurveyed part of District Lot 863, Kootenay District.
- 1.5 The site is located approximately 1.2 km northeast of the Nakusp Municipal Airport.

2. DESIGN AND PERFORMANCE REQUIREMENTS

2.1 Design and Operating Plan

The Operational Certificate holder must prepare and maintain a current Design and Operations Plan prepared by a qualified professional. The Plan must be reviewed and updated as needed at least once every five years. The Plan must address, but not be limited to, each of the subsections in the Landfill Criteria for Municipal Solid Waste including performance, siting, design, operational, closure and post-closure criteria. The facilities must be developed, operated and closed in accordance with the Plan. Should there be any inconsistency between this Operational Certificate and the Plan, this Operational Certificate must take precedence.

Written authorization from the Director must be obtained prior to implementing any changes to the approved plans. Based on any information obtained in connection with this facility, the Director may require revision of, or addition to, the design, operating and closure plans.

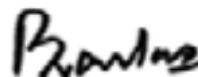
2.2 Qualified Professionals

All facilities and information, including works, plans, assessments, investigations, surveys, programs and reports, must be certified by Qualified Professionals.

2.3 Maintenance of Works and Emergency Procedures

The authorized works must be inspected regularly and maintained in good working order. In the event of an emergency or condition beyond the control of the Regional District of Central Kootenay including, but not limited to, unauthorized fires arising from spontaneous combustion or other causes, or

Date issued: November 29, 2000
Date amended: August 8, 2014
(most recent)



Sajid A. Barlas, Ph.D., P.Ag.
for Director, *Environmental Management Act*
Southern Interior Region - Kootenay

detection of leachate on the property, the Regional District of Central Kootenay must take appropriate remedial action and notify the Director immediately. The Director may reduce or suspend operations to protect the environment until the authorized works has been restored, and/or corrective steps taken to prevent unauthorized discharges.

2.4 Additional Facilities or Works

The Director may require investigations, surveys, and the construction of additional facilities or works. The Director may also amend any information requirements of this Operational Certificate including plans, programs, assessments and reports.

2.5 Public Health, Safety and Nuisance

The landfill must be operated in a manner such that it will not create a public nuisance or become a significant threat to public health or safety with respect to landfill gas, unauthorized access, roads, traffic, airport activity, noise, dust, litter, vectors, or wildlife attraction.

2.6 Ground and Surface Water Quality Impairment

The landfill must be operated in a manner such that ground or surface water quality does not decrease beyond that specified by the British Columbia Water Quality Guidelines, or other appropriate criteria as may be specified by the Director, at or beyond the landfill property boundary.

These measures include but are not limited to:

- a) Prohibiting the discharge of municipal solid waste into water.
- b) Ensuring that no new waste is landfilled within 1.2 m of the highest groundwater level.
- c) Ensuring that adequate surface water and groundwater diversion works are constructed and maintained to minimize surface water run-off and groundwater seepage from entering the landfill.
- d) Ensuring that the management systems for surface water that has not come in contact with waste are hydraulically separate from those for managing impacted surface water.

Date issued: November 29, 2000
Date amended: August 8, 2014
(most recent)



Sajid A. Barlas, Ph.D., P.Ag.
for Director, *Environmental Management Act*
Southern Interior Region - Kootenay

- e) Ensuring that the landfill is operated in a manner that prevents the exceedance in surface water and groundwater of anticipated leachate indicators or parameters distinctive of leachate or those specified by the Director at the landfill boundary.
- f) Ensuring that the indicators in e) above, at specified groundwater monitoring wells within the property boundary are in accordance with those predicted by design and that suitable measures are taken to address the cause of any exceedances.
- g) Ensuring that the landfill is operated in accordance with a Design & Operations Plan which specifies measures to prevent decreases in groundwater and surface water quality at and beyond the property boundary.

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

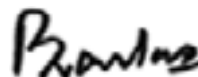
2.7 **Landfill Gas Management**

The Landfill must not cause combustible gas concentrations to exceed the lower explosive limit in soils at the property boundary or 25% of the lower explosive limit at or in on-site or off-site structures.

The Operational Certificate holder must ensure that the facility is in compliance with the requirements of the Landfill Gas Management Regulation under the Greenhouse Gas Reduction (Emissions Standards) Statutes Amendment Act, 2008 on or before applicable dates specified in the regulation. The requirements of the regulation and its guideline documents must be incorporated by the Operational Certificate holder into the Design and Operation Plan revisions as they come into effect and as applicable.

2.8 **Buffer Zone**

Date issued: November 29, 2000
Date amended: August 8, 2014
(most recent)



Sajid A. Barlas, Ph.D., P.Ag.
for Director, *Environmental Management Act*
Southern Interior Region - Kootenay

No material must be landfilled within 50 metres of the property boundary.
Any new facilities or extension of the landfill will be subject to this revised
buffer
requirement.

3. **OPERATIONAL REQUIREMENTS**

3.1 **Waste Compaction and Coverage**

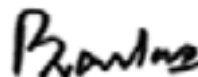
The Operational Certificate holder must ensure that waste deposition and compaction meets or exceeds the requirements of the BC Landfill Criteria or its most current version for daily, intermediate and final cover. Control must be exercised to ensure keeping freshly deposited refuse in a well defined and small / manageable working face.

3.2 **Prohibited Wastes**

The disposal of the following types of wastes is strictly prohibited:

- (a) Hazardous Wastes other than those specifically approved for disposal to authorized landfills in the Hazardous Waste Regulation under the Environmental Management Act.
- (b) Biomedical wastes as defined in the Guidelines for the Management of Biomedical Wastes in Canada (Canadian Council of Ministers of the Environment, February 1992),
- (c) Bulk liquids and semi-solid wastes, which contain free liquids, as determined by US EPA Method 90954 Paint Filter Liquids Test, Test Methods for Evaluating Solid Wastes-Physical/Chemical Methods (EPA Publication No. Sw-846),
- (d) Release of ozone depleting substances from the storage, handling and disposal of used appliances, equipment, or any material containing ozone depleting substances is prohibited in accordance with the requirements of the Ozone Depleting Substances Regulation. Onsite

Date issued: November 29, 2000
Date amended: August 8, 2014
(most recent)



Sajid A. Barlas, Ph.D., P.Ag.
for Director, *Environmental Management Act*
Southern Interior Region - Kootenay

removal or evacuation of Ozone Depleting Substances (ODS) from appliances and the subsequent storage of appliances on site is permitted subject to both activities being in compliance with the Ozone Depleting Substances Regulation

- (e) Additional waste types may be deposited with the Director's approval.

3.3 **Waste Asbestos**

Waste asbestos is authorized for disposal subject to compliance with the requirements of section 40 of the Hazardous Waste Regulation and the following conditions:

- (a) The asbestos waste may not be mixed with any other hazardous waste.
- (b) The Regional District must approve the disposal before disposal takes place.
- (c) All other applicable requirements of the Hazardous Waste Regulation, including but limited to manifesting and waste record keeping, must also be complied with.

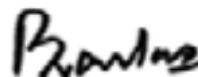
3.4 **Contaminated Soil**

Soil that contains contaminants in concentrations less than "hazardous waste" as defined by the Hazardous Waste Regulation may be disposed of at the landfill site. Disposal includes monofilling, co-disposal with other wastes, use as a refuse cell berm material and use as a refuse cell cover material. Disposal does not include use as final cover material.

3.5 **Wildlife and Vector Control**

Vectors (carriers capable of transmitting a pathogen from one organism to another including, but not limited to flies and other insects, rodents, and birds) must be controlled by the application of cover material at the required frequency or by such additional methods as specified by the Director. Wildlife control fencing must be maintained around the perimeter of the landfill site and must be electrified for at least the active bear season of each year.

Date issued: November 29, 2000
Date amended: August 8, 2014
(most recent)



Sajid A. Barlas, Ph.D., P.Ag.
for Director, *Environmental Management Act*
Southern Interior Region - Kootenay

This landfill must be operated so as to minimize the attraction of wildlife such as bears and birds by applying cover at required frequencies and instituting a good housekeeping program.

3.6 **Site Access and Supervision**

A landfill operator that has received BC Qualified Landfill Operator training, is familiar with the requirements of the Operational Certificate and the specifications of the Design and Operations Plan, must be present at all times during operating hours.

Locking gates must be maintained at all access routes to the landfill site. Gates, perimeter fencing and/or barriers must be installed where necessary to prevent unauthorized access to the site by vehicles. Gates must be locked during non-operating hours.

3.7 **Dust Control**

Dust created within the landfill property must be controlled, using methods and materials acceptable to the Director, such that it does not cause a public nuisance.

3.8 **Litter Control**

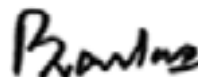
The best practical means must be used to prevent the scatter of litter. Any litter scattered into the neighbouring property, along access roads, in drainage ditches, along litter-control fences, into surrounding trees or elsewhere on the landfill site must be cleaned up. The frequency of clean-up and other additional requirements for refuse scatter control must be determined by the Director.

3.9 **Waste Reduction and Alternate Disposal**

The Provincial Government has developed policies to promote the reduction, reuse and recycling of wastes. The Operational Certificate holder is encouraged to segregate for recycling and reuse, where possible, materials destined for disposal at this site.

Public scavenging must not be permitted at the landfill. The controlled salvaging of waste by the landfill operator or persons authorized by the Operational Certificate holder is encouraged if areas or facilities for separation and storage of recyclable or reusable materials are provided.

Date issued: November 29, 2000
Date amended: August 8, 2014
(most recent)



Sajid A. Barlas, Ph.D., P.Ag.
for Director, *Environmental Management Act*
Southern Interior Region - Kootenay

In certain landfill environments, some construction and demolition debris or other wastes may create specific air and water quality concerns. If problems arise at this site that is attributable to specific wastes, the Director may require that alternate disposal/storage procedures be implemented

3.10 **Fire Prevention & Control**

The Operational Certificate holder must take all reasonable measures to prevent fires from occurring at the site and is responsible for complying with all local fire safety requirements. The Operational Certificate holder must provide and maintain firefighting equipment and materials as required for the site.

In the event of a landfill fire the following must be notified immediately:

- The Fire Department
- Provincial Emergency Program (PEP)
- The Regional Manager Environmental Protection

3.11 **Operations and Maintenance Manual**

The Operational Certificate holder must prepare an Operations and Maintenance Manual to be reviewed and updated annually.

3.12 **Sign Requirements**

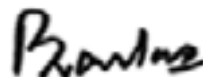
A sign must be posted at each entrance gate with the following current information;

- a. Site name;
- b. Contact phone number and address for owner;
- c. Phone number in case of emergency;
- d. Hours and days of operation;
- e. Materials/waste accepted for landfill; and
- f. Tipping fees.

Additional signs which clearly indicate the directions to the active tipping face, public disposal area, recycling and waste separation areas, etc. should also be displayed within the landfill site as deemed necessary.

4. **MONITORING AND REPORTING REQUIREMENTS**

Date issued: November 29, 2000
Date amended: August 8, 2014
(most recent)



Sajid A. Barlas, Ph.D., P.Ag.
for Director, *Environmental Management Act*
Southern Interior Region - Kootenay

4.1 **Landfill Monitoring**

A monitoring program must be developed by a Qualified Professional and identify potential environmental impacts of the authorized facility and must address but not be limited to the Landfill Criteria for Municipal Solid Waste and Guidelines for Environmental Monitoring. The monitoring program must be submitted to the satisfaction of the Director. Monitoring must be conducted in accordance with the monitoring program.

The program must be designed to assess and identify:

- The design performance of the landfill as per the Design & Operations Plan including but not limited to compliance with water quality performance standards at the landfill boundary.
- Landfill leachate as a contaminant source.
- Residential well water quality.
- Surface water quality.

The Environmental Monitoring Program must take into consideration results from previous monitoring programs and any other investigations conducted at the site to ensure that early detection of potential impacts is possible.

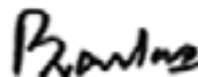
4.2 **Sampling Techniques**

Sampling must be carried out in accordance with the procedures described in the most recent edition of the "British Columbia Field Sampling Manual for Continuous Monitoring Plus the Collection of Air, Air-Emission, Water, Wastewater, Soil, Sediment, and Biological Samples", or by suitable alternative procedures as authorized by the Director. A copy of the above manual may be purchased from the Queen's Printer Publications Centre, P.O. Box 9452, Stn. Prov. Gov't., Victoria, British Columbia, V8W 9V7.

4.3 **Analysis**

Analyses are to be carried out in accordance with procedures described in the most recent edition of the "British Columbia Environmental Laboratory Manual for the Analysis of Water, Wastewater, Sediment and Biological Materials", or by suitable alternative procedures as authorized by the Director. A copy of the above manual may be purchased from the Queen's Printer Publication Centre, P.O. Box 9452, Stn. Prov. Gov't., Victoria, British Columbia, V8W 9V7 (1-800-663-6105 or (250) 387-6409).

Date issued: November 29, 2000
Date amended: August 8, 2014
(most recent)



Sajid A. Barlas, Ph.D., P.Ag.
for Director, *Environmental Management Act*
Southern Interior Region - Kootenay

4.4 **Quality Assurance**

The Operational Certificate holder must produce, within 60 days on the request of the Regional Manager Environmental Protection, 'Field and Laboratory Quality Protocols and Quality Assurance Criteria' acceptable to the Director. The 'Laboratory Quality Protocols' must include the procedures used to assess precision, accuracy and blank quality, including frequency of application of those procedures, the procedures for sampling, handling (e.g. preservation, hold times) and corrective measures to be initiated when deficiencies are indicated. The 'Quality Assurance Criteria' must include the acceptance criteria for accuracy (based on recoveries for reference samples/spikes), for precision (based on deviation in field and lab duplicates) and method blanks (designed to indicate false positives).

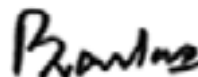
5. **LANDFILL REPORTING**

5.1 **Annual Report**

The Operation Certificate holder must submit an Annual Report to the Director on or before April 30th each year for the previous calendar year. The report must contain at least the following information:

- (a) an executive summary;
- (b) the type and tonnage of waste received, recycled, stored on-site and discharged / landfilled for the year;
- (c) Any proposed changes to the Design and Operations Plan and the environmental monitoring program (EMP), with rationale for the changes; a description of unanticipated occurrences and any changes to the closure or post-closure plans and funds;
- (d) A review of the preceding year of operation or an operations update which summarizes landfill development work completed in the subject reporting year and work planned for the subsequent year. A summary of any new information or changes to the facilities and plans, assessments, surveys, programs and reports;
- (e) Occurrences or observations of wildlife (medium and large carnivores) at the facility;

Date issued: November 29, 2000
Date amended: August 8, 2014
(most recent)



Sajid A. Barlas, Ph.D., P.Ag.
for Director, *Environmental Management Act*
Southern Interior Region - Kootenay

- (f) A statement regarding the facility's progress in reducing the regional solid waste stream being landfilled and the objectives of the Regional Solid Waste Management Plan;
- (g) An outline of the current Environmental Monitoring Program and a compendium of all environmental monitoring data in accordance with requirements specified in the most recent version of Guidelines for Environmental Monitoring at Municipal Solid Waste Landfills and Landfill Criteria for Municipal Solid Waste. The annual report must document any effect of the discharge on the quality of the receiving environment using appropriate statistical and graphical analysis. Trend analyses, as well as an evaluation of the impacts of the discharges on the receiving environment must be included;
- (h) A list of training programs completed for landfill operators during the previous year; and
- (i) Any additional information requested by the Director.

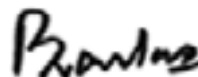
All reports must be submitted, suitably formatted and tabulated in both print and electronic format (portable document format).

5.2 **Five Year Report**

The Operation Certificate holder must submit a Five Year Report to the Director on or before April 30th on the five year anniversary of the last submission. The report must contain at least the following information:

- (a) An executive summary;
- (b) An updated Design and Operations Plan;
- (c) A detailed hydrogeological assessment;
- (d) The type and tonnage of waste received, recycled, stored on-site and discharged / landfilled for the year;
- (e) A current topographic map detailing airspace consumption, on-site borrow pit changes and future developments;

Date issued: November 29, 2000
Date amended: August 8, 2014
(most recent)



Sajid A. Barlas, Ph.D., P.Ag.
for Director, *Environmental Management Act*
Southern Interior Region - Kootenay

- (f) Volume and density analysis or an in-place material summary, updated estimates for the remaining capacity, site life, revised closure date (for the current phase or sequence and revised closure date for the current landfill footprint);
- (g) An outline of the current Environmental Monitoring Program and a compendium of all environmental monitoring data in accordance with requirements specified in the most recent version of Guidelines for Environmental Monitoring at Municipal Solid Waste Landfills and Landfill Criteria for Municipal Solid Waste. The annual report must document any effect of the discharge on the quality of the receiving environment using appropriate statistical and graphical analysis. Trend analyses, as well as an evaluation of the impacts of the discharges on the receiving environment must be included;
- (h) An update on the financial assurance mechanism including a statement of the current dollar value of the Closure Fund and the amount earmarked for the Landfill site; and
- (i) Any additional information requested by the Director.

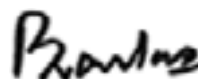
6. **LANDFILL CLOSURE PLAN**

6.1 **Closure Plan and Post Closure**

The Operational Certificate holder must perform closure and post-closure care in accordance with all applicable requirements of the BC Landfill Criteria for Municipal Solid Waste. This Operational Certificate is issued on the condition that a Closure Plan and Final Cover Design that meets or exceeds the requirements of the criteria will be submitted to the Director during the operating life of the landfill. The Closure Plan must be reviewed every five years throughout the operating life of the landfill.

A certification by a Qualified Professional attesting that all closure works have been completed in accordance with the Closure Plan and Final Cover Design is to be submitted to the Director no later than 60 days after the implementation of the Final Cover Design.

Date issued: November 29, 2000
Date amended: August 8, 2014
(most recent)



Sajid A. Barlas, Ph.D., P.Ag.
for Director, *Environmental Management Act*
Southern Interior Region - Kootenay

The Operational Certificate Holder must submit a Post Closure or Aftercare Plan to the Ministry at least one year prior to the anticipated closure date of the landfill.

6.2 **Closure Fund**

The Operational Certificate holder must provide for the funding of progressive closure operations, final closure and operations beyond closure by maintaining a closure fund. The value of the closure fund must meet or exceed the estimated closure and post-closure costs as established in the approved Design and Operations Plan and updated in the annual report, plus a reasonable contingency for any remediation which may be required. Reported costs must be adjusted for inflation annually. Alternately, a closure and post-closure financial security acceptable to the Director may be built over time.

The Operational Certificate holder must determine and ensure that the closure fund is adequate by preparing annually a financial statement of the fund which must be made available to the Director upon request. The financial statement must report the accrued capital, interest and additions to the fund for the previous year and review the sufficiency of the fund and the rate of accrual in consideration of the projected costs of closure and post-closure obligations.

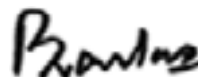
6.3 **Site Decommissioning**

In accordance with Section 40 of the Environmental Management Act and Part 2 of the Contaminated Sites Regulation, the Operational Certificate holder must submit a site profile to the manager at least ten days prior to decommissioning the facilities authorized in Section 1.

6.4 **Declaration of Landfill**

Landfills sited on titled land must register a covenant that the property was used for the purpose of waste disposal as a charge against the title to the property as

Date issued: November 29, 2000
Date amended: August 8, 2014
(most recent)



Sajid A. Barlas, Ph.D., P.Ag.
for Director, *Environmental Management Act*
Southern Interior Region - Kootenay

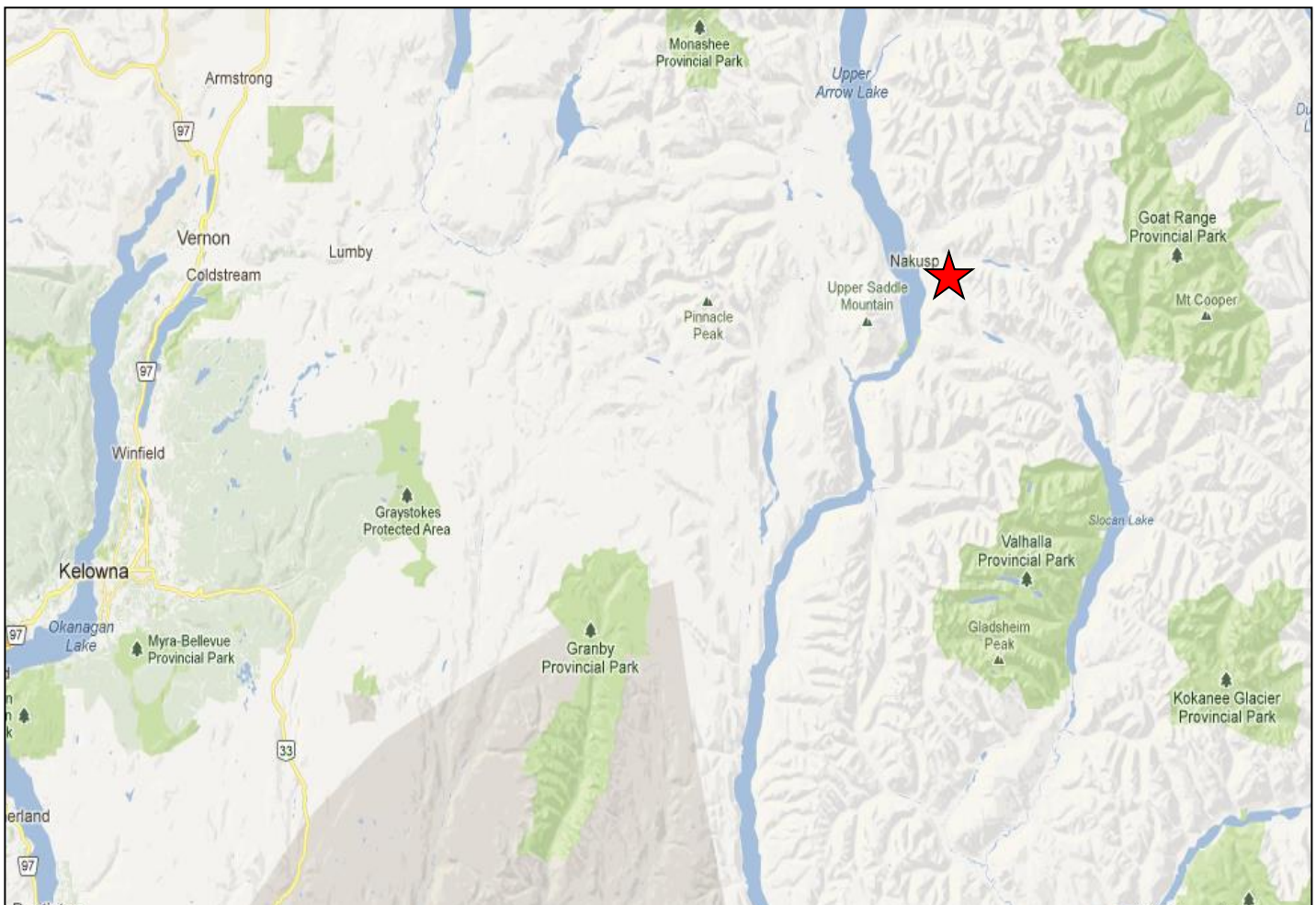
provided for under Section 215.1 of the Land Title Act. Landfills located on crown land are to have a “notation on file” registered that the property was used for the purpose of waste disposal.

The Operational Certificate holder must, upon closure of the landfill, register a charge against the property title, or provide other legal notification acceptable to the Director that the property described in Section 1 was used for the purpose of waste disposal. The Director must be notified of the charge or legal notification.

Site Plan A



Location Map



Date issued: November 29, 2000
Date amended: August 8, 2014
(most recent)



Sajid A. Barlas, Ph.D., P.Ag.
for Director, *Environmental Management Act*
Southern Interior Region - Kootenay

APPENDIX B
CONTAMINATING LIFESPAN ASSESSMENT

Nakusp Landfill Contaminating Lifespan Assessment



PREPARED FOR: REGIONAL DISTRICT OF CENTRAL KOOTENAY

PREPARED BY: SPERLING HANSEN ASSOCIATES

PRJ24072



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

Contents

1. Introduction	1
1.1 Model Overview.....	1
1.1.1 Critical Contaminants	2
1.1.2 Input Parameters.....	3
1.1.3 Underlying Soil Characteristics	3
1.1.4 Leachate Collection System.....	3
1.1.5 Model Results.....	5
1.1.6 Contaminating Lifespan Assessment Summary	5
2. Limitations.....	7
3. References.....	8

Figures

Figure 1 - Nakusp Landfill – Existing Topography

Figure 2 - Chloride Concentrations with Time and Depth (100 Yrs)

Figure 3 - Chloride Concentrations with Time and Depth (50 Yrs)

Figure 4 - Variation of Chloride Concentrations in Aquifer with Time

Tables

Table 1 – Characteristics of the Critical Contaminants

Table 2 – Contaminant Transport Model Input Parameters

1. INTRODUCTION

As per Section 7.4 of the BC Landfill Criteria for Municipal Solid Waste - 2nd Edition (the Criteria), owners of landfills in BC are recommended to complete a contaminating lifespan assessment to better understand the longevity of key contaminants. The purpose of the assessment is to determine the post-closure period when post-closure maintenance of the landfill should be performed. The Criteria also recommends that landfill sites be designed such that the service life of the facilities exceed the contaminating lifespan. The Regional District of Central Kootenay (RDCK) retained Sperling Hansen Associates (SHA) to complete the contaminating lifespan assessment for the Nakusp Landfill.

The contaminating lifespan of a landfill is defined in the Criteria as the period of time during which the landfilled waste has the potential to produce effluent or air contaminants. In Kerry Rowe's 1991 paper on *Contaminant Impact Assessment and the Contaminating Lifespan of Landfills*, the contaminating lifespan is defined as: "the period of time during which the landfill will produce contaminants at levels that could have unacceptable impact if they were discharged into the surrounding environment" (Rowe 1991). As Rowe outlines, the contaminating lifespan of a landfill depends mainly on the following factors:

- The mass of the contaminant per unit area (thickness and density of waste);
- The amount of infiltration through the cover system;
- The characteristics of the leachate produced; and
- The available pathway for contaminant release.

In general, if all other parameters are constant: the thicker the waste, the greater the mass of any given contaminant, and the longer the contaminating lifespan (Rowe 1991). Infiltration through the waste provides an opportunity for contaminants to be leached and removed from the waste mass; and as such, infiltration has an important role in removing contaminants from the source. The characteristics of the leachate produced will influence the contaminating lifespan and the amount of time it takes for an allowable concentration to be reached for each contaminant. And finally, the available pathway for release may also impact on the contaminating lifespan by contributing through attenuation.

1.1 Model Overview

A contaminating lifespan analysis for the Nakusp Landfill was completed using 1-D contaminant transport modelling. The computer program POLLUTE was used to predict the groundwater quality as contaminants migrated from the landfill into the groundwater environment. The impact of the landfill on the groundwater quality was assessed by comparing the predicted impact and concentrations to the BC Water Quality Guidelines. The modelling methodology is described below.

SHA notes that the Nakusp Landfill will have only unlined areas as none of the phases have basal liner.

1.1.1 Critical Contaminants

To undertake the assessment, critical contaminants related to landfills were identified. A critical contaminant is a contaminant that will have greater potential impact than other contaminants. For this analysis, Chloride was chosen as the critical contaminant based on the following considerations:

- Chloride has been proven to be an important leachate indicator at landfills;
- While they are not defined in BC, the critical contaminants typical for landfills and the associated leachate characteristics are defined in regulations in Ontario (O. Reg 232/98);
- Chloride is considered to be a common contaminant in the analysis in most jurisdictions.

The characteristics of chloride considered in our analysis are summarized below in Table 1:

Table 1- Characteristics of the Critical Contaminants

Contaminant	Initial Source Concentration	Half-Life in Leachate	Fresh Aquatic Life Standard	Drinking Water Standard
	(mg/L)	(Years)	(mg/L)	(mg/L)
Chloride	1,500 ^a	∞	600 ^b	<250 ^b

a: O.Reg. 232/98; b: BC Water Quality Guidelines;

As shown above, Table 1 indicates the initial source concentrations for Chloride that were used for the modelling, as well as the half-life of each contaminant in leachate, and the British Columbia Approved Water Quality Guidelines (BCWQG) for Freshwater Aquatic Life (AW) and Drinking Water (DW). Although the Contaminated Sites Regulation (CSR) standards may apply to the landfill following closure, SHA has used the BCWQG standards for the purpose of this assessment because these standards are more stringent than the CSR. For the purpose of this assessment, SHA has taken a conservative approach and used the lower limit of the standard; however, in some cases, the upper limit may be more applicable. The initial starting concentration of chloride in leachate was set at 1,500 mg/L as per Ontario Regulation 232/98 which is also highly conservative for the site.

The computer program POLLUTE was used to simulate contaminant transport in time and space. POLLUTE is a finite layer contaminant transport model that is based on the one-dimensional advection dispersion equation for porous media (GAEA Technologies et al., 2004). The model boundary conditions representing the contaminant source (i.e., the waste within the landfill) were considered to be finite mass type. The finite mass approach assumes that the mass of a potential contaminant within the landfill is finite and subsurface transport mechanisms, including radioactive/biological decay and leachate collection from the landfill remove contaminants from the waste. The finite mass approach results in a decrease in leachate source strength with time. This means that as the contaminants move towards the aquifer, attenuation occurs.

The transport mechanisms considered in POLLUTE are advection and hydrodynamic dispersion; a description of each is as follows:

- **advection** –the process whereby contaminants are transported as a result of groundwater movement; and
- **hydrodynamic dispersion** – the mechanism whereby the contaminants are transported due to diffusion (a gradient in their concentration) and mechanical dispersion (arising from heterogeneity in the size and the geometry of the soil pores).

The retardation mechanisms considered in POLLUTE include sorption and biological/chemical decay; a description of each is as follows:

- **Sorption** –the mechanism where contaminants are removed from solution by interaction with solid matters in the soil; and
- **Biological/chemical decay** – which removes the contaminants from the porewater phase, most of the time through first order decay.

The model allows the user to obtain concentrations of any contaminant at any specified depth and time as migration occurs through transport and retardation. It should be noted that the retardation mechanisms will not reduce concentration of chloride due to the infinite half-life of the contaminant.

1.1.2 Input Parameters

The contaminant transport modelling was performed for the Nakusp Landfill with unlined areas. The input parameters are listed in Table 2 below.

1.1.3 Underlying Soil Characteristics

The underlying stratigraphy has been discussed in the Hydrogeology and Hydrogeology Characterization Report – Nakusp Landfill (SLR, 2024). Based on the interpretation of bore hole logs and available information, a layer of 5 m (average) of sand and gravel, underlain by a layer of 5 m (average) gravel underlain by a layer of 3 m (average) silty sand overlying the sand aquifer (water table) below the bottom of the landfill bottom for the existing unlined footprint area has been assumed.

1.1.4 Leachate Collection System

As none of the phases has a basal liner, leachate is not collected and treated.

Table 2: Contaminant Transport Model Input Parameters

Input Parameter	Assumed/Estimated Value	Reference
Area: Unlined Area	1.3 Ha	See Figure 1
Average Length: Unlined Area	100 m	See Figure 1
Average Width: Unlined Area	120 m	See Figure 1
Height of Waste (Avg): Unlined Area	13 m	See Figure 1
Porosity of Sand	0.25	SLR, 2024
Hydraulic Conductivity of Sand and Gravel	4×10^{-6} m/s	SLR, 2024
Hydraulic Conductivity of Silty Sand	5×10^{-6} m/s	SLR, 2024
Dry Density of Sand and Gravel	2.0 g/cm ³	Booker et al., 2004
Diffusion Coefficient in Sand and Gravel	0.02 m ² /a	Booker et al., 2004
Infiltration: When landfill is closed	0.0075 m/a	HELP Modeling
Darcy Velocity – Unlined Area: Cover System Operational Cover System (Geomembrane) Failed	0.0075 m/a 0.0225 m/a	
Post-closure Life of Geomembrane in the un-lined Area	100 years	Booker et al., 2004
Horizontal Base Flow in Aquifer	794.7 m/a	SLR, 2024

1.1.5 Model Results

As mentioned, the POLLUTE Model was run for chloride for the unlined landfill. The landfill will reach the end of its lifespan this year i.e. 2025 (SHA, 2025).

It is expected that the cover system will continue to remain operational for a significant period following landfill closure. The results of the model are presented in Table 3 below.

Table 3: Summary of POLLUTE Modelling Results

Stage/Area of the Landfill	Parameter	Maximum Concentration in Aquifer in mg/L (Post-closure Years to Reach Concentration)	Standard (mg/L)
Unlined Footprint Area ^a	Geomembrane Cover System Fails after 100 years		
	Chloride	1.08 (460 years)	250
	Geomembrane Cover System Fails after 50 years		
	Chloride	1.10 (420 years)	250

a: No leachate treatment system in place, Note: Closure in 2025

1.1.6 Contaminating Lifespan Assessment Summary

From the contaminant transport modeling using preliminary assumed parameters, the maximum concentration of chloride found in the saturated aquifer underlying the landfill is estimated to be below the standard of only 1.08 mg/L if the geomembrane failure is assumed to happen in 50 years after closure while its only 1.10 mg/L if the geomembrane failure occurs in 100 years after closure (see Figures 2-4).

An effective final cover system, leachate management system, and LFG management system would eliminate potential contaminants if assured by implementing a Post-closure Maintenance Plan. A minimum contaminating lifespan of 30 years post-installation of the final cover can be recommended, subject to the ongoing implementation of following six action items:

1. Maintenance of the final cover system so that it remains effective. This maintenance should include consideration of the estimated lifespan of LLDPE geomembrane, which is estimated to be on the order of more than 100 years;
2. Operation and maintenance of the leachate management system. Leachate generation at a phase is expected to be minimal once the phase has received a geomembrane final cover;
3. Maintenance of the surface water drainage control system;
4. Operation and maintenance of the landfill gas management system. LFG generation for any given phase is expected to decline with time after the phase has been closed. As a

- result, the LFG generation rate for each phase is expected to exhibit a significant reduction 30 years after closure and is expected to continue to decline thereafter;
5. On-going environmental monitoring including maintenance and replacement of monitoring stations, if required (e.g., ground water monitoring wells, etc.); and
 6. Accurate record keeping on all key elements of post-closure operation and monitoring.

Section 7.3 of the Criteria requires that the “post-closure operation and maintenance shall be done in accordance with the Closure Plan” and Section 7.4 of the Criteria requires that, “As part of the Closure Plan, the contaminating lifespan of the landfill shall be determined using the latest updated environmental monitoring information.”

SHA suggests that the scope of post-closure undertakings be reassessed annually based on the recent monitoring results. If any of the aforementioned post closure activities are not implemented, a reevaluation of the contaminating lifespan will be required based on the updated monitoring results.

SHA recommends a minimum 30-year post-closure care period, contingent on the effective implementation of the aforementioned recommended Post-closure Maintenance Plan, encompassing detailed post-closure operations, maintenance programs, and specified environmental monitoring outlined in Section 10.3.4 of the Criteria.

2. LIMITATIONS

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

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

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

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

We appreciate the opportunity to work with the RDCK on this project. Please do not hesitate to contact the undersigned if you have any questions.

Report Prepared by:

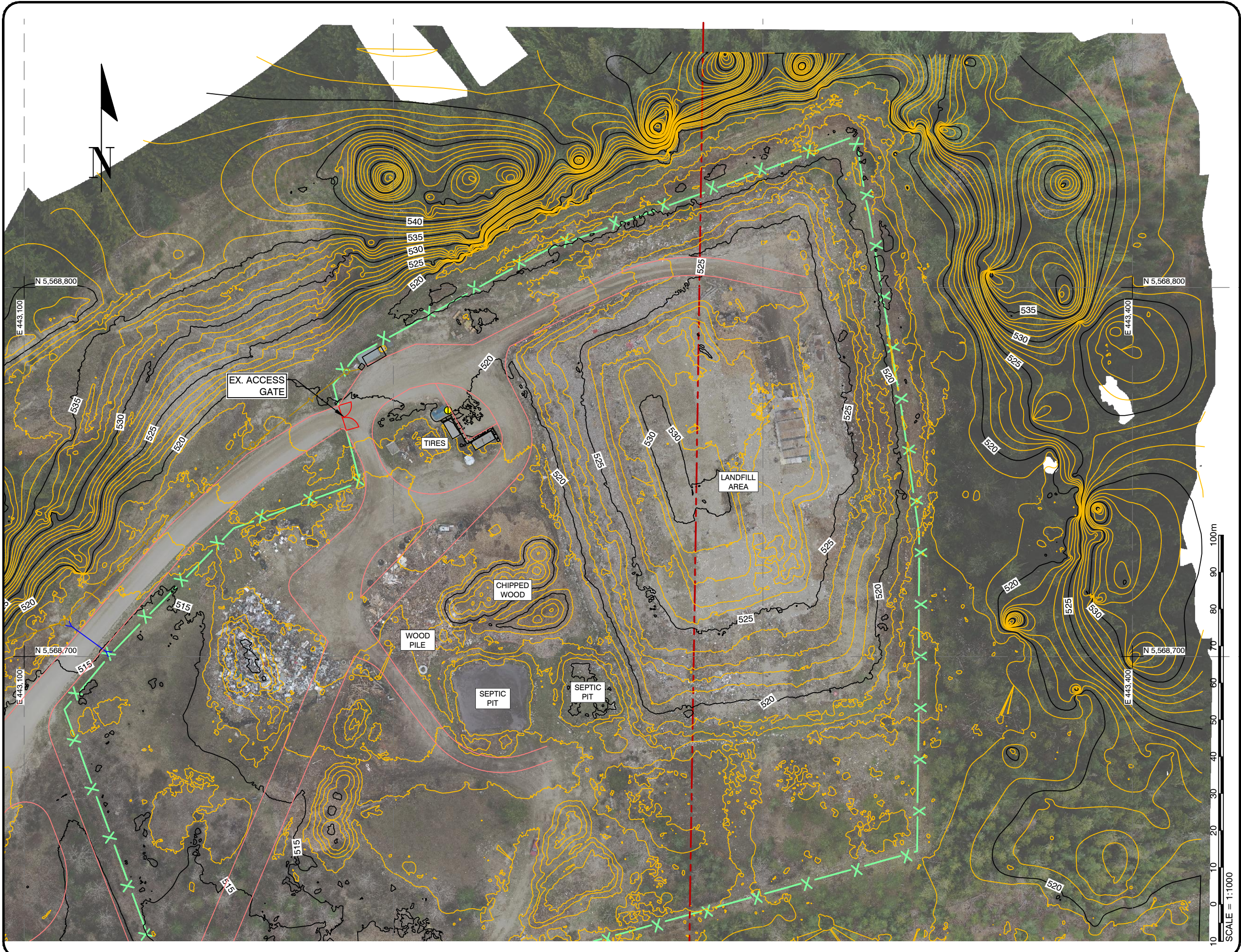


Dr. Iqbal Bhuiyan, P. Eng.
Senior Environmental Engineer

3. REFERENCES

7. Booker JR, Brachman R, Quigley RM, Rowe RK. 2004. Barrier systems for waste disposal facilities. 2nd edition. E & FN Spon; New York (NY). Gartner Lee Limited (GLL). 1993, Landfill Site Assessment- Port Clement Sub-Regional Landfill, Prepared for Skeena Queen Charlotte Regional District.
8. GAEA Technologies et al., 2004. POLLUTEv7.
9. [O. Reg. 232/98]. Ontario. Environmental Protection Act. Ontario Regulation 232/98: Landfilling Sites. Last amended 2011. Available from: <https://www.ontario.ca/laws/regulation/980232#BK38>
10. Rowe K. 1991. Contaminant impact assessment and the contaminating lifespan of landfills. Can. J. Civ. Env. 18: 244-253.
11. SLR Consulting. 2024. Hydrogeology and Hydrogeology Characterization Report – Nakusp Landfill.
12. Sperling Hansen Associates. 2025. Nakusp Landfill Closure Plan.

PDF GENERATED by: Angus Tsang | 2/18/2025 3:20 PM
X:\PRJ\PRJ24\PRJ24072 - NAKUSP LANDFILL FILL TO CLOSURE AND CLOSURE PLANNING\06_AUTOCAD DRAWINGS\01_DRAWINGS\PRODUCTION DRAWINGS\CLOSURE CONCEPT\FIG 1 CONTAMINATION LIFE SPAN.DWG



Landfill Services Group
• Landfill Siting
• Design & Operations Plans
• Landfill Closure
• Environmental Monitoring
#8 - 1225 Keith Road East
North Vancouver, B.C. V7J 1J3
Phone: (604) 966-7723

- LEGEND:
- (1m) EG MIN. CONT. - 2024 NOV 5
 - (5m) EX. MAJ. CONT. - 2024 NOV 5
 - EXISTING ROAD
 - PROPERTY LINE
 - EXISTING ELECTRIC FENCE

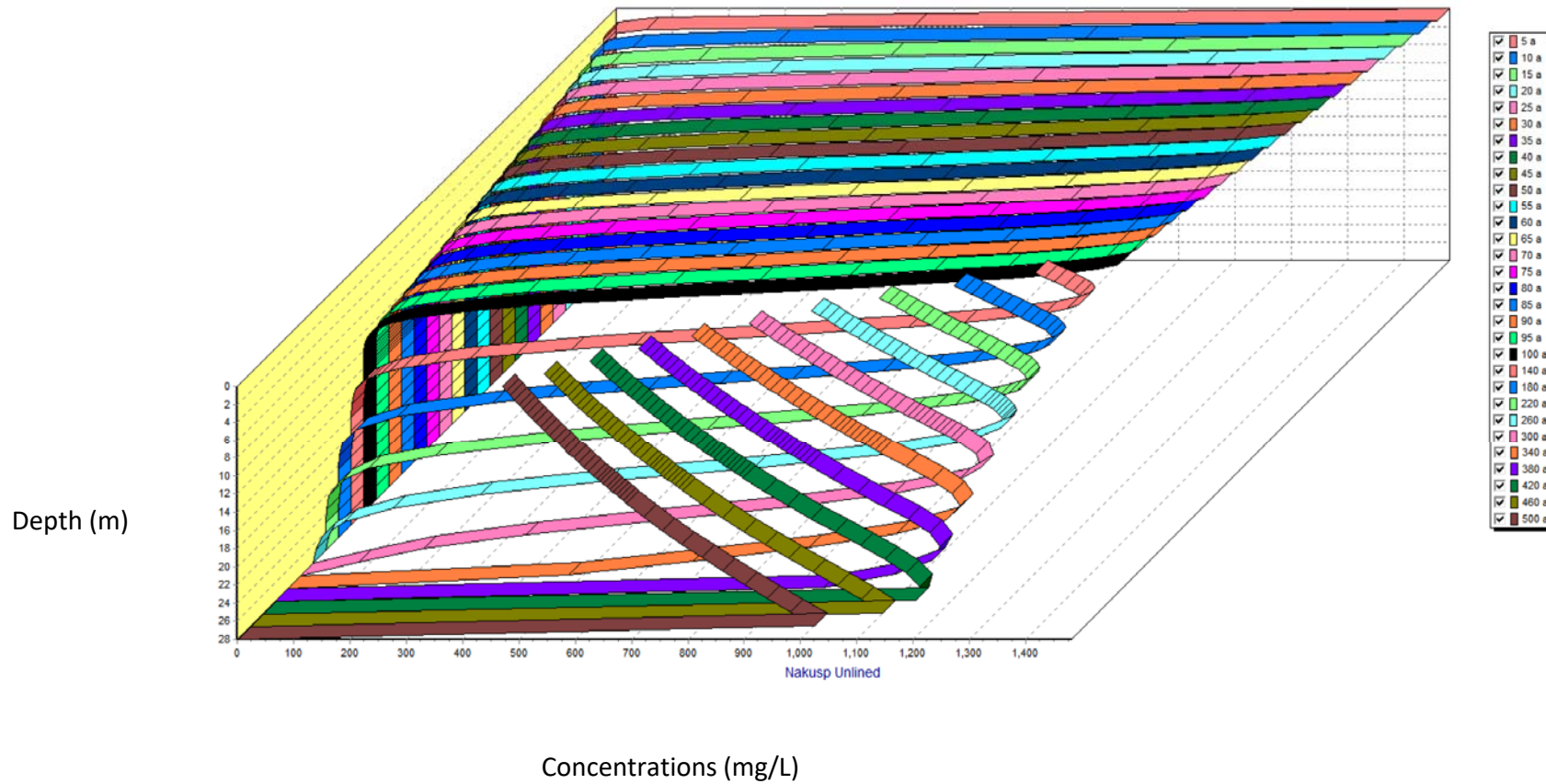


PROJECT:
NAKUSP LANDFILL CONTAMINATING
LIFESPAN ANALYSIS

TITLE:
EXISTING TOPOGRAPHY
5 NOV 2024

SCALE: 1:1000	DATE: 2025/02/18 yyyy/mm/dd	PROJECT NO: PRJ 24072
DESIGNED SG	DRAWN AT	DRAWING NO: FIGURE 1
CHECKED IB		

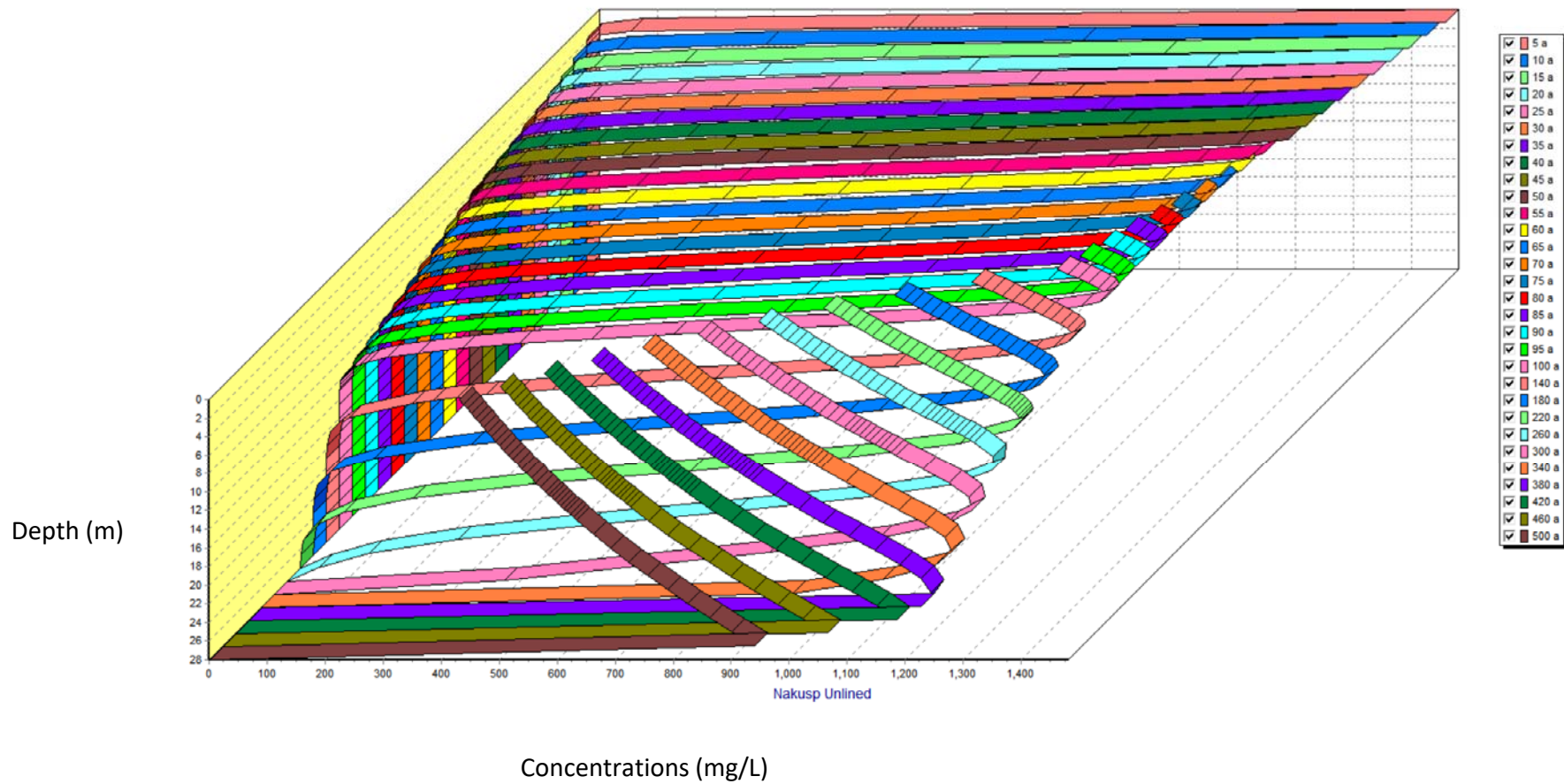
Chloride Concentration with Time and Depth



**Nakusp Landfill Contaminating Lifespan
Assessment-Unlined
Geomembrane Failure in 100 Years**

Figure 2

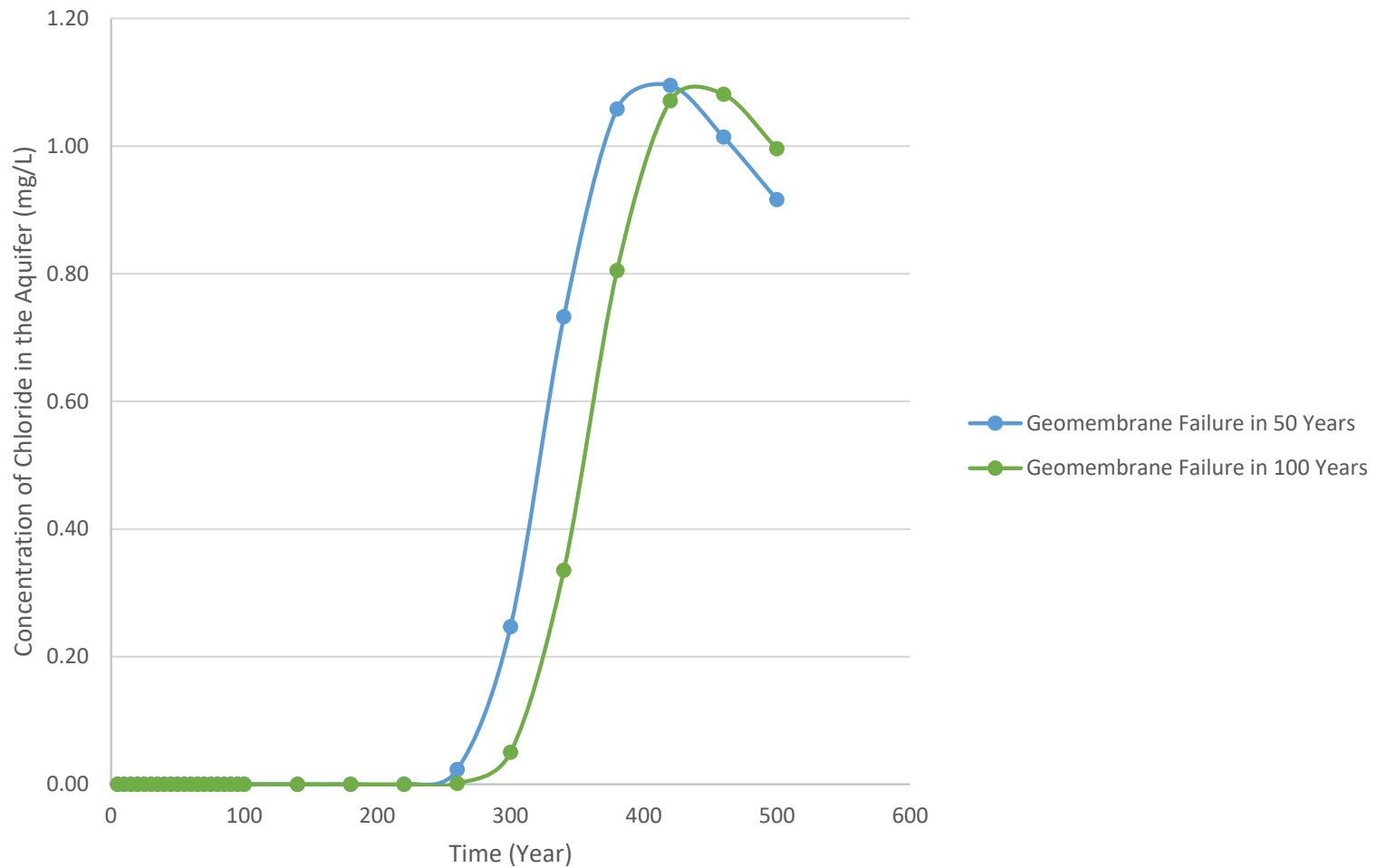
Chloride Concentration with Time and Depth



**Nakusp Landfill Contaminating Lifespan
Assessment-Unlined
Geomembrane Failure in 50 Years**

Figure 3

Variation of Chloride Concentration in the Aquifer with Time



**Nakusp Landfill Contaminating Lifespan
Assessment-Unlined
Geomembrane Failure in 50 and 100
Years**

Figure 4

APPENDIX E: ENVIRONMENTAL MONITORING PLAN

ENVIRONMENTAL MONITORING PROGRAM
NAKUSP LANDFILL

				Spring		Fall		
EMS Number	Location ID	On or Off Site	Area	General/ Organics/ Anions/ Nutrients	Dissolved Metals	General/ Organics/ Anions/ Nutrients	Dissolved Metals	VOCs/ PAHs*
GROUNDWATER								
E225548	MW1-95	ON	down-gradient	x	x	x	x	**
E225549	MW2-95	ON	down-gradient	x	x	x	x	**
E225550	MW3-95	ON	down-gradient	x	x	x	x	
E265109	MW4-06	ON	source	x	x	x	x	x
E265110	MW5-06	ON	background	x	x	x	x	
E309170	MW17-07	ON***	down-gradient	x	x	x	x	

*if issues are identified, add analyses to nearby down-gradient wells the following year

**if insufficient water in MW4-06

***on RDCK property, but pending OC update to extend site boundary as defined by OC

Field measurements must be collected during each sampling event

Field Measurements
pH
temperature
conductivity
DO
ORP
turbidity
hydraulic levels

General
lab pH
hardness (as CaCO ₃ , from metals)
conductivity
total suspended solids (TSS)
total dissolved solids (TDS)
alkalinity
Organics
dissolved organic carbon (DOC)*
total organic carbon (TOC)
Anions/Nutrients
ammonia
bromide
chloride
fluoride
nitrate
nitrite
total Kjeldahl nitrogen (TKN)
sulphate

*SW only

ICP-MS Metals
aluminum
antimony
arsenic
barium
beryllium
bismuth
boron
cadmium
calcium
cesium
chromium
cobalt
copper
iron
lead
lithium
magnesium
manganese
mercury
molybdenum
nickel
phosphorus
potassium
rubidium
selenium
silicon
silver
sodium
strontium
sulfur
tellurium
thallium
thorium
tin
titanium
tungsten
uranium
vanadium
zinc
zirconium

VOCs
Benzene
Bromodichloromethane
Bromoform
Carbon Tetrachloride
Chlorobenzene
Dibromochloromethane
Chloroethane
Chloroform (trichloromethane)
Chloromethane (methyl chloride)
1,2-Dichlorobenzene
1,3-Dichlorobenzene
1,4-Dichlorobenzene
1,1-Dichloroethane
1,2-Dichloroethane
1,1-Dichloroethylene
cis-1,2-Dichloroethylene
trans-1,2-Dichloroethylene
Dichloromethane (methylene chloride)
1,2-Dichloropropane
cis-1,3-Dichloropropylene
trans-1,3-Dichloropropylene
1,3-Dichloropropene (cis & trans)
Ethylbenzene
Methyl t-butyl ether (MTBE)
Styrene
1,1,1,2-Tetrachloroethane
1,1,2,2-Tetrachloroethane
Tetrachloroethylene
Toluene
1,1,1-Trichloroethane
1,1,2-Trichloroethane
Trichloroethylene
Trichlorofluoromethane
Vinyl Chloride
ortho-Xylene
meta- & para-Xylene
Xylenes
4-Bromofluorobenzene (SS)
1,4-Difluorobenzene (SS)

PAHs
Acenaphthene
Acenaphthylene
Acridine
Anthracene
Benzo(a)anthracene
Benzo(a)pyrene
Benzo(b&j)fluoranthene
Benzo(b+j+k)fluoranthene
Benzo(g,h,i)perylene
Benzo(k)fluoranthene
Chrysene
Dibenz(a,h)anthracene
Fluoranthene
Fluorene
Indeno(1,2,3-c,d)pyrene
1-Methylnaphthalene
2-Methylnaphthalene
Methylnaphthalene, 1+2-
Naphthalene
Phenanthrene
Pyrene
Quinoline
Chrysene d12
Naphthalene d8
Phenanthrene d10

APPENDIX F: 2025 ANNUAL ENVIRONMENTAL MONITORING PROGRAM REPORT



Annual Environmental Monitoring Program

Nakusp Landfill

Prepared for:

Regional District of Central Kootenay

202 Lakeside Drive

Nelson, BC, V1L 6B9

March 25, 2026

Prepared by:

Masse Environmental Consultants

812 Vernon Street

Nelson, BC, V1L 4G4

Project Number 2016-503

TABLE OF CONTENTS

Table of Contents	i
List of Tables	i
List of Appendices	ii
1 Introduction	1
1.1 Environmental Monitoring Program	1
1.2 Site Overview	1
1.3 Applicable Water Quality Standards	2
2 Results and Assessment.....	3
2.1 Field Monitoring Results.....	3
2.1.1 Landfill Gas Monitoring.....	3
2.1.2 Hydraulic Monitoring.....	3
2.2 Quality Assurance/Quality Control Results	3
2.3 Groundwater	4
2.3.1 Background Groundwater Quality.....	4
2.3.2 Groundwater Quality at the Source Concentration Well	5
2.3.3 Leachate Indicator Parameters	5
2.3.4 Spatial Trends.....	5
2.3.5 Temporal Trends	6
2.3.6 Volatile Organic Compound (VOC) and Polyaromatic Hydrocarbon (PAH) Results	6
2.3.7 Groundwater Compliance.....	7
2.4 Surface Water	9
3 Recommendations.....	9
4 Closure	10
5 References	11

LIST OF TABLES

Table 1: Field Blank Summary for 2025	4
Table 2. Spatial Trends.....	5
Table 3. Temporal Trends	6
Table 4. Summary of exceedences of CSR criteria in compliance wells.	7

LIST OF APPENDICES

Appendix 1. 2025 Environmental Monitoring Program

Appendix 2. Site Map

Appendix 3. Field Monitoring Summary

Appendix 4. Analytical Results Summary

Appendix 5. Trend Graphs

Appendix 6. Laboratory Certificates of Analysis

1 INTRODUCTION

The Regional District of Central Kootenay's (RDCK's) Nakusp Landfill has been in operation since 1977. Surface and ground water quality monitoring at the landfill is a requirement of Operational Certificate MR-16521 (BC MELP 2000).

1.1 Environmental Monitoring Program

Groundwater sampling was conducted in accordance with the most recent version of the environmental monitoring program (Appendix 1). The groundwater monitoring program consists of six groundwater monitoring well locations as follows (refer to the Site Map in Appendix 2):

- One up-gradient background well (MW5-06),
- One cross-gradient well (MW3-95),
- One downgradient source concentration well (MW4-06), and
- Three downgradient compliance wells (MW1-95, MW2-95, MW17-07).

Groundwater sampling was conducted in May and October. During each monitoring event, the appropriate field data (e.g. headspace gas analysis, water levels, water flow, purging information, and field parameters) were recorded by the environmental technician. Water samples were collected in laboratory supplied bottles and submitted under Chain of Custody (COC) protocols for analytical analysis to ALS Environmental (Burnaby, BC).

The results of the 2025 water quality monitoring program were evaluated relative to the water quality results over the past five years, and in consideration of the current understanding of the hydrogeological/hydrological site conditions (SLR 2024), applicable regulatory criteria, background conditions, assessment parameters indicative of landfill impacts, as well as spatial and temporal trends.

1.2 Site Overview

The Nakusp Landfill is located on a gently sloping terrace on the north side of Kuskanax Creek, ~2 km northeast of Nakusp. Topography surrounding the site slopes in a southerly direction towards Kuskanax Creek and in a westerly direction towards the Arrow Lakes Reservoir. The landfill is located on top of overburden at least 39 m thick and consisting of cobbles and boulders followed by sandy soils. A deep unconfined sand aquifer is mapped under the southwestern portion of the site at a depth of ~30-36 m below ground surface. Groundwater flows in a southwest to south direction towards Kuskanax Creek and the Arrow Lakes Reservoir (SLR 2024).

1.3 Applicable Water Quality Standards

The Operational Certificate (OC) for the Nakusp Landfill states that “ground or surface water quality in existing or potential future water supply aquifers or surface waters does not decrease beyond that allowed by the Approved and Working Criteria for Water Quality, at or beyond the Landfill property boundary” (BC MELP 2000). Water quality guidelines are used by the Province to protect water values for different uses, including aquatic life, wildlife, drinking water sources, agriculture (livestock watering and irrigation), and recreation (BC MWLRS 2025a, 2025b and BC MoECCS 2019, 2020). Many of these are only applicable to surface water which is not present on site.

Analytical results for groundwater were compared to the *British Columbia Contaminated Sites Regulation* (BC 2025) Schedule 3.2 generic and matrix numerical standards, which include standards for drinking water (DW), aquatic life (AW), irrigation (IW) and livestock (LW) uses. The CSR standards are designed for application to groundwater data, are legally enforceable under the *BC Environmental Management Act*, and the most recent hydrogeological review (SLR 2024) recommends that the CSR AW and DW standards be used to assess groundwater quality. Protocol 21 for Contaminated Sites – Water Use Determination (BC MoECCS 2017) provides a framework for identifying what water uses to apply to a site.

- The CSR drinking water standard applies as three wells used for water supply are reported within 500 m of the landfill, and because an aquifer that could be used for a future drinking water supply underlies the site.
- The CSR aquatic life standard applies to the groundwater wells as they are located within 500 m of an aquatic receiving environment. Kuskanax Creek is the nearest surface water feature and is ~ 440 m southeast of the site.
- The irrigation and livestock standards are not applied as there are no groundwater wells or surface water intakes currently used for irrigation or livestock watering within 500 m of the site.

The above guidelines are herein referred to as the *Criteria*.

2 RESULTS AND ASSESSMENT

2.1 Field Monitoring Results

2.1.1 Landfill Gas Monitoring

The composition of gas in the headspace of each groundwater monitoring well was measured prior to hydraulic monitoring and water quality monitoring. The groundwater monitoring wells do not have a dedicated gas sampling port, so PVC tubing was threaded into the monitoring well (~3 m deep) and the top of the well was sealed with plastic during the analysis. The headspace gas monitoring results are presented in Appendix 3.

In all of the wells methane was well below the ‘hazardous condition’ limit for landfills (<25 % LEL CH₄, in facility structures and <100 % LEL CH₄ in soils at the property boundary) (BC MoE 1996). Methane was detected at very low concentrations (0.1 to 0.2 % by volume) in wells MW3-95 and MW5-06 in May, and in wells MW1-95, MW2-95, MW3-95, and MW5-06 in October. No H₂S was detected at any of the wells in 2025.

2.1.2 Hydraulic Monitoring

The depth to groundwater in metres below the top of riser (m BTOR) was measure biannually in 2025 (Appendix 3). Groundwater depths ranged from 30.98 m BTOR (MW17-07) to 37.51 m BTOR (MW5-06) and groundwater fluctuations observed during the year ranged from 0.17 m (MW5-06) to 0.72 m (MW17-07). The depths to groundwater in 2025 were measured at or near historical lows for wells MW1-95, MW3-95, MW4-06, and MW17-07 in May. Well MW4-06 was dry during both sampling events, it has been dry since 2023. There was insufficient water within well MW17-07 for sampling in May. In MW3-95, a sample was not collected in October due to the large amount of sand that was becoming entrained in the purge water.

2.2 Quality Assurance/Quality Control Results

To ensure adequate quality control for water quality monitoring samples, the following field quality assurance/quality control (QA/QC) practices were employed:

- Field sampling activities were performed by qualified and trained personnel.
- Laboratory supplied clean bottles were used for sample collection.
- QA/QC sampling included field duplicates and field blanks.
- Standardised COC forms were used for sample submission.

No duplicate samples were collected from the Nakusp Landfill during the 2025 sampling program.

Field blanks assess for contamination in the field and document the effectiveness of cleaning and decontamination procedures for field equipment between samples. One field blank was collected following sampling at the Nakusp Landfill in May. This field blank was collected using laboratory-supplied de-ionized water that was exposed to the sampling environment and handled in the same manner as all other field samples, including a pass through the same equipment used to collect the field samples.

Table 1: Field Blank Summary for 2025

Total No. of Parameters	No. of Parameters >DL	No. of Parameters <5x DL	Remainder
54	12	11	1

Of the 54 parameters measured, 12 (22 %) parameters were measured at a level greater than the detection limit. ALS uses very low detection limits, and many parameters detected at or near the detection limits are not necessarily representative of contamination from field procedures. Where parameters were measured at levels less than 5x the detection limit (11 parameters), no further discussion was deemed necessary. Where field blank parameters were measured at levels greater than 5x the detection limit, the potential for cross-contamination was investigated (refer to Appendix 4).

One parameter (2 %) was measured at a level greater than 5x the detection limit in the field blank. This elevated parameter does not affect interpretation of the results as it was lower than the relevant *Criteria*.

The 2025 sampling QA/QC program provides assurance that field techniques used were adequate to produce results that can be reliably compared to the *Criteria*.

2.3 Groundwater

2.3.1 Background Groundwater Quality

Background water quality is characterized using analytical results for groundwater samples collected at MW5-06, which is located up-gradient of all landfilling activities based on the current understanding of the physical setting of the Site and groundwater flow. Groundwater analytical results for this well were within the historical range and were below the *Criteria* for all parameters, with exception of cobalt. Dissolved cobalt was measured at 3.3 µg/L in May, and 2.24 µg/L in October, which is higher than the BC CSR DW standard of 1 µg/L (Appendix 4). Prior to 2025, cobalt was consistently measured at < 1 µg/L.

2.3.2 Groundwater Quality at the Source Concentration Well

The results of groundwater sampling at monitoring well MW4-06 is used to evaluate leachate impacts directly downgradient of the existing refuse limits and to help identify assessment parameters. Water levels in this well were too low to collect samples in 2025, as has been the case since 2023.

2.3.3 Leachate Indicator Parameters

Ammonia, chloride, sodium, dissolved iron, and dissolved manganese are used to assess spatial and temporal trends at the Nakusp Landfill. These parameters are typically found in leachate at elevated levels, are susceptible to migration, and are associated with leachate plume evolution, and have previously been observed in MW4-06 at elevated levels compared to other wells (AMEC 2017, SLR 2024).

Historical trend graphs for these parameters over the past 5 years are presented in Appendix 5.

2.3.4 Spatial Trends

Groundwater quality at downgradient wells (MW1-95, MW2-95, and MW17-07) and cross gradient well (MW3-95) were compared to historical groundwater quality at MW4-06 (source concentration well) and MW5-06 (background well) to assess the spatial distribution of the leachate indicator parameters. Spatial observations are summarized in Table 2.

Table 2. Spatial Trends

Parameter	Observations	Comments on Trends
Ammonia	Highest at source (MW4-06) although this well has been dry since 2023. Occasionally measured above detection limits in MW1-95, MW2-95 and MW3-95. Variable in recent years.	Concentrations vary but are <0.025 mg/L.
Chloride	Highest at source (MW4-06) although this well has been dry since 2023. Low (<10 mg/L at other wells.	MW1-95 is still slightly higher than the other wells suggesting some downgradient leachate migration.
Sodium	Highest at source (MW4-06) although this well has been dry since 2023 and slightly elevated at MW1-95.	The slightly elevated concentration in MW1-95 suggests some downgradient leachate migration.
Iron	Highest at source (MW4-06) prior to 2023. Stable and low (<0.2 mg/L) at other wells.	Background concentrations (MW5-06) are consistently higher than those at the downgradient and cross-gradient wells.
Manganese	Highest at source (MW4-06) although this well has been dry since 2023. Low (< 0.1 mg/L) in other wells.	Background concentrations (MW5-06) are consistently higher than those at the downgradient wells.

2.3.5 Temporal Trends

Groundwater quality data from the past 5 years was reviewed to identify temporal trends in groundwater quality. These trends are summarized in Table 3.

Table 3. Temporal Trends

Location	Parameter	5-Year Temporal Trends			Notes
		Decreasing	Variable	Increasing	
Background (MW5-06)	Ammonia				Stable, generally below DL.
	Chloride				Stable and within 5x the DL.
	Sodium				Stable at ~3.5 mg/L.
	Iron				Stable, but ranging from 14 to 169 µg/L.
	Manganese		MW5-06		Variable, ranging from 3.8 to 53.6 µg/L.
Source (MW4-06)	Ammonia		MW4-06		Well has been dry since 2023
	Chloride		MW4-06	MW4-06	Appeared to be increasing prior to well becoming dry in 2023.
	Sodium		MW4-06		Ranged from 18.4 to 50.5 mg/L prior to well becoming dry in 2023.
	Iron		MW4-06		Variable prior to well becoming dry in 2023. Highest in spring.
	Manganese		MW4-06		Variable prior to well becoming dry in 2023. Highest in spring.
		Decreasing	Variable	Increasing	
Down-gradient / cross-gradient	Ammonia		MW1-95 MW3-95 MW2-95		Consistently < 0.05 mg/L.
	Chloride				Consistently below 10 mg/L.
	Sodium				Stable
	Iron				Generally stable and near detection limits.
	Manganese			MW3-95	Increasing since 2022 from ~0.75 to 71.4 µg/L.

2.3.6 Volatile Organic Compound (VOC) and Polyaromatic Hydrocarbon (PAH) Results

In October 2025, samples were collected at groundwater wells MW1-95 and MW2-95 for analysis of VOCs and PAHs. Analytical results are presented in Appendix 4. All of the VOCs and PAHs were all quantified below the *Criteria* and below detection limits.

2.3.7 Groundwater Compliance

Section 4.1 of the Landfill Criteria for Municipal Solid Waste states that: “At a minimum, the appropriate water quality criteria must be satisfied at and beyond the landfill site boundary, or 150 m from the landfill footprint, whichever is closer” (BC MoE 2016). Groundwater compliance is assessed at the four downgradient and cross-gradient wells (MW1-95, MW2-95, MW3-95, and MW17-07). Groundwater quality was compared to the BC CSR Schedule 3.2 AW and DW numerical standards. Note that the CSR DW standards are designed for unfiltered samples obtained at the point of consumption (total substance concentrations) (BC 2025). The drinking water standards have been applied to the dissolved substance concentrations for the Nakusp Landfill to be more representative of in-situ aquifer conditions.

Table 4 summarizes the *Criteria* exceedances observed in the compliance wells in 2025. MW1-95, MW2-95 and MW3-95 exceeded the BC CSR DW standard for lithium of 8 µg/L. MW3-95 also exceeded the BC CSR DW standard for cobalt of 1 µg/L and barium of 1,000 µg/L. Results for lithium and barium are consistent with historical data. Cobalt has only exceeded the BC CSR DW standard at MW3-95 since late 2024. Prior to 2024, cobalt was not detected in MW3-95 above the detection limit of 0.1 µg/L. Cobalt was detected in the source well (MW4-06) until it dried up in 2023. It was also detected in the background well (MW5-06) since 2021. Trend graphs for these parameters from 2007 to the present are provided (Figure 1 - Figure 3).

Table 4. Summary of exceedences of CSR criteria in compliance wells.

		CSR DW	MW1-95 27/5/2025	MW1-95 14/10/2025	MW2-95 27/5/2025	MW2-95 15/10/2025	MW3-95 27/5/2025	MW17-07 15/10/2025
Barium	µg/L	1000	934	886	962	925	1050	385
Cobalt	µg/L	1	0.11	<0.10	<0.10	<0.10	1.28	<0.10
Lithium	µg/L	8	12.9	12.5	13.3	13.9	13.3	5.9

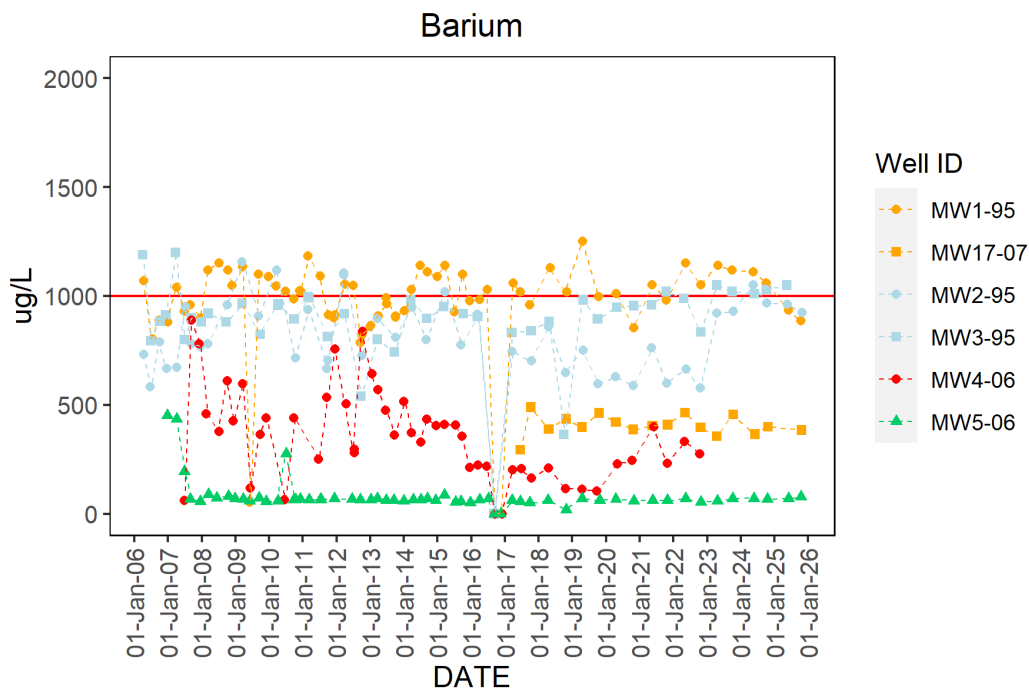


Figure 1. Dissolved barium concentrations over time (2007-2025). The red line corresponds to the BC CSR DW standard of 1,000 µg/L.

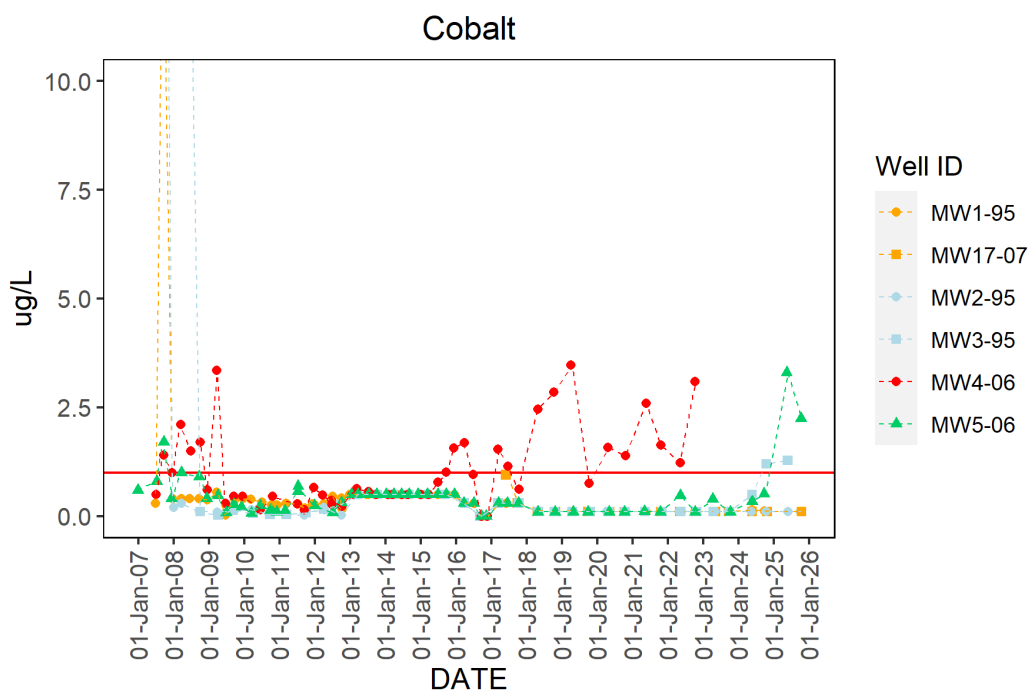


Figure 2. Dissolved cobalt concentrations over time (2007-2025). The red line corresponds to the BC CSR DW standard of 1 µg/L.

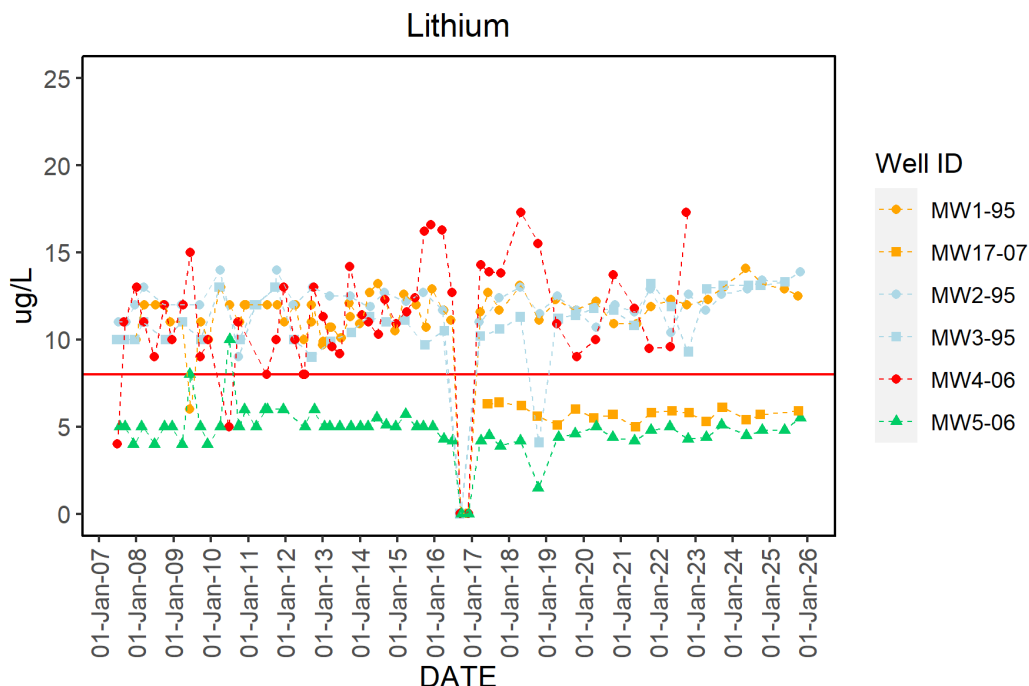


Figure 3. Dissolved lithium concentrations over time (2007-2025). The red line corresponds to the BC CSR DW standard of 8 µg/L.

2.4 Surface Water

There is no surface water sampling conducted as part of the Nakusp Landfill EMP.

3 RECOMMENDATIONS

With respect to sampling, the following is recommended:

- Collection of groundwater samples at wells MW3-95, MW4-06, and MW17-07 has been affected by low groundwater levels and/or the presence of a large amount of sand in the well. These wells may need to re-drilled to deeper depths or re-developed if reliable samples are to be obtained.
- Improving access to wells MW2-95, MW3-95, MW4-06, and MW5-06 is recommended. The access road to MW5-06 is overgrown. Stockpiles of waste materials and fill occasionally impede access to wells MW2-95, MW3-95, and MW4-06.
- The height of the PVC casing above ground surface should be measured so that groundwater elevation can be determined.

4 CLOSURE

This report was prepared by Jennifer Ross and Ico de Zwart of Masse Environmental Consultants Ltd. on March 25, 2026, for the Regional District of Central Kootenay. Both Jennifer and Ico are registered in good standing with the Association of the Chemical Profession of British Columbia (ACPBC). Ico is also a Registered Professional Biologist in good standing with the College of Applied Biology.

We trust the information provided in this report meets your current requirements. If you have any questions or require any further information do not hesitate to contact the undersigned.

Sincerely,



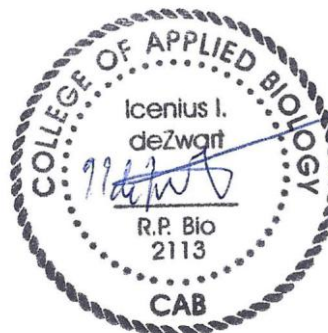
Jennifer Ross, M.Sc., P.Chem.



and



Ico de Zwart, PH.D., P.Chem., R.P.Bio.



5 REFERENCES

AMEC Foster Wheeler. 2017. Five Year Hydrogeology Review Nakusp Landfill Nakusp, BC. Prepared for the Regional District of Central Kootenay, Nelson, BC.

BC 2025. *Environmental Management Act*, Contaminated Sites Regulation (B.C. Reg. 375/96) last amended October 27, 2025, by B.C. Reg. 171/2025. Current to January 13, 2026.

BC [MELP] Ministry of Environment, Lands and Parks. 2000. Operational Certificate MR-16521. Prepared by the Ministry of Environment, Lands and Parks for the Regional District of Central Kootenay. Dated November 29, 2000.

BC [MoE] Ministry of Environment. 1996. Guidelines for Environmental Monitoring at Municipal Solid Waste Landfills. Published by the B. C. Ministry of Environment, Lands and Parks in 1996.

BC MoE. 2016. B. C. Landfill Criteria for Municipal Solid Waste, 2nd Edition, Prepared by the B.C. Ministry of Environment, June 2016.

BC [MoECCS] Ministry of Environment and Climate Change Strategy. 2017. Protocol 21 for Contaminated Sites – Water Use Determination. Version 2.0. Province of B.C., Victoria, BC. November 1, 2017.

BC MoECCS. 2019. B.C. Recreation Water Quality Guidelines: Guideline Summary. Water Quality Guideline Series, WQG-02. Province of B.C., Victoria B.C.

BC MoECCS. 2020. B.C. Source Drinking Water Quality Guidelines: Guideline Summary. Water Quality Guideline Series, WQG-01. Province of B.C., Victoria B.C.

BC [MWLRS] Ministry of Water, Land and Resource Stewardship. 2025a. British Columbia Approved Water Quality Guidelines: Aquatic Life, Wildlife & Agriculture - Guideline Summary. Water Quality Guidelines Series, WQG-20. Province of B.C., Victoria, BC.

BC MWLRS. 2025b. British Columbia Working Water Quality Guidelines: Aquatic Life, Wildlife & Agriculture. Water Quality Guidelines Series, WQG-08-01. Province of B.C., Victoria, BC.

SLR 2024. Hydrogeology and Hydrology Characterization Report. Nakusp Landfill. SLR Project No. 29.030089.00001. September 27, 2024.

APPENDIX 1. 2025 ENVIRONMENTAL MONITORING PROGRAM

ENVIRONMENTAL MONITORING PROGRAM
NAKUSP LANDFILL

				Spring		Fall		
EMS Number	Location ID	On or Off Site	Area	General/ Organics/ Anions/ Nutrients	Dissolved Metals	General/ Organics/ Anions/ Nutrients	Dissolved Metals	VOCs/ PAHs*
GROUNDWATER								
E225548	MW1-95	ON	down-gradient	x	x	x	x	**
E225549	MW2-95	ON	down-gradient	x	x	x	x	**
E225550	MW3-95	ON	down-gradient	x	x	x	x	
E265109	MW4-06	ON	source	x	x	x	x	x
E265110	MW5-06	ON	background	x	x	x	x	
E309170	MW17-07	ON***	down-gradient	x	x	x	x	

*if issues are identified, add analyses to nearby down-gradient wells the following year

**if insufficient water in MW4-06

***on RDCK property, but pending OC update to extend site boundary as defined by OC

Field measurements must be collected during each sampling event

Field Measurements
pH
temperature
conductivity
DO
ORP
turbidity
hydraulic levels

General
lab pH
hardness (as CaCO ₃ , from metals)
conductivity
total suspended solids (TSS)
total dissolved solids (TDS)
alkalinity
Organics
dissolved organic carbon (DOC)*
total organic carbon (TOC)
Anions/Nutrients
ammonia
bromide
chloride
fluoride
nitrate
nitrite
total Kjeldahl nitrogen (TKN)
sulphate

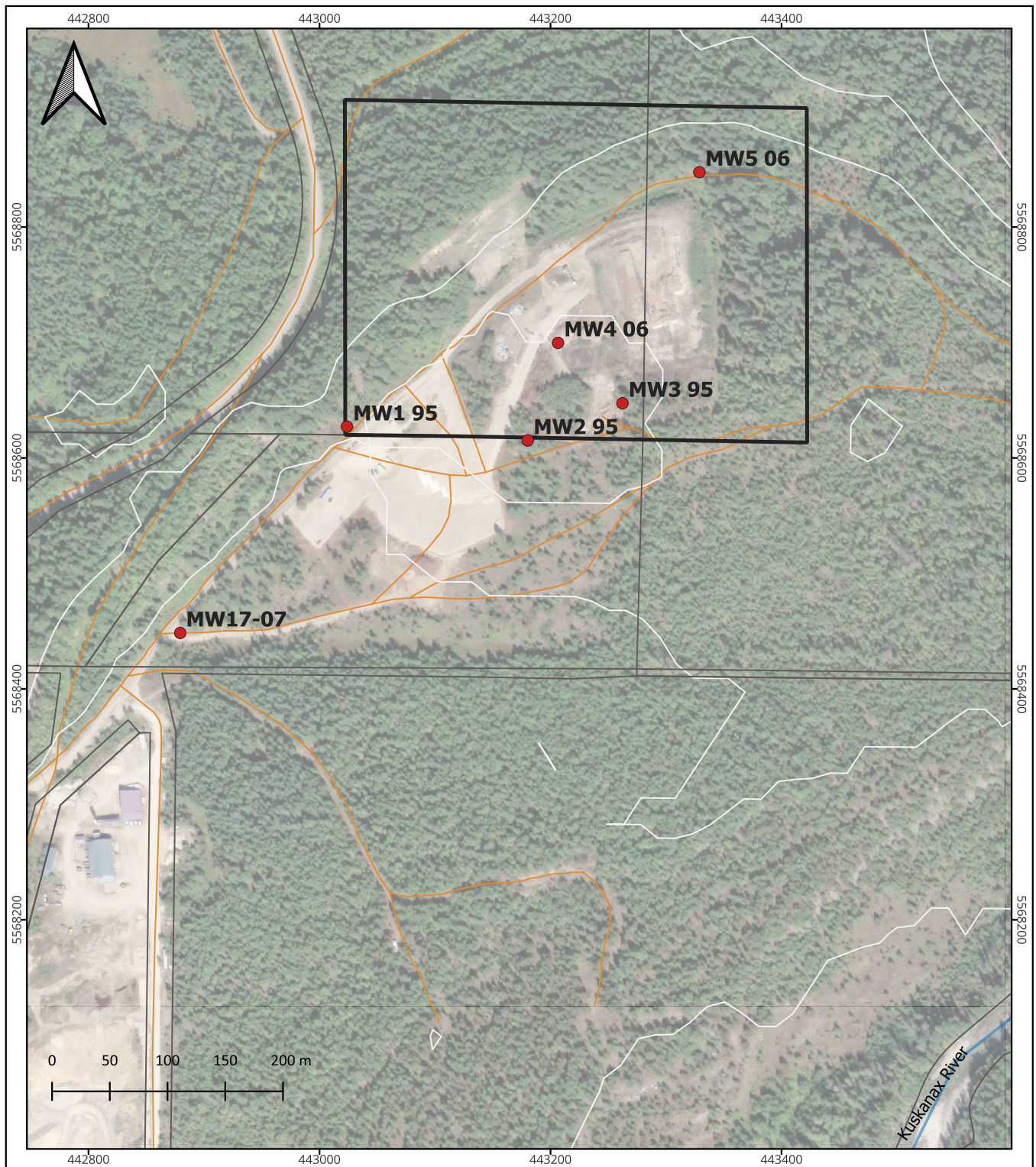
*SW only

ICP-MS Metals
aluminum
antimony
arsenic
barium
beryllium
bismuth
boron
cadmium
calcium
cesium
chromium
cobalt
copper
iron
lead
lithium
magnesium
manganese
mercury
molybdenum
nickel
phosphorus
potassium
rubidium
selenium
silicon
silver
sodium
strontium
sulfur
tellurium
thallium
thorium
tin
titanium
tungsten
uranium
vanadium
zinc
zirconium

VOCs
Benzene
Bromodichloromethane
Bromoform
Carbon Tetrachloride
Chlorobenzene
Dibromochloromethane
Chloroethane
Chloroform (trichloromethane)
Chloromethane (methyl chloride)
1,2-Dichlorobenzene
1,3-Dichlorobenzene
1,4-Dichlorobenzene
1,1-Dichloroethane
1,2-Dichloroethane
1,1-Dichloroethylene
cis-1,2-Dichloroethylene
trans-1,2-Dichloroethylene
Dichloromethane (methylene chloride)
1,2-Dichloropropane
cis-1,3-Dichloropropylene
trans-1,3-Dichloropropylene
1,3-Dichloropropene (cis & trans)
Ethylbenzene
Methyl t-butyl ether (MTBE)
Styrene
1,1,1,2-Tetrachloroethane
1,1,2,2-Tetrachloroethane
Tetrachloroethylene
Toluene
1,1,1-Trichloroethane
1,1,2-Trichloroethane
Trichloroethylene
Trichlorofluoromethane
Vinyl Chloride
ortho-Xylene
meta- & para-Xylene
Xylenes
4-Bromofluorobenzene (SS)
1,4-Difluorobenzene (SS)

PAHs
Acenaphthene
Acenaphthylene
Acridine
Anthracene
Benzo(a)anthracene
Benzo(a)pyrene
Benzo(b&j)fluoranthene
Benzo(b+j+k)fluoranthene
Benzo(g,h,i)perylene
Benzo(k)fluoranthene
Chrysene
Dibenz(a,h)anthracene
Fluoranthene
Fluorene
Indeno(1,2,3-c,d)pyrene
1-Methylnaphthalene
2-Methylnaphthalene
Methylnaphthalene, 1+2-
Naphthalene
Phenanthrene
Pyrene
Quinoline
Chrysene d12
Naphthalene d8
Phenanthrene d10

APPENDIX 2. SITE MAP



Nakusp Landfill Environmental Monitoring Site Plan

- | | | | |
|---|---------------------|---|----------------|
|  | Site Boundary |  | Roads |
|  | Sample locations |  | Contours (20m) |
|  | Property boundaries |  | Streams |



Map Date: 2026-03-17
Projection: NAD83 / UTM zone 11N
Project #: 2016-503 Nakusp
Main Map Scale: 1:5000
Overview Map Scale: 1:250000

APPENDIX 3. FIELD MONITORING SUMMARY

Regional District of Central Kootenay
Gas Analysis - 2025
Nakusp Landfill, Nakusp, BC

Date (DD/MM/YYYY)	EMS	Site ID	Sampled	Barometric Pressure (mm Hg)	CH ₄ (%)	Calculated LEL CH ₄ (%) ¹	CO ₂ (%)	O ₂ (%)	Gas Balance	CO (ppm)	H ₂ S (ppm)
26/05/2025	E265110	MW5-06	Y	28.14	0.1	2	0.3	20.4	79.2	1	0
26/05/2025	E225550	MW2-95	Y	28.18	0.0	0	0.3	20.0	79.7	0	0
26/05/2025	E225549	MW3-95	Y	28.19	0.1	2	1.9	17.9	80.1	0	0
26/05/2025	E265109	MW4-06	Y	28.19	0.0	0	0.5	19.9	79.5	0	0
26/05/2025	E225548	MW1-95	Y	28.20	0.0	0	0.0	20.7	79.3	0	0
26/05/2025	E309170	MW17-07	Y	28.21	0.0	0	0.0	20.9	79.1	0	0
14/10/2025	E265110	MW5-06	Y	28.30	0.2	4	0.1	20.6	79.2	1	0
14/10/2025	E225548	MW1-95	Y	28.32	0.1	2	2.6	18.1	79.1	0	0
15/10/2025	E225549	MW2-95	Y	28.33	0.1	2	0.2	21.2	78.6	0	0
15/10/2025	E225550	MW3-95	Y	28.30	0.1	2	4.0	16.7	79.3	0	0
15/10/2025	E265109	MW4-06	Y	28.3	0.0	0	0.1	19.9	80.0	1	0
15/10/2025	E309170	MW17-07	Y	28.31	0.0	0	0.1	20.5	79.4	0	0

¹ LEL CH₄ (%) is calculated from the measured volume of CH₄ in air (%) using the following equation: (CH₄/5)x100.

General Comments

All wells have been fitted with sealable gas caps. These were observed to be in place and functional.
Gas monitoring was completed using a GEM 5000 Plus instrument operated in gas analyzer mode.

Regional District of Central Kootenay
 2025 Hydraulic Monitoring Results
 Nakusp Landfill, Nakusp, BC

EMS Number	Field Designation	Aquifer	Ground Elevation (m AMSL) ¹	Depth to Groundwater (m BTOR)	
				May-25	Oct-25
E225548	MW1-95	OB	515.16	33.49	33.00
E225549	MW2-95	OB	517.31	34.52	34.29
E225550	MW3-95	OB	519.31	36.46	36.21
E265109	MW4-06	OB	519.50	36.60	36.71
E265110	MW5-06	OB	520.50	37.34	37.51
E309170	MW17-07	OB	504.36	31.70	30.98

¹ Top of pipe elevations have not been surveyed, so depth to groundwater in m AMSL is not available.

Notes:

EMS	Environmental Monitoring System
m AMSL	metres above mean sea level
m BTOR	meters below top of riser (top of pvc pipe)
OB	overburden

Regional District of Central Kootenay
Field Notes 2025
Nakusp Landfill, Nakusp, BC

Date (DD/MM/YYYY)	Time	EMS	Site ID	Sample d	Depth to Water (m BTOC)	Well Depth (m)	Sampling Device	Purge Volume (L)	T (°C)	pH	Cond. (mS/cm)	DO (mg/L)	ORP (mV)	Turb (NTU)	Comment
26/05/2025	15:41	E309170	MW17-07	N	31.70	31.69									Insufficient water for sampling
27/05/2025	9:26	E265110	MW5-06	Y	37.34	37.00	Bailer	15	6.9	6.70	239.8	8.20	70.0	132	opaque, brown, odourless
27/05/2025	11:05	E225549	MW2-95	Y	34.52	36.71	Bailer	17	8.4	5.94	191.9	4.00	166	73.5	translucent, grey, briny odour, sandy
27/05/2025	13:30	E225550	MW3-95	Y	36.46	39.68	Bailer	17	9.7	5.97	241.7	3.50	166	93.0	translucent, grey, odourless, sandy
27/05/2025	14:20	E265109	MW4-06	N	36.60	35.63									Insufficient water for sampling
27/05/2025	15:40	E225548	MW1-95	Y	33.49	34.60	Bailer	15	9.2	6.19	307.2	5.05	160	23.4	translucent, grey, odourless, some sand
27/05/2025			Field Blank	Y											clear, colourless, odourless
14/10/2025	15:30	E265110	MW5-06	Y	37.51	37.00	Bailer	15	6.9	6.49	296.6	2.97	-14.1	123	turbid, orange, odourless
14/10/2025	16:30	E225548	MW1-95	Y	33.00	34.60	Bailer	15	7.9	6.24	278.7	2.27	9.8	79.6	opaque, brown, odourless
15/10/2025	9:30	E225549	MW2-95	Y	34.29	36.71	Bailer	17	7.1	6.02	210.2	3.31	200.7	931 AU	opaque, brown, odourless, sandy
15/10/2025		E225550	MW3-95	N	36.21	39.68									Insufficient water for sampling, very sandy
15/10/2025	15:30	E309170	MW17-07	Y	30.98	31.69	Bailer	8	8.3	7.10	98.6	1.99	194.9	1111 AU	opaque, brown, odourless, sandy
15/10/2025		E265109	MW4-06	N	36.71	35.63									Insufficient water for sampling

APPENDIX 4. ANALYTICAL RESULTS SUMMARY

Regional District of Central Kootenay
Groundwater Analytical Results Summary 2025
Nakusp Landfill, Nakusp, BC

		BC CSR		BC CSR							
		Aqu	DW								
EMS ID				E225548	E225548	E225549	E225549	E225550	E265110	E265110	E309170
Client Sample ID				MW1-95	MW1-95	MW2-95	MW2-95	MW3-95	MW5-06	MW5-06	MW17-07
Date Sampled				27-May-2025	14-Oct-2025	27-May-2025	15-Oct-2025	27-May-2025	27-May-2025	14-Oct-2025	15-Oct-2025
Time Sampled				15:40	16:30	11:05	09:30	13:30	09:26	13:30	13:15
ALS Sample ID				VA25B2628-001	VA25C7679-001	VA25B2628-002	VA25C7679-002	VA25B2628-003	VA25B2628-004	VA25C7679-003	VA25C7679-004
				Sub-Matrix: Groundwater	Sub-Matrix: Groundwater	Sub-Matrix: Groundwater	Sub-Matrix: Groundwater	Sub-Matrix: Groundwater	Sub-Matrix: Groundwater	Sub-Matrix: Groundwater	Sub-Matrix: Groundwater
Parameter	Lowest Detection Limit	Units									
Physical Tests (Matrix: Water)											
Conductivity	2.0	µS/cm		364	402	275	287	283	323	372	129
Alkalinity, total (as CaCO3)	1.0	mg/L		164	187	137	132	149	158	179	60.3
Hardness (as CaCO3), dissolved	0.50	mg/L		167	164	136	129	140	159	185	57.6
Solids, total dissolved [TDS]	10	mg/L		273	288	220	237	216	227	238	129
Solids, total suspended [TSS]	3.0	mg/L		70.6	328	533	1480	265	195	281	1710
pH	0.10	pH units		7.24	7.77	6.83	7.07	6.73	7.66	8.07	7.61
Anions and Nutrients (Matrix: Water)											
Ammonia, total (as N)	0.0050	mg/L	pH dep.	0.0073	0.0137	<0.0050	0.0154	0.0104	0.0054	0.006	<0.0050
Bromide	0.050	mg/L		<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Chloride	0.50	mg/L	1500	6.50	5.47	2.27	4.28	1.61	1.38	1.42	2.2
Fluoride	0.020	mg/L	hardness dep.	0.020	<0.024	0.025	0.029	0.026	0.614	0.576	0.076
Kjeldahl nitrogen, total [TKN]	0.050	mg/L		0.689	1.04	0.255	0.552	0.924	0.258	0.218	0.544
Nitrate (as N)	0.0050	mg/L	400	2.77	2.23	0.762	0.999	0.0102	0.0777	0.33	0.313
Nitrite (as N)	0.0010	mg/L	chloride dep.	<0.0010	0.0013	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0127
Sulfate (as SO4)	0.30	mg/L	hardness dep.	13.4	11.8	6.12	7.31	2.42	14.8	14.7	1.68
Organic / Inorganic Carbon (Matrix: Water)											
Carbon, total organic [TOC]	0.50	mg/L		4.08	46.8	2.29	27.6	9.39	3.72	7.56	12.3
Dissolved Metals (Matrix: Water)											
Aluminum (Al)-Dissolved	1.0	µg/L			5	9.9	39.3	6.8	5.6	15.3	12
Antimony (Sb)-Dissolved	0.10	µg/L	90	<0.10	<0.10	<0.10	<0.10	0.27	<0.10	<0.10	<0.10
Arsenic (As)-Dissolved	0.10	µg/L	50	<0.10	<0.10	<0.10	<0.10	<0.10	0.11	<0.10	<0.10
Barium (Ba)-Dissolved	0.10	µg/L	10000	934	886	962	925	1050	70	77.4	385
Beryllium (Be)-Dissolved	0.100	µg/L	1.5	<0.100	<0.100	0.139	0.142	0.190	<0.100	<0.100	<0.100
Bismuth (Bi)-Dissolved	0.050	µg/L		<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Boron (B)-Dissolved	10	µg/L	12000	178	144	23	51	<10	<10	<10	<10
Cadmium (Cd)-Dissolved	0.0050	µg/L	hardness dep.	0.0425	0.0365	0.0358	0.0409	0.0897	0.0167	0.045	0.0074
Calcium (Ca)-Dissolved	50	µg/L		43800	45300	35400	34400	36700	57400	67200	16100
Cesium (Cs)-Dissolved	0.010	µg/L		<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Chromium (Cr)-Dissolved	0.50	µg/L	10 ¹	1.74	1.81	1.84	1.76	<0.50	<0.50	<0.50	2.94
Cobalt (Co)-Dissolved	0.10	µg/L	40	0.11	<0.10	<0.10	<0.10	1.28	3.30	2.24	<0.10
Copper (Cu)-Dissolved	0.20	µg/L	hardness dep.	2.61	2.25	0.87	1.4	1.73	0.29	2.44	0.25
Iron (Fe)-Dissolved	10	µg/L		<10	<10	<10	36	69	169	23	30
Lead (Pb)-Dissolved	0.050	µg/L	hardness dep.	<0.050	<0.050	<0.050	0.114	2.14	<0.050	<0.050	<0.050
Lithium (Li)-Dissolved	1.0	µg/L		12.9	12.5	13.3	13.9	13.3	4.8	5.5	5.9
Magnesium (Mg)-Dissolved	5.0	µg/L		14100	12300	11700	10400	11700	3760	4090	4220
Manganese (Mn)-Dissolved	0.10	µg/L	1500	4.18	1.65	1.59	5.34	50.1	53.6	22.7	1.7
Mercury (Hg)-Dissolved	0.0050	µg/L	0.25	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Molybdenum (Mo)-Dissolved	0.050	µg/L	10000	<0.050	<0.050	<0.050	<0.050	0.055	0.378	0.225	<0.050
Nickel (Ni)-Dissolved	0.50	µg/L	hardness dep.	3.55	3.54	3.69	4.36	6.16	1.70	1.8	0.77
Phosphorus (P)-Dissolved	50	µg/L		<50	<50	<50	<50	<50	<50	<50	<50
Potassium (K)-Dissolved	50	µg/L		1720	1590	967	1080	1050	1220	1290	586
Rubidium (Rb)-Dissolved	0.20	µg/L		1.74	1.72	1.28	1.4	1.18	0.30	0.39	1.05
Selenium (Se)-Dissolved	0.050	µg/L	20	<0.050	<0.050	<0.050	<0.050	<0.050	0.152	0.152	<0.050
Silicon (Si)-Dissolved	50	µg/L		22100	22000	23700	23600	24300	9520	10400	18700
Silver (Ag)-Dissolved	0.010	µg/L	hardness dep.	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Sodium (Na)-Dissolved	50	µg/L	200000	9690	9180	4520	5550	3900	3670	3790	2380
Strontium (Sr)-Dissolved	0.20	µg/L	2500	608	539	539	487	486	771	834	377
Sulfur (S)-Dissolved	500	µg/L		4640	4480	1990	2760	640	5190	5480	560
Tellurium (Te)-Dissolved	0.20	µg/L		<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Thallium (Tl)-Dissolved	0.010	µg/L	3	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Thorium (Th)-Dissolved	0.10	µg/L		<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Tin (Sn)-Dissolved	0.10	µg/L	2500	0.14	0.18	<0.10	0.1	0.38	0.10	0.19	0.11
Titanium (Ti)-Dissolved	0.30	µg/L	1000	<0.30	<0.30	<0.30	0.43	<0.30	<0.30	<0.30	<0.30
Tungsten (W)-Dissolved	0.10	µg/L		<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Uranium (U)-Dissolved	0.010	µg/L	85	0.73	0.59	0.473	0.373	0.467	0.632	0.507	0.179
Vanadium (V)-Dissolved	0.50	µg/L		1.08	1.02	1.14	1.07	1.03	<0.50	<0.50	0.97
Zinc (Zn)-Dissolved	1.0	µg/L	hardness dep.	19.1	16.5	6.3	15.8	30.6	4.1	6.7	6.1
Zirconium (Zr)-Dissolved	0.20	µg/L		<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Dissolved Mercury Filtration Location	-			Field	Field	Field	Field	Field	Field	Field	Field
Dissolved Metals Filtration Location	-			Field	Field	Field	Field	Field	Field	Field	Field

NOTES: CSR standards for heavy metals, metalloids and inorganic ions applied to groundwater are designed for the dissolved substance concentrations with the exception of the drinking water standards, which are designed for unfiltered samples obtained at the point of consumption (total substance concentrations) (B.C. Reg. 375/96, current to January 20, 2026, Schedule 3.2). Since these groundwater samples are obtained from groundwater monitoring wells and not from a water supply well, the drinking water standards have been applied to the dissolved substance concentrations to be more representative of in-situ aquifer conditions.

¹ Cr (VI) generic numerical water standard (B.C. Reg. 375/96, current to January 20, 2026, Schedule 3.2).

LEGEND:

	Parameter higher than the BC CSR generic numerical water standard for aquatic life.
	Parameter higher than the BC CSR generic numerical water standard for drinking water.
	Parameter higher than both the BC CSR generic numerical water standards for aquatic life and drinking water.

Regional District of Central Kootenay
Groundwater Analytical Results Summary 2025 - PAH/VOC
Nakusp Landfill, Nakusp, BC

			BC CSR		BC CSR	
			AW	DW		
Client Sample ID					E225548	E225549
Client Sample ID					MW 1-95	MW2-95
Date Sampled					14-Oct-2025	15-Oct-2025
Time Sampled					16:30	09:30
ALS Sample ID					VA25C7679-001	VA25C7679-002
					Sub-Matrix Groundwater	Sub-Matrix Groundwater
Parameter	Lowest Detection Limit	Units				
Volatile Organic Compounds (Matrix: Water)						
Chlorobenzene	0.50	µg/L	13	80	<0.50	<0.50
Chloromethane	5.0	µg/L			<5.0	<5.0
Dichlorobenzene, 1,2-	0.50	µg/L	7	200	<0.50	<0.50
Dichlorobenzene, 1,3-	0.50	µg/L	1500		<0.50	<0.50
Dichlorobenzene, 1,4-	0.50	µg/L	260	5	<0.50	<0.50
Dichloropropane, 1,2-	0.50	µg/L		4.5	<0.50	<0.50
Dichloropropylene, cis+trans-1,3-	0.75	µg/L		1.5	<0.75	<0.75
Dichloropropylene, cis-1,3-	0.50	µg/L			<0.50	<0.50
Tetrachloroethane, 1,1,1,2-	0.50	µg/L		6	<0.50	<0.50
Tetrachloroethane, 1,1,2,2-	0.20	µg/L		0.8	<0.20	<0.20
Trichloroethane, 1,1,2-	0.50	µg/L		3	<0.50	<0.50
Trichlorofluoromethane	0.50	µg/L		1000	<0.50	<0.50
Volatile Organic Compounds [Drycleaning] (Matrix: Water)						
Carbon tetrachloride	0.50	µg/L	130	2	<0.50	<0.50
Chloroethane	0.50	µg/L			<0.50	<0.50
Dichloroethane, 1,1-	0.50	µg/L		30	<0.50	<0.50
Dichloroethane, 1,2-	0.50	µg/L	1000	5	<0.50	<0.50
Dichloroethylene, 1,1-	0.50	µg/L		14	<0.50	<0.50
Dichloroethylene, cis-1,2-	0.50	µg/L		8	<0.50	<0.50
Dichloroethylene, trans-1,2-	0.50	µg/L		80	<0.50	<0.50
Dichloromethane	1.0	µg/L	980	50	<1.0	<1.0
Dichloropropylene, trans-1,3-	0.50	µg/L			<0.50	<0.50
Tetrachloroethylene	0.50	µg/L	1100	30	<0.50	<0.50
Trichloroethane, 1,1,1-	0.50	µg/L		8000	<0.50	<0.50
Trichloroethylene	0.50	µg/L	200	5	<0.50	<0.50
Vinyl chloride	0.40	µg/L		2	<0.40	<0.40
Volatile Organic Compounds [Fuels] (Matrix: Water)						
Benzene	0.50	µg/L	400	5	<0.50	<0.50
Ethylbenzene	0.50	µg/L	2000	140	<0.50	<0.50
Methyl-tert-butyl ether [MTBE]	0.50	µg/L	34000	95	<0.50	<0.50
Styrene	0.50	µg/L	720	800	<0.50	<0.50
Toluene	0.40	µg/L	5	60	<0.40	<0.40
Xylene, m+p-	0.40	µg/L			<0.40	<0.40
Xylene, o-	0.30	µg/L			<0.30	<0.30
Xylenes, total	0.50	µg/L	300	90	<0.50	<0.50
Volatile Organic Compounds [THMs] (Matrix: Water)						
Bromodichloromethane	0.50	µg/L		100	<0.50	<0.50
Bromoform	0.50	µg/L		100	<0.50	<0.50
Chloroform	0.50	µg/L	20	100	<0.50	<0.50
Dibromochloromethane	0.50	µg/L		100	<0.50	<0.50
Volatile Organic Compounds Surrogates (Matrix: Water)						
Bromofluorobenzene, 4-	1.0	%			95	94.7
Difluorobenzene, 1,4-	1.0	%			104	103
Polycyclic Aromatic Hydrocarbons (Matrix: Water)						
Acenaphthene	0.010	µg/L	60	250	<0.010	<0.010
Acenaphthylene	0.010	µg/L			<0.010	<0.010
Acridine	0.010	µg/L	0.5		<0.010	<0.010
Anthracene	0.010	µg/L	1	1000	<0.010	<0.010
Benzo(a)anthracene	0.010	µg/L	1	0.07	<0.010	<0.010
Benzo(a)pyrene	0.0050	µg/L	0.1	0.01	<0.0050	<0.0050
Benzo(b)fluoranthene	0.010	µg/L		0.07	<0.010	<0.010
Benzo(b+r+j+k)fluoranthene	0.015	µg/L			<0.015	<0.015
Benzo(g,h,i)perylene	0.010	µg/L			<0.010	<0.010
Benzo(k)fluoranthene	0.010	µg/L			<0.010	<0.010
Chrysene	0.010	µg/L	1	7	<0.010	<0.010
Dibenz(a,h)anthracene	0.0050	µg/L		0.01	<0.0050	<0.0050
Fluoranthene	0.010	µg/L	2	150	<0.010	<0.010
Fluorene	0.010	µg/L	120	150	<0.010	<0.010
Indeno(1,2,3-c,d)pyrene	0.010	µg/L			<0.010	<0.010
Methylnaphthalene, 1+2-	0.015	µg/L			<0.015	<0.015
Methylnaphthalene, 1-	0.010	µg/L		5.5	<0.010	<0.010
Methylnaphthalene, 2-	0.010	µg/L		15	<0.010	<0.010
Naphthalene	0.050	µg/L	10	80	<0.050	<0.050
Phenanthrene	0.020	µg/L	3		<0.020	<0.020
Pyrene	0.010	µg/L	0.2	100	<0.010	<0.010
Quinoline	0.050	µg/L	34	0.05	<0.050	<0.050
B(a)P total potency equivalents [B(a)P TPE]	0.010	µg/L			<0.010	<0.010
PAHs, high molecular weight (BC AWQ)	0.030	µg/L			<0.030	<0.030
PAHs, low molecular weight (BC AWQ)	0.060	µg/L			<0.060	<0.060
PAHs, total (CCME sewer 18)	0.070	µg/L			<0.070	<0.070
PAHs, total (EPA 16)	0.065	µg/L			<0.065	<0.065
Polycyclic Aromatic Hydrocarbons Surrogates (Matrix: Water)						
Chrysene-d12	0.1	%			95.5	86.2
Naphthalene-d8	0.1	%			92.7	77.7
Phenanthrene-d10	0.1	%			105	89.2

LEGEND:

	Parameter higher than the BC CSR generic numerical water standard for aquatic life.
	Parameter higher than the BC CSR generic numerical water standard for drinking water.
	Parameter higher than both the BC CSR generic numerical water standards for aquatic life and drinking water.

Regional District of Central Kootenay
Quality Assurance - Quality Control Summary - Blanks 2025
Nakusp Landfill, Nakusp, BC

			First Half
Client Sample ID			Field Blank
Date Sampled			27-May-2025
Time Sampled			15:55
ALS Sample ID			VA25B2628-005
Parameter	Lowest Detection Limit	Units	
Physical Tests (Matrix: Water)			
Conductivity	2	µS/cm	<2.0
Alkalinity, total (as CaCO ₃)	1	mg/L	<1.0
Hardness (as CaCO ₃), dissolved	0.6	mg/L	<0.60
Solids, total dissolved [TDS]	10	mg/L	<10
Solids, total suspended [TSS]	3	mg/L	<3.0
pH	0.1	pH units	5.77
Anions and Nutrients (Matrix: Water)			
Ammonia, total (as N)	0.005	mg/L	<0.0050
Bromide	0.05	mg/L	<0.050
Chloride	0.5	mg/L	<0.50
Fluoride	0.02	mg/L	<0.020
Kjeldahl nitrogen, total [TKN]	0.05	mg/L	<0.050
Nitrate (as N)	0.005	mg/L	0.0087
Nitrite (as N)	0.001	mg/L	<0.0010
Sulfate (as SO ₄)	0.3	mg/L	<0.30
Organic / Inorganic Carbon (Matrix: Water)			
Carbon, total organic [TOC]	0.5	mg/L	<0.50
Dissolved Metals (Matrix: Water)			
Aluminum, dissolved	1	µg/L	<1.0
Antimony, dissolved	0.1	µg/L	<0.10
Arsenic, dissolved	0.1	µg/L	<0.10
Barium, dissolved	0.1	µg/L	0.31
Beryllium, dissolved	0.1	µg/L	<0.100
Bismuth, dissolved	0.05	µg/L	<0.050
Boron, dissolved	10	µg/L	<10
Cadmium, dissolved	0.005	µg/L	<0.0050
Calcium, dissolved	50	µg/L	54
Cesium, dissolved	0.01	µg/L	<0.010
Chromium, dissolved	0.5	µg/L	<0.50
Cobalt, dissolved	0.1	µg/L	<0.10
Copper, dissolved	0.2	µg/L	0.56
Iron, dissolved	10	µg/L	<10
Lead, dissolved	0.05	µg/L	0.078
Lithium, dissolved	1	µg/L	<1.0
Magnesium, dissolved	5	µg/L	15
Manganese, dissolved	0.1	µg/L	0.14
Mercury, dissolved	0.005	µg/L	<0.0050
Molybdenum, dissolved	0.05	µg/L	<0.050
Nickel, dissolved	0.5	µg/L	<0.50
Phosphorus, dissolved	50	µg/L	<50
Potassium, dissolved	50	µg/L	67
Rubidium, dissolved	0.2	µg/L	<0.20
Selenium, dissolved	0.05	µg/L	<0.050
Silicon, dissolved	50	µg/L	<50
Silver, dissolved	0.01	µg/L	<0.010
Sodium, dissolved	50	µg/L	85
Strontium, dissolved	0.2	µg/L	0.35
Sulfur, dissolved	500	µg/L	<500
Tellurium, dissolved	0.2	µg/L	<0.20
Thallium, dissolved	0.01	µg/L	<0.010
Thorium, dissolved	0.1	µg/L	<0.10
Tin, dissolved	0.1	µg/L	1.6
Titanium, dissolved	0.3	µg/L	<0.30
Tungsten, dissolved	0.1	µg/L	<0.10
Uranium, dissolved	0.01	µg/L	<0.010
Vanadium, dissolved	0.5	µg/L	<0.50
Zinc, dissolved	1	µg/L	4.0
Zirconium, dissolved	0.2	µg/L	<0.20
Dissolved mercury filtration location			Field
Dissolved metals filtration location			Field

Total Parameters	54	
Number >DL	12	22%
Number <5 x DL	11	20%
Remainder	1	2%

¹ Acceptable, the result is within 5x the detection limit.

² The groundwater Field Blank results for dissolved tin were greater than those quantified at all of the landfill wells in H1. However, the high field blank result (16x the DL) should not affect the overall interpretation of the results as these tin results are still more than three orders of magnitude lower than CSR DW standard (2500 µg/L). There is no CSR AW standard for tin.

APPENDIX 5. TREND GRAPHS

Figure A5-1

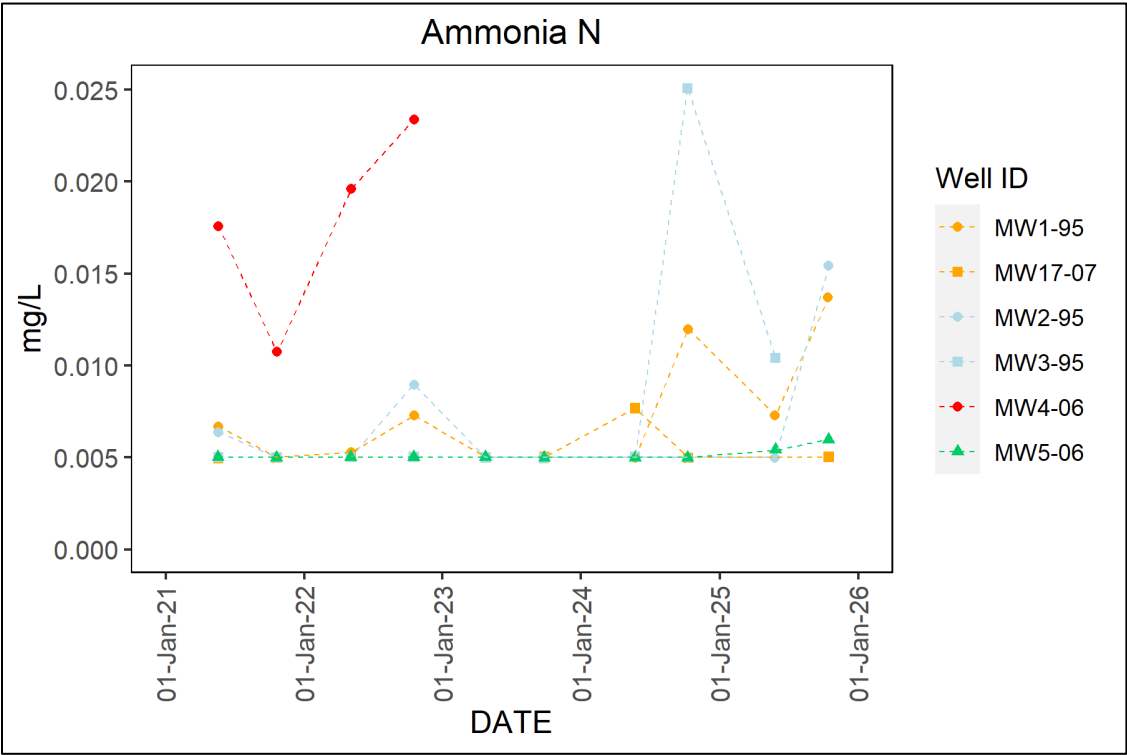


Figure A5-2

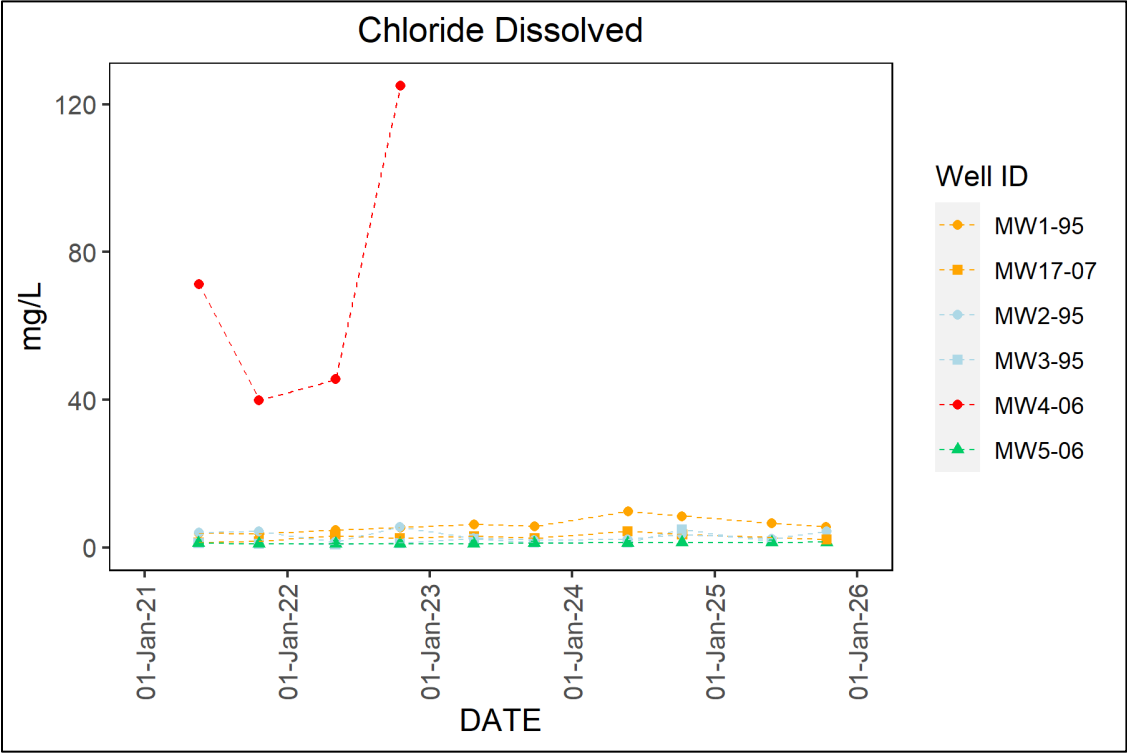


Figure A5-3

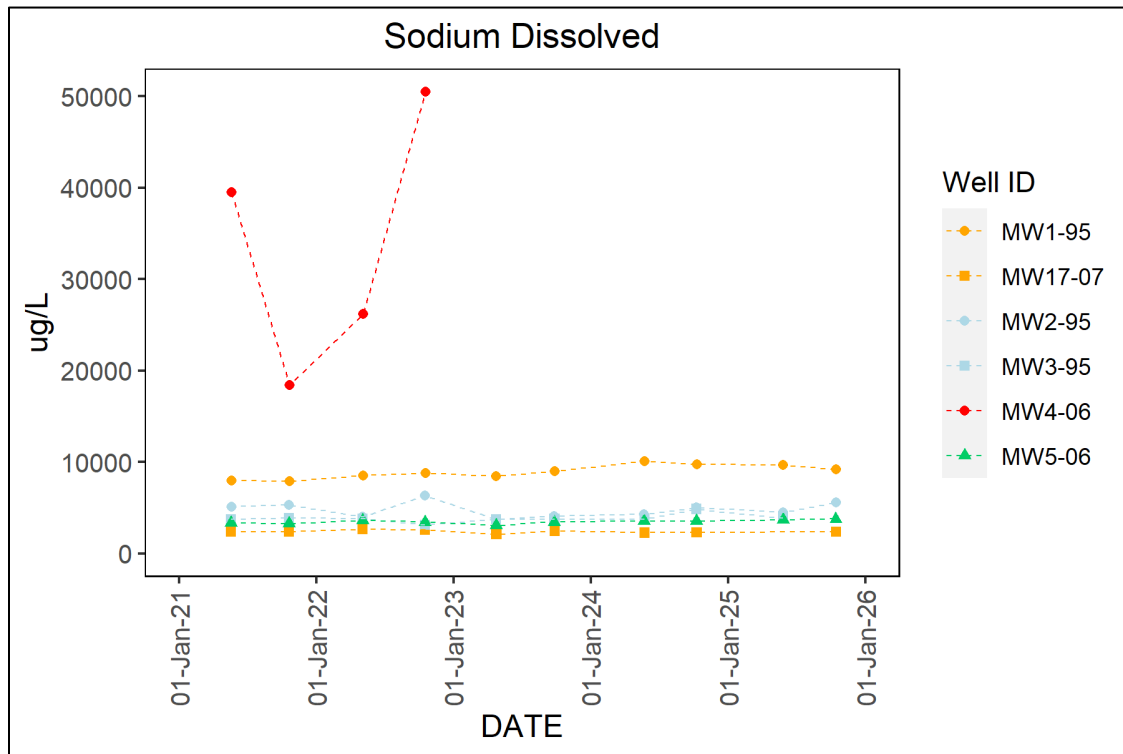


Figure A5-4

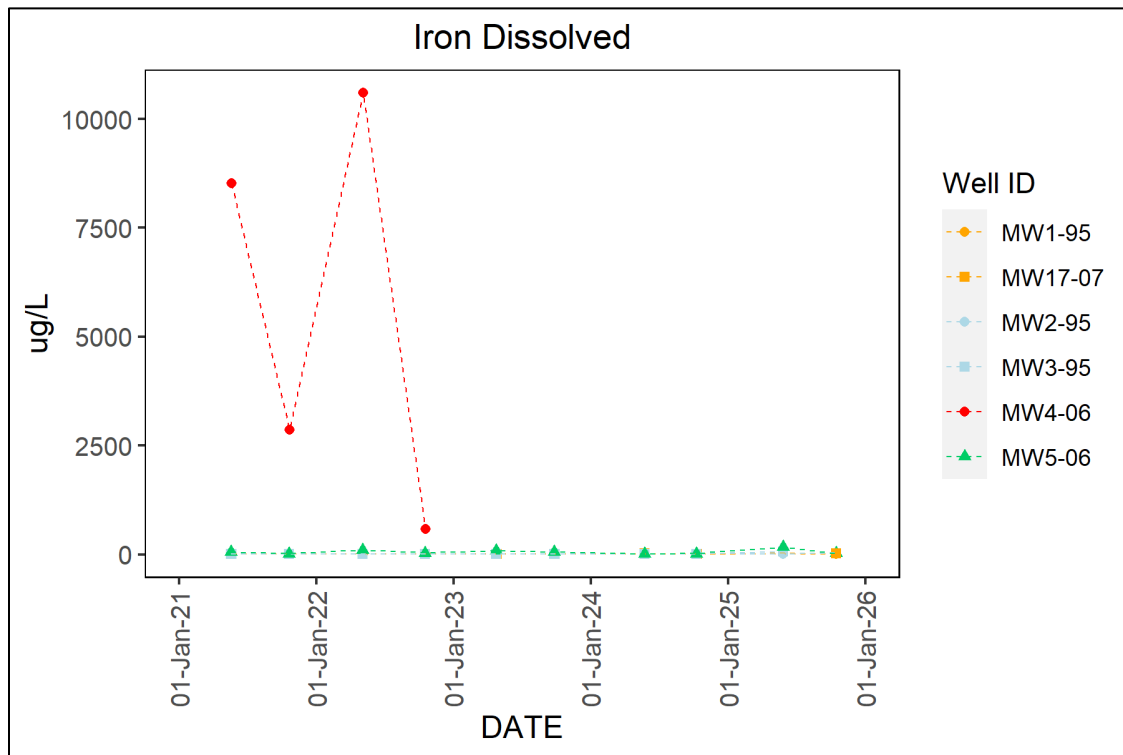
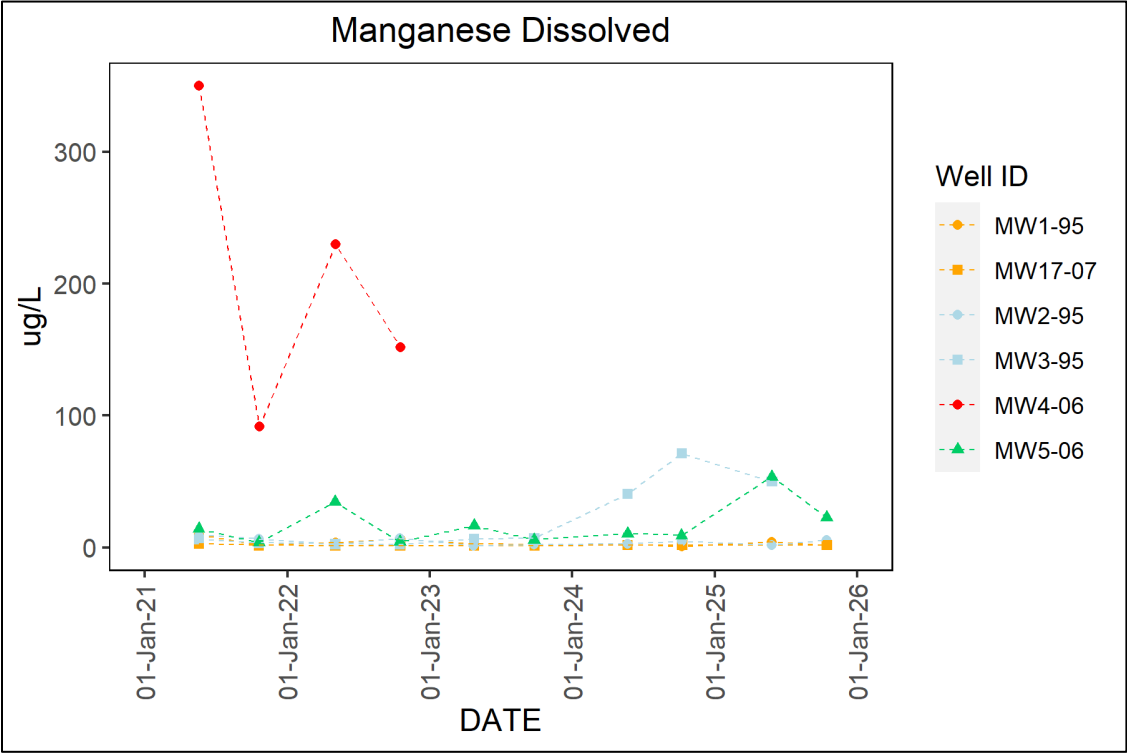


Figure A5-5



APPENDIX 6. LABORATORY CERTIFICATES OF ANALYSIS

CERTIFICATE OF ANALYSIS

Work Order	: VA25B2628		
Client	: Masse Environmental Consultants Ltd.	Laboratory	: ALS Environmental - Vancouver
Contact	: Ico de Zwart	Account Manager	: Can Dang
Address	: 812 Vernon Street Nelson British Columbia Canada V1L 4G4	Address	: 8081 Lougheed Highway Burnaby BC Canada V5A 1W9
Telephone	: ----	E-mail	: Can.Dang@ALSGlobal.com
Project	: 2016-503 Nasusp	Telephone	: +1 604 253 4188
PO	: ----	Date Samples Received	: 29-May-2025 12:15
C-O-C number	: 22-20250528	Date Analysis Commenced	: 30-May-2025
Sampler	: Chris Stephanou	Issue Date	: 04-Jun-2025 15:13
Site	: RDCK		
Quote number	: ----		
No. of samples received	: 5		
No. of samples analysed	: 5		

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

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

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

Signatories

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

<i>Signatories</i>	<i>Position</i>	<i>Laboratory Department</i>
Angelo Salandanan	Lab Assistant	Metals, Burnaby, British Columbia
Dan Gebert	Supervisor - Metals Mercury & Speciation	Metals, Burnaby, British Columbia
Ilnaz Badbezanchi	Supervisor - Metals Prep	Metals, Burnaby, British Columbia
Kim Jensen	Department Manager - Metals	Metals, Burnaby, British Columbia
Monica Ko	Supervisor - Inorganic	Inorganics, Burnaby, British Columbia



General Comments

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

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

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

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

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

Unit	Description
-	no units
mg/L	milligrams per litre
pH units	pH units
µg/L	micrograms per litre
µS/cm	microsiemens per centimetre

<: less than.

>: greater than.

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

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

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

Qualifiers

Qualifier	Description
HTDC	Hold time exceeded for dilution or re-analysis. Reported results are consistent with initial results (tested within hold time), and are valid and defensible.
RRV	Reported result verified by repeat analysis.



Analytical Results

Sub-Matrix: Groundwater

(Matrix: Water)

Sub-Matrix: Groundwater (Matrix: Water)					Client sample ID	MW1-95	MW2-95	MW3-95	MW5-06	Field Blank
Client sampling date / time					27-May-2025 15:40	27-May-2025 11:05	27-May-2025 13:30	27-May-2025 09:26	27-May-2025 15:55	
Analyte	CAS Number	Method/Lab	LOR	Unit	VA25B2628-001	VA25B2628-002	VA25B2628-003	VA25B2628-004	VA25B2628-005	
					Result	Result	Result	Result	Result	
Physical Tests										
Alkalinity, total (as CaCO3)	----	E290/VA	1.0	mg/L	164	137	149	158	<1.0	
Conductivity	----	E100/VA	2.0	µS/cm	364	275	283	323	<2.0	
Hardness (as CaCO3), dissolved	----	EC100/VA	0.60	mg/L	167	136	140	159	<0.60	
pH	----	E108/VA	0.10	pH units	7.24	6.83	6.73	7.66	5.77	
Solids, total dissolved [TDS]	----	E162/VA	10	mg/L	273	220	216	227	<10	
Solids, total suspended [TSS]	----	E160/VA	3.0	mg/L	70.6	533	265	195	<3.0	
Anions and Nutrients										
Ammonia, total (as N)	7664-41-7	E298/VA	0.0050	mg/L	0.0073	<0.0050	0.0104	0.0054	<0.0050	
Bromide	24959-67-9	E235.Br-L/VA	0.050	mg/L	<0.050	<0.050	<0.050	<0.050	<0.050	
Chloride	16887-00-6	E235.Cl/VA	0.50	mg/L	6.50	2.27	1.61	1.38	<0.50	
Fluoride	16984-48-8	E235.F/VA	0.020	mg/L	0.020	0.025	0.026	0.614	<0.020	
Kjeldahl nitrogen, total [TKN]	----	E318/VA	0.050	mg/L	0.689	0.255	0.924	0.258	<0.050	
Nitrate (as N)	14797-55-8	E235.NO3-L/VA	0.0050	mg/L	2.77	0.762	0.0102	0.0777	0.0087 RRV, HTDC	
Nitrite (as N)	14797-65-0	E235.NO2-L/VA	0.0010	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	
Sulfate (as SO4)	14808-79-8	E235.SO4/VA	0.30	mg/L	13.4	6.12	2.42	14.8	<0.30	
Organic / Inorganic Carbon										
Carbon, total organic [TOC]	----	E355-L/VA	0.50	mg/L	4.08	2.29	9.39	3.72	<0.50	
Dissolved Metals										
Aluminum, dissolved	7429-90-5	E421/VA	1.0	µg/L	3.6	9.9	6.8	5.6	<1.0	
Antimony, dissolved	7440-36-0	E421/VA	0.10	µg/L	<0.10	<0.10	0.27	<0.10	<0.10	
Arsenic, dissolved	7440-38-2	E421/VA	0.10	µg/L	<0.10	<0.10	<0.10	0.11	<0.10	



Analytical Results

Sub-Matrix: Groundwater
 (Matrix: Water)

					Client sample ID	MW1-95	MW2-95	MW3-95	MW5-06	Field Blank
					Client sampling date / time	27-May-2025 15:40	27-May-2025 11:05	27-May-2025 13:30	27-May-2025 09:26	27-May-2025 15:55
Analyte	CAS Number	Method/Lab	LOR	Unit	VA25B2628-001	VA25B2628-002	VA25B2628-003	VA25B2628-004	VA25B2628-005	
					Result	Result	Result	Result	Result	
Dissolved Metals										
Barium, dissolved	7440-39-3	E421/VA	0.10	µg/L	934	962	1050	70.0	0.31	RRV
Beryllium, dissolved	7440-41-7	E421/VA	0.100	µg/L	<0.100	0.139	0.190	<0.100	<0.100	
Bismuth, dissolved	7440-69-9	E421/VA	0.050	µg/L	<0.050	<0.050	<0.050	<0.050	<0.050	
Boron, dissolved	7440-42-8	E421/VA	10	µg/L	178	23	<10	<10	<10	
Cadmium, dissolved	7440-43-9	E421/VA	0.0050	µg/L	0.0425	0.0358	0.0897	0.0167	<0.0050	
Calcium, dissolved	7440-70-2	E421/VA	50	µg/L	43800	35400	36700	57400	54	RRV
Cesium, dissolved	7440-46-2	E421/VA	0.010	µg/L	<0.010	<0.010	<0.010	<0.010	<0.010	
Chromium, dissolved	7440-47-3	E421/VA	0.50	µg/L	1.74	1.84	<0.50	<0.50	<0.50	
Cobalt, dissolved	7440-48-4	E421/VA	0.10	µg/L	0.11	<0.10	1.28	3.30	<0.10	
Copper, dissolved	7440-50-8	E421/VA	0.20	µg/L	2.61	0.87	1.73	0.29	0.56	RRV
Iron, dissolved	7439-89-6	E421/VA	10	µg/L	<10	<10	69	169	<10	
Lead, dissolved	7439-92-1	E421/VA	0.050	µg/L	<0.050	<0.050	2.14	<0.050	0.078	RRV
Lithium, dissolved	7439-93-2	E421/VA	1.0	µg/L	12.9	13.3	13.3	4.8	<1.0	
Magnesium, dissolved	7439-95-4	E421/VA	5.0	µg/L	14100	11700	11700	3760	15.0	RRV
Manganese, dissolved	7439-96-5	E421/VA	0.10	µg/L	4.18	1.59	50.1	53.6	0.14	RRV
Mercury, dissolved	7439-97-6	E509/VA	0.0050	µg/L	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	
Molybdenum, dissolved	7439-98-7	E421/VA	0.050	µg/L	<0.050	<0.050	0.055	0.378	<0.050	
Nickel, dissolved	7440-02-0	E421/VA	0.50	µg/L	3.55	3.69	6.16	1.70	<0.50	
Phosphorus, dissolved	7723-14-0	E421/VA	50	µg/L	<50	<50	<50	<50	<50	
Potassium, dissolved	7440-09-7	E421/VA	50	µg/L	1720	967	1050	1220	67	RRV
Rubidium, dissolved	7440-17-7	E421/VA	0.20	µg/L	1.74	1.28	1.18	0.30	<0.20	



Analytical Results

Sub-Matrix: Groundwater

(Matrix: Water)

					Client sample ID	MW1-95	MW2-95	MW3-95	MW5-06	Field Blank
					Client sampling date / time	27-May-2025 15:40	27-May-2025 11:05	27-May-2025 13:30	27-May-2025 09:26	27-May-2025 15:55
Analyte	CAS Number	Method/Lab	LOR	Unit	VA25B2628-001	VA25B2628-002	VA25B2628-003	VA25B2628-004	VA25B2628-005	
					Result	Result	Result	Result	Result	
Dissolved Metals										
Selenium, dissolved	7782-49-2	E421/VA	0.050	µg/L	<0.050	<0.050	<0.050	0.152	<0.050	
Silicon, dissolved	7440-21-3	E421/VA	50	µg/L	22100	23700	24300	9520	<50	
Silver, dissolved	7440-22-4	E421/VA	0.010	µg/L	<0.010	<0.010	<0.010	<0.010	<0.010	
Sodium, dissolved	7440-23-5	E421/VA	50	µg/L	9690	4520	3900	3670	85	RRV
Strontium, dissolved	7440-24-6	E421/VA	0.20	µg/L	608	539	486	771	0.35	RRV
Sulfur, dissolved	7704-34-9	E421/VA	500	µg/L	4640	1990	640	5190	<500	
Tellurium, dissolved	13494-80-9	E421/VA	0.20	µg/L	<0.20	<0.20	<0.20	<0.20	<0.20	
Thallium, dissolved	7440-28-0	E421/VA	0.010	µg/L	<0.010	<0.010	<0.010	<0.010	<0.010	
Thorium, dissolved	7440-29-1	E421/VA	0.10	µg/L	<0.10	<0.10	<0.10	<0.10	<0.10	
Tin, dissolved	7440-31-5	E421/VA	0.10	µg/L	0.14	<0.10	0.38	0.10	1.60	RRV
Titanium, dissolved	7440-32-6	E421/VA	0.30	µg/L	<0.30	<0.30	<0.30	<0.30	<0.30	
Tungsten, dissolved	7440-33-7	E421/VA	0.10	µg/L	<0.10	<0.10	<0.10	<0.10	<0.10	
Uranium, dissolved	7440-61-1	E421/VA	0.010	µg/L	0.730	0.473	0.467	0.632	<0.010	
Vanadium, dissolved	7440-62-2	E421/VA	0.50	µg/L	1.08	1.14	1.03	<0.50	<0.50	
Zinc, dissolved	7440-66-6	E421/VA	1.0	µg/L	19.1	6.3	30.6	4.1	4.0	RRV
Zirconium, dissolved	7440-67-7	E421/VA	0.20	µg/L	<0.20	<0.20	<0.20	<0.20	<0.20	
Dissolved mercury filtration location	----	EP509/VA	-	-	Field	Field	Field	Field	Field	
Dissolved metals filtration location	----	EP421/VA	-	-	Field	Field	Field	Field	Field	

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

QUALITY CONTROL INTERPRETIVE REPORT

Work Order	: VA25B2628	Page	: 1 of 17
Client	: Masse Environmental Consultants Ltd.	Laboratory	: ALS Environmental - Vancouver
Contact	: Ico de Zwart	Account Manager	: Can Dang
Address	: 812 Vernon Street Nelson BC Canada V1L 4G4	Address	: 8081 Lougheed Highway Burnaby, British Columbia Canada V5A 1W9
Telephone	: ----	Telephone	: +1 604 253 4188
Project	: 2016-503 Nasusp	Date Samples Received	: 29-May-2025 12:15
PO	: ----	Issue Date	: 04-Jun-2025 15:13
C-O-C number	: 22-20250528		
Sampler	: Chris Stephanou		
Site	: RDCK		
Quote number	: ----		
No. of samples received	: 5		
No. of samples analysed	: 5		

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

Key

Anonymous: Refers to samples which are not part of this work order, but which formed part of the QC process lot.

CAS Number: Chemical Abstracts Service number is a unique identifier assigned to discrete substances.

DQO: Data Quality Objective.

LOR: Limit of Reporting (detection limit).

RPD: Relative Percent Difference.

Workorder Comments

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

Summary of Outliers

Outliers : Quality Control Samples

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

Outliers: Reference Material (RM) Samples

- No Reference Material (RM) Sample outliers occur.

Outliers : Analysis Holding Time Compliance (Breaches)

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

Outliers : Frequency of Quality Control Samples

- No Quality Control Sample Frequency Outliers occur.



Analysis Holding Time Compliance

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

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

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

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

Matrix: **Water**

Evaluation: ✖ = Holding time exceedance ; ✔ = Within Holding Time

Analyte Group : Analytical Method Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times		Eval	Analysis Date	Holding Times		Eval
				Rec	Actual			Rec	Actual	
Anions and Nutrients : Ammonia by Fluorescence										
Amber glass total (sulfuric acid) Field Blank	E298	27-May-2025	30-May-2025	28 days	3 days	✓	04-Jun-2025	28 days	3 days	✓
Anions and Nutrients : Ammonia by Fluorescence										
Amber glass total (sulfuric acid) MW1-95	E298	27-May-2025	30-May-2025	28 days	3 days	✓	04-Jun-2025	28 days	3 days	✓
Anions and Nutrients : Ammonia by Fluorescence										
Amber glass total (sulfuric acid) MW2-95	E298	27-May-2025	30-May-2025	28 days	3 days	✓	04-Jun-2025	28 days	3 days	✓
Anions and Nutrients : Ammonia by Fluorescence										
Amber glass total (sulfuric acid) MW3-95	E298	27-May-2025	30-May-2025	28 days	3 days	✓	04-Jun-2025	28 days	3 days	✓
Anions and Nutrients : Ammonia by Fluorescence										
Amber glass total (sulfuric acid) MW5-06	E298	27-May-2025	30-May-2025	28 days	3 days	✓	04-Jun-2025	28 days	3 days	✓
Anions and Nutrients : Bromide in Water by IC (Low Level)										
HDPE Field Blank	E235.Br-L	27-May-2025	30-May-2025	28 days	2 days	✓	30-May-2025	28 days	2 days	✓
Anions and Nutrients : Bromide in Water by IC (Low Level)										
HDPE MW1-95	E235.Br-L	27-May-2025	30-May-2025	28 days	2 days	✓	30-May-2025	28 days	2 days	✓



Matrix: **Water** Evaluation: ✖ = Holding time exceedance ; ✔ = Within Holding Time

Analyte Group : Analytical Method	Method	Sampling Date	Extraction / Preparation				Analysis			
Container / Client Sample ID(s)			Preparation Date	Holding Times		Eval	Analysis Date	Holding Times		Eval
				Rec	Actual			Rec	Actual	
Anions and Nutrients : Bromide in Water by IC (Low Level)										
HDPE MW3-95	E235.Br-L	27-May-2025	30-May-2025	28 days	2 days	✓	30-May-2025	28 days	2 days	✓
Anions and Nutrients : Bromide in Water by IC (Low Level)										
HDPE MW2-95	E235.Br-L	27-May-2025	30-May-2025	28 days	3 days	✓	30-May-2025	28 days	3 days	✓
Anions and Nutrients : Bromide in Water by IC (Low Level)										
HDPE MW5-06	E235.Br-L	27-May-2025	30-May-2025	28 days	3 days	✓	30-May-2025	28 days	3 days	✓
Anions and Nutrients : Chloride in Water by IC										
HDPE Field Blank	E235.Cl	27-May-2025	30-May-2025	28 days	2 days	✓	30-May-2025	28 days	2 days	✓
Anions and Nutrients : Chloride in Water by IC										
HDPE MW1-95	E235.Cl	27-May-2025	30-May-2025	28 days	2 days	✓	30-May-2025	28 days	2 days	✓
Anions and Nutrients : Chloride in Water by IC										
HDPE MW3-95	E235.Cl	27-May-2025	30-May-2025	28 days	2 days	✓	30-May-2025	28 days	2 days	✓
Anions and Nutrients : Chloride in Water by IC										
HDPE MW2-95	E235.Cl	27-May-2025	30-May-2025	28 days	3 days	✓	30-May-2025	28 days	3 days	✓
Anions and Nutrients : Chloride in Water by IC										
HDPE MW5-06	E235.Cl	27-May-2025	30-May-2025	28 days	3 days	✓	30-May-2025	28 days	3 days	✓
Anions and Nutrients : Fluoride in Water by IC										
HDPE Field Blank	E235.F	27-May-2025	30-May-2025	28 days	2 days	✓	30-May-2025	28 days	2 days	✓



Matrix: **Water** Evaluation: ✖ = Holding time exceedance ; ✔ = Within Holding Time

Analyte Group : Analytical Method	Method	Sampling Date	Extraction / Preparation				Analysis			
Container / Client Sample ID(s)			Preparation Date	Holding Times		Eval	Analysis Date	Holding Times		Eval
				Rec	Actual			Rec	Actual	
Anions and Nutrients : Fluoride in Water by IC										
HDPE MW1-95	E235.F	27-May-2025	30-May-2025	28 days	2 days	✓	30-May-2025	28 days	2 days	✓
Anions and Nutrients : Fluoride in Water by IC										
HDPE MW3-95	E235.F	27-May-2025	30-May-2025	28 days	2 days	✓	30-May-2025	28 days	2 days	✓
Anions and Nutrients : Fluoride in Water by IC										
HDPE MW2-95	E235.F	27-May-2025	30-May-2025	28 days	3 days	✓	30-May-2025	28 days	3 days	✓
Anions and Nutrients : Fluoride in Water by IC										
HDPE MW5-06	E235.F	27-May-2025	30-May-2025	28 days	3 days	✓	30-May-2025	28 days	3 days	✓
Anions and Nutrients : Nitrate in Water by IC (Low Level)										
HDPE Field Blank	E235.NO3-L	27-May-2025	30-May-2025	3 days	2 days	✓	30-May-2025	3 days	2 days	✓
Anions and Nutrients : Nitrate in Water by IC (Low Level)										
HDPE MW1-95	E235.NO3-L	27-May-2025	30-May-2025	3 days	2 days	✓	30-May-2025	3 days	2 days	✓
Anions and Nutrients : Nitrate in Water by IC (Low Level)										
HDPE MW3-95	E235.NO3-L	27-May-2025	30-May-2025	3 days	2 days	✓	30-May-2025	3 days	2 days	✓
Anions and Nutrients : Nitrate in Water by IC (Low Level)										
HDPE MW2-95	E235.NO3-L	27-May-2025	30-May-2025	3 days	3 days	✓	30-May-2025	3 days	3 days	✓
Anions and Nutrients : Nitrate in Water by IC (Low Level)										
HDPE MW5-06	E235.NO3-L	27-May-2025	30-May-2025	3 days	3 days	✓	30-May-2025	3 days	3 days	✓



Matrix: **Water** Evaluation: ✖ = Holding time exceedance ; ✔ = Within Holding Time

Analyte Group : Analytical Method Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times		Eval	Analysis Date	Holding Times		Eval
				Rec	Actual			Rec	Actual	
Anions and Nutrients : Nitrite in Water by IC (Low Level)										
HDPE Field Blank	E235.NO2-L	27-May-2025	30-May-2025	3 days	2 days	✓	30-May-2025	3 days	2 days	✓
Anions and Nutrients : Nitrite in Water by IC (Low Level)										
HDPE MW1-95	E235.NO2-L	27-May-2025	30-May-2025	3 days	2 days	✓	30-May-2025	3 days	2 days	✓
Anions and Nutrients : Nitrite in Water by IC (Low Level)										
HDPE MW3-95	E235.NO2-L	27-May-2025	30-May-2025	3 days	2 days	✓	30-May-2025	3 days	2 days	✓
Anions and Nutrients : Nitrite in Water by IC (Low Level)										
HDPE MW2-95	E235.NO2-L	27-May-2025	30-May-2025	3 days	3 days	✓	30-May-2025	3 days	3 days	✓
Anions and Nutrients : Nitrite in Water by IC (Low Level)										
HDPE MW5-06	E235.NO2-L	27-May-2025	30-May-2025	3 days	3 days	✓	30-May-2025	3 days	3 days	✓
Anions and Nutrients : Sulfate in Water by IC										
HDPE Field Blank	E235.SO4	27-May-2025	30-May-2025	28 days	2 days	✓	30-May-2025	28 days	2 days	✓
Anions and Nutrients : Sulfate in Water by IC										
HDPE MW1-95	E235.SO4	27-May-2025	30-May-2025	28 days	2 days	✓	30-May-2025	28 days	2 days	✓
Anions and Nutrients : Sulfate in Water by IC										
HDPE MW3-95	E235.SO4	27-May-2025	30-May-2025	28 days	2 days	✓	30-May-2025	28 days	2 days	✓
Anions and Nutrients : Sulfate in Water by IC										
HDPE MW2-95	E235.SO4	27-May-2025	30-May-2025	28 days	3 days	✓	30-May-2025	28 days	3 days	✓



Matrix: **Water** Evaluation: ✖ = Holding time exceedance ; ✔ = Within Holding Time

Analyte Group : Analytical Method Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times		Eval	Analysis Date	Holding Times		Eval
				Rec	Actual			Rec	Actual	
Anions and Nutrients : Sulfate in Water by IC										
HDPE MW5-06	E235.SO4	27-May-2025	30-May-2025	28 days	3 days	✓	30-May-2025	28 days	3 days	✓
Anions and Nutrients : Total Kjeldahl Nitrogen by Fluorescence (Low Level)										
Amber glass total (sulfuric acid) Field Blank	E318	27-May-2025	30-May-2025	28 days	3 days	✓	03-Jun-2025	28 days	3 days	✓
Anions and Nutrients : Total Kjeldahl Nitrogen by Fluorescence (Low Level)										
Amber glass total (sulfuric acid) MW1-95	E318	27-May-2025	30-May-2025	28 days	3 days	✓	03-Jun-2025	28 days	3 days	✓
Anions and Nutrients : Total Kjeldahl Nitrogen by Fluorescence (Low Level)										
Amber glass total (sulfuric acid) MW2-95	E318	27-May-2025	30-May-2025	28 days	3 days	✓	03-Jun-2025	28 days	3 days	✓
Anions and Nutrients : Total Kjeldahl Nitrogen by Fluorescence (Low Level)										
Amber glass total (sulfuric acid) MW3-95	E318	27-May-2025	30-May-2025	28 days	3 days	✓	03-Jun-2025	28 days	3 days	✓
Anions and Nutrients : Total Kjeldahl Nitrogen by Fluorescence (Low Level)										
Amber glass total (sulfuric acid) MW5-06	E318	27-May-2025	30-May-2025	28 days	3 days	✓	03-Jun-2025	28 days	3 days	✓
Dissolved Metals : Dissolved Mercury in Water by CVAAS										
Glass vial - dissolved (lab preserved) Field Blank	E509	27-May-2025	03-Jun-2025	28 days	7 days	✓	03-Jun-2025	28 days	7 days	✓
Dissolved Metals : Dissolved Mercury in Water by CVAAS										
Glass vial - dissolved (lab preserved) MW1-95	E509	27-May-2025	03-Jun-2025	28 days	7 days	✓	03-Jun-2025	28 days	7 days	✓
Dissolved Metals : Dissolved Mercury in Water by CVAAS										
Glass vial - dissolved (lab preserved) MW2-95	E509	27-May-2025	03-Jun-2025	28 days	7 days	✓	03-Jun-2025	28 days	7 days	✓



Matrix: **Water** Evaluation: ✖ = Holding time exceedance ; ✔ = Within Holding Time

Analyte Group : Analytical Method	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times		Eval	Analysis Date	Holding Times		Eval
				Rec	Actual			Rec	Actual	
Dissolved Metals : Dissolved Mercury in Water by CVAAS										
Glass vial - dissolved (lab preserved) MW3-95	E509	27-May-2025	03-Jun-2025	28 days	7 days	✓	03-Jun-2025	28 days	7 days	✓
Dissolved Metals : Dissolved Mercury in Water by CVAAS										
Glass vial - dissolved (lab preserved) MW5-06	E509	27-May-2025	03-Jun-2025	28 days	7 days	✓	03-Jun-2025	28 days	7 days	✓
Dissolved Metals : Dissolved Metals in Water by CRC ICPMS										
HDPE - dissolved (lab preserved) Field Blank	E421	27-May-2025	02-Jun-2025	180 days	6 days	✓	03-Jun-2025	180 days	6 days	✓
Dissolved Metals : Dissolved Metals in Water by CRC ICPMS										
HDPE - dissolved (lab preserved) MW1-95	E421	27-May-2025	02-Jun-2025	180 days	6 days	✓	03-Jun-2025	180 days	6 days	✓
Dissolved Metals : Dissolved Metals in Water by CRC ICPMS										
HDPE - dissolved (lab preserved) MW2-95	E421	27-May-2025	02-Jun-2025	180 days	6 days	✓	03-Jun-2025	180 days	6 days	✓
Dissolved Metals : Dissolved Metals in Water by CRC ICPMS										
HDPE - dissolved (lab preserved) MW3-95	E421	27-May-2025	02-Jun-2025	180 days	6 days	✓	03-Jun-2025	180 days	6 days	✓
Dissolved Metals : Dissolved Metals in Water by CRC ICPMS										
HDPE - dissolved (lab preserved) MW5-06	E421	27-May-2025	02-Jun-2025	180 days	6 days	✓	03-Jun-2025	180 days	6 days	✓
Organic / Inorganic Carbon : Total Organic Carbon (Non-Purgeable) by Combustion (Low Level)										
Amber glass total (sulfuric acid) Field Blank	E355-L	27-May-2025	30-May-2025	28 days	3 days	✓	30-May-2025	28 days	3 days	✓
Organic / Inorganic Carbon : Total Organic Carbon (Non-Purgeable) by Combustion (Low Level)										
Amber glass total (sulfuric acid) MW1-95	E355-L	27-May-2025	30-May-2025	28 days	3 days	✓	30-May-2025	28 days	3 days	✓



Matrix: **Water** Evaluation: ✖ = Holding time exceedance ; ✔ = Within Holding Time

Analyte Group : Analytical Method Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times		Eval	Analysis Date	Holding Times		Eval
				Rec	Actual			Rec	Actual	
Organic / Inorganic Carbon : Total Organic Carbon (Non-Purgeable) by Combustion (Low Level)										
Amber glass total (sulfuric acid) MW2-95	E355-L	27-May-2025	30-May-2025	28 days	3 days	✓	30-May-2025	28 days	3 days	✓
Organic / Inorganic Carbon : Total Organic Carbon (Non-Purgeable) by Combustion (Low Level)										
Amber glass total (sulfuric acid) MW3-95	E355-L	27-May-2025	30-May-2025	28 days	3 days	✓	30-May-2025	28 days	3 days	✓
Organic / Inorganic Carbon : Total Organic Carbon (Non-Purgeable) by Combustion (Low Level)										
Amber glass total (sulfuric acid) MW5-06	E355-L	27-May-2025	30-May-2025	28 days	3 days	✓	30-May-2025	28 days	3 days	✓
Physical Tests : Alkalinity Species by Titration										
HDPE Field Blank	E290	27-May-2025	30-May-2025	14 days	2 days	✓	30-May-2025	14 days	2 days	✓
Physical Tests : Alkalinity Species by Titration										
HDPE MW1-95	E290	27-May-2025	30-May-2025	14 days	2 days	✓	30-May-2025	14 days	2 days	✓
Physical Tests : Alkalinity Species by Titration										
HDPE MW3-95	E290	27-May-2025	30-May-2025	14 days	2 days	✓	30-May-2025	14 days	2 days	✓
Physical Tests : Alkalinity Species by Titration										
HDPE MW2-95	E290	27-May-2025	30-May-2025	14 days	3 days	✓	30-May-2025	14 days	3 days	✓
Physical Tests : Alkalinity Species by Titration										
HDPE MW5-06	E290	27-May-2025	30-May-2025	14 days	3 days	✓	30-May-2025	14 days	3 days	✓
Physical Tests : Conductivity in Water										
HDPE Field Blank	E100	27-May-2025	30-May-2025	28 days	2 days	✓	30-May-2025	28 days	2 days	✓



Matrix: **Water** Evaluation: ✖ = Holding time exceedance ; ✔ = Within Holding Time

Analyte Group : Analytical Method Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times		Eval	Analysis Date	Holding Times		Eval
				Rec	Actual			Rec	Actual	
Physical Tests : Conductivity in Water										
HDPE MW1-95	E100	27-May-2025	30-May-2025	28 days	2 days	✓	30-May-2025	28 days	2 days	✓
Physical Tests : Conductivity in Water										
HDPE MW3-95	E100	27-May-2025	30-May-2025	28 days	2 days	✓	30-May-2025	28 days	2 days	✓
Physical Tests : Conductivity in Water										
HDPE MW2-95	E100	27-May-2025	30-May-2025	28 days	3 days	✓	30-May-2025	28 days	3 days	✓
Physical Tests : Conductivity in Water										
HDPE MW5-06	E100	27-May-2025	30-May-2025	28 days	3 days	✓	30-May-2025	28 days	3 days	✓
Physical Tests : pH by Meter										
HDPE Field Blank	E108	27-May-2025	30-May-2025	0.25 hrs	57 hrs	✗ EHTR-FM	30-May-2025	0.25 hrs	57 hrs	✗ EHTR-FM
Physical Tests : pH by Meter										
HDPE MW1-95	E108	27-May-2025	30-May-2025	0.25 hrs	57 hrs	✗ EHTR-FM	30-May-2025	0.25 hrs	57 hrs	✗ EHTR-FM
Physical Tests : pH by Meter										
HDPE MW3-95	E108	27-May-2025	30-May-2025	0.25 hrs	59 hrs	✗ EHTR-FM	30-May-2025	0.25 hrs	59 hrs	✗ EHTR-FM
Physical Tests : pH by Meter										
HDPE MW2-95	E108	27-May-2025	30-May-2025	0.25 hrs	62 hrs	✗ EHTR-FM	30-May-2025	0.25 hrs	62 hrs	✗ EHTR-FM
Physical Tests : pH by Meter										
HDPE MW5-06	E108	27-May-2025	30-May-2025	0.25 hrs	63 hrs	✗ EHTR-FM	30-May-2025	0.25 hrs	63 hrs	✗ EHTR-FM



Matrix: **Water** Evaluation: ✖ = Holding time exceedance ; ✔ = Within Holding Time

<i>Analyte Group : Analytical Method</i>	<i>Method</i>	<i>Sampling Date</i>	<i>Extraction / Preparation</i>				<i>Analysis</i>			
<i>Container / Client Sample ID(s)</i>			<i>Preparation Date</i>	<i>Holding Times</i>		<i>Eval</i>	<i>Analysis Date</i>	<i>Holding Times</i>		<i>Eval</i>
				<i>Rec</i>	<i>Actual</i>			<i>Rec</i>	<i>Actual</i>	
Physical Tests : TDS by Gravimetry										
HDPE Field Blank	E162	27-May-2025	----	----	----		02-Jun-2025	7 days	6 days	✔
Physical Tests : TDS by Gravimetry										
HDPE MW1-95	E162	27-May-2025	----	----	----		02-Jun-2025	7 days	6 days	✔
Physical Tests : TDS by Gravimetry										
HDPE MW2-95	E162	27-May-2025	----	----	----		02-Jun-2025	7 days	6 days	✔
Physical Tests : TDS by Gravimetry										
HDPE MW3-95	E162	27-May-2025	----	----	----		02-Jun-2025	7 days	6 days	✔
Physical Tests : TDS by Gravimetry										
HDPE MW5-06	E162	27-May-2025	----	----	----		02-Jun-2025	7 days	6 days	✔
Physical Tests : TSS by Gravimetry										
HDPE Field Blank	E160	27-May-2025	----	----	----		02-Jun-2025	7 days	6 days	✔
Physical Tests : TSS by Gravimetry										
HDPE MW1-95	E160	27-May-2025	----	----	----		02-Jun-2025	7 days	6 days	✔
Physical Tests : TSS by Gravimetry										
HDPE MW2-95	E160	27-May-2025	----	----	----		02-Jun-2025	7 days	6 days	✔
Physical Tests : TSS by Gravimetry										
HDPE MW3-95	E160	27-May-2025	----	----	----		02-Jun-2025	7 days	6 days	✔

Page : 12 of 17
 Work Order : VA25B2628
 Client : Masse Environmental Consultants Ltd.
 Project : 2016-503 Nasusp



Matrix: **Water** Evaluation: ✖ = Holding time exceedance ; ✔ = Within Holding Time

Analyte Group : Analytical Method			Method	Sampling Date	Extraction / Preparation			Analysis			
Container / Client Sample ID(s)		Preparation Date			Holding Times		Eval	Analysis Date	Holding Times		Eval
					Rec	Actual			Rec	Actual	
Physical Tests : TSS by Gravimetry											
HDPE MW5-06		E160	27-May-2025	----	----	----		02-Jun-2025	7 days	6 days	✓

Legend & Qualifier Definitions

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

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



Quality Control Parameter Frequency Compliance

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

Matrix: **Water** Evaluation: ✖ = QC frequency outside specification; ✔ = QC frequency within specification.

Quality Control Sample Type	Method	QC Lot #	Count		Frequency (%)		
Analytical Methods			QC	Regular	Actual	Expected	Evaluation
Laboratory Duplicates (DUP)							
Conductivity in Water	E100	2023462	1	19	5.2	5.0	✓
pH by Meter	E108	2023461	1	19	5.2	5.0	✓
TSS by Gravimetry	E160	2028925	2	29	6.9	5.0	✓
TDS by Gravimetry	E162	2028928	2	29	6.9	5.0	✓
Bromide in Water by IC (Low Level)	E235.Br-L	2023470	1	13	7.6	5.0	✓
Chloride in Water by IC	E235.Cl	2023466	1	19	5.2	5.0	✓
Fluoride in Water by IC	E235.F	2023469	1	13	7.6	5.0	✓
Nitrite in Water by IC (Low Level)	E235.NO2-L	2023465	1	20	5.0	5.0	✓
Nitrate in Water by IC (Low Level)	E235.NO3-L	2023464	1	18	5.5	5.0	✓
Sulfate in Water by IC	E235.SO4	2023468	1	19	5.2	5.0	✓
Alkalinity Species by Titration	E290	2023463	1	17	5.8	5.0	✓
Ammonia by Fluorescence	E298	2024617	1	20	5.0	5.0	✓
Total Kjeldahl Nitrogen by Fluorescence (Low Level)	E318	2024615	1	13	7.6	5.0	✓
Total Organic Carbon (Non-Purgeable) by Combustion (Low Level)	E355-L	2024616	1	15	6.6	5.0	✓
Dissolved Metals in Water by CRC ICPMS	E421	2024306	2	19	10.5	5.0	✓
Dissolved Mercury in Water by CVAAS	E509	2029768	1	20	5.0	5.0	✓
Laboratory Control Samples (LCS)							
Conductivity in Water	E100	2023462	1	19	5.2	5.0	✓
pH by Meter	E108	2023461	1	19	5.2	5.0	✓
TSS by Gravimetry	E160	2028925	2	29	6.9	5.0	✓
TDS by Gravimetry	E162	2028928	2	29	6.9	5.0	✓
Bromide in Water by IC (Low Level)	E235.Br-L	2023470	1	13	7.6	5.0	✓
Chloride in Water by IC	E235.Cl	2023466	1	19	5.2	5.0	✓
Fluoride in Water by IC	E235.F	2023469	1	13	7.6	5.0	✓
Nitrite in Water by IC (Low Level)	E235.NO2-L	2023465	1	20	5.0	5.0	✓
Nitrate in Water by IC (Low Level)	E235.NO3-L	2023464	1	18	5.5	5.0	✓
Sulfate in Water by IC	E235.SO4	2023468	1	19	5.2	5.0	✓
Alkalinity Species by Titration	E290	2023463	1	17	5.8	5.0	✓
Ammonia by Fluorescence	E298	2024617	1	20	5.0	5.0	✓
Total Kjeldahl Nitrogen by Fluorescence (Low Level)	E318	2024615	1	13	7.6	5.0	✓
Total Organic Carbon (Non-Purgeable) by Combustion (Low Level)	E355-L	2024616	1	15	6.6	5.0	✓
Dissolved Metals in Water by CRC ICPMS	E421	2024306	1	19	5.2	5.0	✓
Dissolved Mercury in Water by CVAAS	E509	2029768	1	20	5.0	5.0	✓
Method Blanks (MB)							
Conductivity in Water	E100	2023462	1	19	5.2	5.0	✓



Matrix: **Water**

Evaluation: ✖ = QC frequency outside specification; ✔ = QC frequency within specification.

Quality Control Sample Type			Count		Frequency (%)		
Analytical Methods	Method	QC Lot #	QC	Regular	Actual	Expected	Evaluation
Method Blanks (MB) - Continued							
TSS by Gravimetry	E160	2028925	2	29	6.9	5.0	✔
TDS by Gravimetry	E162	2028928	2	29	6.9	5.0	✔
Bromide in Water by IC (Low Level)	E235.Br-L	2023470	1	13	7.6	5.0	✔
Chloride in Water by IC	E235.Cl	2023466	1	19	5.2	5.0	✔
Fluoride in Water by IC	E235.F	2023469	1	13	7.6	5.0	✔
Nitrite in Water by IC (Low Level)	E235.NO2-L	2023465	1	20	5.0	5.0	✔
Nitrate in Water by IC (Low Level)	E235.NO3-L	2023464	1	18	5.5	5.0	✔
Sulfate in Water by IC	E235.SO4	2023468	1	19	5.2	5.0	✔
Alkalinity Species by Titration	E290	2023463	1	17	5.8	5.0	✔
Ammonia by Fluorescence	E298	2024617	1	20	5.0	5.0	✔
Total Kjeldahl Nitrogen by Fluorescence (Low Level)	E318	2024615	1	13	7.6	5.0	✔
Total Organic Carbon (Non-Purgeable) by Combustion (Low Level)	E355-L	2024616	1	15	6.6	5.0	✔
Dissolved Metals in Water by CRC ICPMS	E421	2024306	1	19	5.2	5.0	✔
Dissolved Mercury in Water by CVAAS	E509	2029768	1	20	5.0	5.0	✔
Matrix Spikes (MS)							
Bromide in Water by IC (Low Level)	E235.Br-L	2023470	1	13	7.6	5.0	✔
Chloride in Water by IC	E235.Cl	2023466	1	19	5.2	5.0	✔
Fluoride in Water by IC	E235.F	2023469	1	13	7.6	5.0	✔
Nitrite in Water by IC (Low Level)	E235.NO2-L	2023465	1	20	5.0	5.0	✔
Nitrate in Water by IC (Low Level)	E235.NO3-L	2023464	1	18	5.5	5.0	✔
Sulfate in Water by IC	E235.SO4	2023468	1	19	5.2	5.0	✔
Ammonia by Fluorescence	E298	2024617	1	20	5.0	5.0	✔
Total Kjeldahl Nitrogen by Fluorescence (Low Level)	E318	2024615	1	13	7.6	5.0	✔
Total Organic Carbon (Non-Purgeable) by Combustion (Low Level)	E355-L	2024616	1	15	6.6	5.0	✔
Dissolved Metals in Water by CRC ICPMS	E421	2024306	1	19	5.2	5.0	✔
Dissolved Mercury in Water by CVAAS	E509	2029768	1	20	5.0	5.0	✔



Methodology References and Summaries

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

Analytical Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
Conductivity in Water	E100 ALS Environmental - Vancouver	Water	APHA 2510 (mod)	Conductivity, also known as Electrical Conductivity (EC) or Specific Conductance, is measured by immersion of a conductivity cell with platinum electrodes into a water sample. Conductivity measurements are temperature-compensated to 25°C.
pH by Meter	E108 ALS Environmental - Vancouver	Water	APHA 4500-H (mod)	pH is determined by potentiometric measurement with a pH electrode, and is conducted at ambient laboratory temperature (normally $20 \pm 5^\circ\text{C}$). For high accuracy test results, pH should be measured in the field within the recommended 15 minute hold time.
TSS by Gravimetry	E160 ALS Environmental - Vancouver	Water	APHA 2540 D (mod)	Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, following by drying of the filter at $104 \pm 1^\circ\text{C}$, with gravimetric measurement of the filtered solids. Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.
TDS by Gravimetry	E162 ALS Environmental - Vancouver	Water	APHA 2540 C (mod)	Total Dissolved Solids (TDS) are determined by filtering a sample through a glass fibre filter, with evaporation of the filtrate at $180 \pm 2^\circ\text{C}$ for 16 hours or to constant weight, with gravimetric measurement of the residue.
Bromide in Water by IC (Low Level)	E235.Br-L ALS Environmental - Vancouver	Water	EPA 300.1 (mod)	Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.
Chloride in Water by IC	E235.Cl ALS Environmental - Vancouver	Water	EPA 300.1 (mod)	Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.
Fluoride in Water by IC	E235.F ALS Environmental - Vancouver	Water	EPA 300.1 (mod)	Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.
Nitrite in Water by IC (Low Level)	E235.NO2-L ALS Environmental - Vancouver	Water	EPA 300.1 (mod)	Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.
Nitrate in Water by IC (Low Level)	E235.NO3-L ALS Environmental - Vancouver	Water	EPA 300.1 (mod)	Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.



Analytical Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
Sulfate in Water by IC	E235.SO4 ALS Environmental - Vancouver	Water	EPA 300.1 (mod)	Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.
Alkalinity Species by Titration	E290 ALS Environmental - Vancouver	Water	APHA 2320 B (mod)	Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.
Ammonia by Fluorescence	E298 ALS Environmental - Vancouver	Water	Method Fialab 100, 2018	Ammonia in water is determined by automated continuous flow analysis with membrane diffusion and fluorescence detection, after reaction with OPA (ortho-phthalaldehyde). This method is approved under US EPA 40 CFR Part 136 (May 2021)
Total Kjeldahl Nitrogen by Fluorescence (Low Level)	E318 ALS Environmental - Vancouver	Water	Method Fialab 100, 2018	TKN in water is determined by automated continuous flow analysis with membrane diffusion and fluorescence detection, after reaction with OPA (ortho-phthalaldehyde). This method is approved under US EPA 40 CFR Part 136 (May 2021).
Total Organic Carbon (Non-Purgeable) by Combustion (Low Level)	E355-L ALS Environmental - Vancouver	Water	APHA 5310 B (mod)	Total Organic Carbon (Non-Purgeable), also known as NPOC (total), is a direct measurement of TOC after an acidified sample has been purged to remove carbonate-based Inorganic Carbon (IC). Analysis is by high temperature combustion with infrared detection of CO ₂ . Forms of carbon associated with inorganic or organic molecules (e.g. SCN and CN) are included in NPOC if they are not removed by purging under acidic conditions. Notably, NPOC excludes most volatile organic compounds and free cyanide. For samples where the majority of Total Carbon is inorganic, this method provides greater accuracy and reliability versus the TOC by subtraction method (TC minus TIC).
Dissolved Metals in Water by CRC ICPMS	E421 ALS Environmental - Vancouver	Water	APHA 3030B/EPA 6020B (mod)	Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by Collision/Reaction Cell ICPMS. Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.
Dissolved Mercury in Water by CVAAS	E509 ALS Environmental - Vancouver	Water	APHA 3030B/EPA 1631E (mod)	Water samples are filtered (0.45 um), preserved with HCl, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS.
Dissolved Hardness (Calculated)	EC100 ALS Environmental - Vancouver	Water	APHA 2340B	"Hardness (as CaCO ₃), dissolved" is calculated from the sum of dissolved Calcium and Magnesium concentrations, expressed in CaCO ₃ equivalents. "Total Hardness" refers to the sum of Calcium and Magnesium Hardness. Hardness is normally or preferentially calculated from dissolved Calcium and Magnesium concentrations, because it is a property of water due to dissolved divalent cations.
Preparation Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
Preparation for Ammonia	EP298 ALS Environmental - Vancouver	Water		Sample preparation for Preserved Nutrients Water Quality Analysis.



<i>Preparation Methods</i>	<i>Method / Lab</i>	<i>Matrix</i>	<i>Method Reference</i>	<i>Method Descriptions</i>
Digestion for TKN in water	EP318 ALS Environmental - Vancouver	Water	APHA 4500-Norg D (mod)	Samples are digested at high temperature using Sulfuric Acid with Copper catalyst, which converts organic nitrogen sources to Ammonia, which is then quantified by the analytical method as TKN. This method is unsuitable for samples containing high levels of nitrate. If nitrate exceeds TKN concentration by ten times or more, results may be biased low.
Preparation for Total Organic Carbon by Combustion	EP355 ALS Environmental - Vancouver	Water		Preparation for Total Organic Carbon by Combustion
Dissolved Metals Water Filtration	EP421 ALS Environmental - Vancouver	Water	APHA 3030B	Water samples are filtered (0.45 um), and preserved with HNO ₃ .
Dissolved Mercury Water Filtration	EP509 ALS Environmental - Vancouver	Water	APHA 3030B	Water samples are filtered (0.45 um), and preserved with HCl.

QUALITY CONTROL REPORT

Work Order	: VA25B2628	Page	: 1 of 13
Client	: Masse Environmental Consultants Ltd.	Laboratory	: ALS Environmental - Vancouver
Contact	: Ico de Zwart	Account Manager	: Can Dang
Address	: 812 Vernon Street Nelson BC Canada V1L 4G4	Address	: 8081 Lougheed Highway Burnaby, British Columbia Canada V5A 1W9
Telephone	: ----	Telephone	: +1 604 253 4188
Project	: 2016-503 Nasusp	Date Samples Received	: 29-May-2025 12:15
PO	: ----	Date Analysis Commenced	: 30-May-2025
C-O-C number	: 22-20250528	Issue Date	: 04-Jun-2025 15:13
Sampler	: Chris Stephanou		
Site	: RDCK		
Quote number	: ----		
No. of samples received	: 5		
No. of samples analysed	: 5		

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

This Quality Control Report contains the following information:

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

Signatories

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

Signatories	Position	Laboratory Department
Angelo Salandanan	Lab Assistant	Vancouver Metals, Burnaby, British Columbia
Dan Gebert	Supervisor - Metals Mercury & Speciation	Vancouver Metals, Burnaby, British Columbia
Ilnaz Badbezanchi	Supervisor - Metals Prep	Vancouver Metals, Burnaby, British Columbia
Kim Jensen	Department Manager - Metals	Vancouver Metals, Burnaby, British Columbia
Monica Ko	Supervisor - Inorganic	Vancouver Inorganics, Burnaby, British Columbia



General Comments

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

Key :

Anonymous = Refers to samples which are not part of this work order, but which formed part of the QC process lot.

CAS Number = Chemical Abstracts Service number is a unique identifier assigned to discrete substances.

DQO = Data Quality Objective.

LOR = Limit of Reporting (detection limit).

RPD = Relative Percent Difference

= Indicates a QC result that did not meet the ALS DQO.

Workorder Comments

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



Laboratory Duplicate (DUP) Report

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

Sub-Matrix: Water					Laboratory Duplicate (DUP) Report						
Laboratory sample ID	Client sample ID	Analyte	CAS Number	Method	LOR	Unit	Original Result	Duplicate Result	RPD(%) or Difference	Duplicate Limits	Qualifier
Physical Tests (QC Lot: 2023461)											
VA25B2544-003	Anonymous	pH	----	E108	0.10	pH units	7.68	7.68	0.00%	4%	----
Physical Tests (QC Lot: 2023462)											
VA25B2544-003	Anonymous	Conductivity	----	E100	2.0	µS/cm	77.7	77.4	0.387%	10%	----
Physical Tests (QC Lot: 2023463)											
VA25B2544-003	Anonymous	Alkalinity, total (as CaCO3)	----	E290	1.0	mg/L	27.9	28.8	3.17%	20%	----
Physical Tests (QC Lot: 2028925)											
VA25B2348-007	Anonymous	Solids, total suspended [TSS]	----	E160	3.0	mg/L	<3.0	<3.0	0	Diff <2x LOR	----
Physical Tests (QC Lot: 2028926)											
VA25B2628-005	Field Blank	Solids, total suspended [TSS]	----	E160	3.0	mg/L	<3.0	<3.0	0	Diff <2x LOR	----
Physical Tests (QC Lot: 2028928)											
VA25B2348-007	Anonymous	Solids, total dissolved [TDS]	----	E162	10	mg/L	<10	<10	0	Diff <2x LOR	----
Physical Tests (QC Lot: 2028929)											
VA25B2628-005	Field Blank	Solids, total dissolved [TDS]	----	E162	10	mg/L	<10	<10	0	Diff <2x LOR	----
Anions and Nutrients (QC Lot: 2023464)											
VA25B2544-001	Anonymous	Nitrate (as N)	14797-55-8	E235.NO3-L	0.0050	mg/L	0.303	0.304	0.339%	20%	----
Anions and Nutrients (QC Lot: 2023465)											
VA25B2544-001	Anonymous	Nitrite (as N)	14797-65-0	E235.NO2-L	0.0010	mg/L	<0.0010	<0.0010	0	Diff <2x LOR	----
Anions and Nutrients (QC Lot: 2023466)											
VA25B2524-001	Anonymous	Chloride	16887-00-6	E235.Cl	0.50	mg/L	<0.50	<0.50	0	Diff <2x LOR	----
Anions and Nutrients (QC Lot: 2023468)											
VA25B2524-001	Anonymous	Sulfate (as SO4)	14808-79-8	E235.SO4	0.30	mg/L	14.4	14.5	0.691%	20%	----
Anions and Nutrients (QC Lot: 2023469)											
VA25B2544-001	Anonymous	Fluoride	16984-48-8	E235.F	0.020	mg/L	0.022	0.023	0.0008	Diff <2x LOR	----
Anions and Nutrients (QC Lot: 2023470)											
VA25B2544-001	Anonymous	Bromide	24959-67-9	E235.Br-L	0.050	mg/L	<0.050	<0.050	0	Diff <2x LOR	----
Anions and Nutrients (QC Lot: 2024615)											
KS2501991-005	Anonymous	Kjeldahl nitrogen, total [TKN]	----	E318	0.050	mg/L	0.360	0.355	0.005	Diff <2x LOR	----
Anions and Nutrients (QC Lot: 2024617)											
KS2501991-001	Anonymous	Ammonia, total (as N)	7664-41-7	E298	0.0050	mg/L	0.0066	0.0070	0.0004	Diff <2x LOR	----
Organic / Inorganic Carbon (QC Lot: 2024616)											



Sub-Matrix: Water					Laboratory Duplicate (DUP) Report						
Laboratory sample ID	Client sample ID	Analyte	CAS Number	Method	LOR	Unit	Original Result	Duplicate Result	RPD(%) or Difference	Duplicate Limits	Qualifier
Organic / Inorganic Carbon (QC Lot: 2024616) - continued											
KS2501991-001	Anonymous	Carbon, total organic [TOC]	----	E355-L	0.50	mg/L	2.13	2.15	0.02	Diff <2x LOR	----
Dissolved Metals (QC Lot: 2024306)											
VA25B2537-001	Anonymous	Aluminum, dissolved	7429-90-5	E421	0.0010	mg/L	0.0197	0.0208	5.55%	20%	----
		Antimony, dissolved	7440-36-0	E421	0.00010	mg/L	<0.00010	<0.00010	0	Diff <2x LOR	----
		Arsenic, dissolved	7440-38-2	E421	0.00010	mg/L	0.00013	0.00013	0.000002	Diff <2x LOR	----
		Barium, dissolved	7440-39-3	E421	0.00010	mg/L	0.00869	0.00872	0.387%	20%	----
		Beryllium, dissolved	7440-41-7	E421	0.000020	mg/L	<0.000020	<0.000020	0	Diff <2x LOR	----
		Bismuth, dissolved	7440-69-9	E421	0.000050	mg/L	<0.000050	<0.000050	0	Diff <2x LOR	----
		Boron, dissolved	7440-42-8	E421	0.010	mg/L	<0.010	<0.010	0	Diff <2x LOR	----
		Cadmium, dissolved	7440-43-9	E421	0.0000050	mg/L	<0.0000050	<0.0000050	0	Diff <2x LOR	----
		Calcium, dissolved	7440-70-2	E421	0.050	mg/L	13.0	12.3	5.37%	20%	----
		Cesium, dissolved	7440-46-2	E421	0.000010	mg/L	<0.000010	<0.000010	0	Diff <2x LOR	----
		Chromium, dissolved	7440-47-3	E421	0.00050	mg/L	<0.00050	<0.00050	0	Diff <2x LOR	----
		Cobalt, dissolved	7440-48-4	E421	0.00010	mg/L	<0.00010	<0.00010	0	Diff <2x LOR	----
		Copper, dissolved	7440-50-8	E421	0.00020	mg/L	0.00075	0.00082	0.00007	Diff <2x LOR	----
		Iron, dissolved	7439-89-6	E421	0.010	mg/L	0.022	0.025	0.002	Diff <2x LOR	----
		Lead, dissolved	7439-92-1	E421	0.000050	mg/L	<0.000050	<0.000050	0	Diff <2x LOR	----
		Lithium, dissolved	7439-93-2	E421	0.0010	mg/L	<0.0010	<0.0010	0	Diff <2x LOR	----
		Magnesium, dissolved	7439-95-4	E421	0.0050	mg/L	2.68	2.68	0.112%	20%	----
		Manganese, dissolved	7439-96-5	E421	0.00010	mg/L	0.00216	0.00229	5.70%	20%	----
		Molybdenum, dissolved	7439-98-7	E421	0.000050	mg/L	0.000764	0.000726	5.09%	20%	----
		Nickel, dissolved	7440-02-0	E421	0.00050	mg/L	<0.00050	<0.00050	0	Diff <2x LOR	----
		Phosphorus, dissolved	7723-14-0	E421	0.050	mg/L	<0.050	<0.050	0	Diff <2x LOR	----
		Potassium, dissolved	7440-09-7	E421	0.050	mg/L	0.844	0.845	0.0814%	20%	----
		Rubidium, dissolved	7440-17-7	E421	0.00020	mg/L	0.00127	0.00113	0.00014	Diff <2x LOR	----
		Selenium, dissolved	7782-49-2	E421	0.000050	mg/L	0.000094	0.000111	0.000017	Diff <2x LOR	----
		Silicon, dissolved	7440-21-3	E421	0.050	mg/L	2.99	2.96	1.02%	20%	----
		Silver, dissolved	7440-22-4	E421	0.000010	mg/L	<0.000010	<0.000010	0	Diff <2x LOR	----
		Strontium, dissolved	7440-24-6	E421	0.00020	mg/L	0.0821	0.0776	5.68%	20%	----
		Sulfur, dissolved	7704-34-9	E421	0.50	mg/L	3.55	3.47	0.08	Diff <2x LOR	----
		Tellurium, dissolved	13494-80-9	E421	0.00020	mg/L	<0.00020	<0.00020	0	Diff <2x LOR	----
		Thallium, dissolved	7440-28-0	E421	0.000010	mg/L	<0.000010	<0.000010	0	Diff <2x LOR	----
		Thorium, dissolved	7440-29-1	E421	0.00010	mg/L	<0.00010	<0.00010	0	Diff <2x LOR	----
		Tin, dissolved	7440-31-5	E421	0.00010	mg/L	<0.00010	<0.00010	0	Diff <2x LOR	----



Sub-Matrix: Water					Laboratory Duplicate (DUP) Report						
Laboratory sample ID	Client sample ID	Analyte	CAS Number	Method	LOR	Unit	Original Result	Duplicate Result	RPD(%) or Difference	Duplicate Limits	Qualifier
Dissolved Metals (QC Lot: 2024306) - continued											
VA25B2537-001	Anonymous	Titanium, dissolved	7440-32-6	E421	0.00030	mg/L	0.00038	0.00046	0.00008	Diff <2x LOR	----
		Tungsten, dissolved	7440-33-7	E421	0.00010	mg/L	<0.00010	<0.00010	0	Diff <2x LOR	----
		Uranium, dissolved	7440-61-1	E421	0.000010	mg/L	0.000305	0.000302	0.957%	20%	----
		Vanadium, dissolved	7440-62-2	E421	0.00050	mg/L	<0.00050	<0.00050	0	Diff <2x LOR	----
		Zinc, dissolved	7440-66-6	E421	0.0010	mg/L	0.0012	0.0011	0.0002	Diff <2x LOR	----
		Zirconium, dissolved	7440-67-7	E421	0.00030	mg/L	<0.00030	<0.00030	0	Diff <2x LOR	----
VA25B2537-001	Anonymous	Sodium, dissolved	7440-23-5	E421	0.050	mg/L	3.30	3.36	1.80%	20%	----
Dissolved Metals (QC Lot: 2029768)											
VA25B2607-013	Anonymous	Mercury, dissolved	7439-97-6	E509	0.0000050	mg/L	<0.0000050	<0.0000050	0	Diff <2x LOR	----



Method Blank (MB) Report

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

Sub-Matrix: Water

Analyte	CAS Number	Method	LOR	Unit	Result	Qualifier
Physical Tests (QCLot: 2023462)						
Conductivity	----	E100	1	µS/cm	1.1	----
Physical Tests (QCLot: 2023463)						
Alkalinity, total (as CaCO ₃)	----	E290	1	mg/L	<1.0	----
Physical Tests (QCLot: 2028925)						
Solids, total suspended [TSS]	----	E160	3	mg/L	<3.0	----
Physical Tests (QCLot: 2028926)						
Solids, total suspended [TSS]	----	E160	3	mg/L	<3.0	----
Physical Tests (QCLot: 2028928)						
Solids, total dissolved [TDS]	----	E162	10	mg/L	<10	----
Physical Tests (QCLot: 2028929)						
Solids, total dissolved [TDS]	----	E162	10	mg/L	<10	----
Anions and Nutrients (QCLot: 2023464)						
Nitrate (as N)	14797-55-8	E235.NO3-L	0.005	mg/L	<0.0050	----
Anions and Nutrients (QCLot: 2023465)						
Nitrite (as N)	14797-65-0	E235.NO2-L	0.001	mg/L	<0.0010	----
Anions and Nutrients (QCLot: 2023466)						
Chloride	16887-00-6	E235.Cl	0.5	mg/L	<0.50	----
Anions and Nutrients (QCLot: 2023468)						
Sulfate (as SO ₄)	14808-79-8	E235.SO4	0.3	mg/L	<0.30	----
Anions and Nutrients (QCLot: 2023469)						
Fluoride	16984-48-8	E235.F	0.02	mg/L	<0.020	----
Anions and Nutrients (QCLot: 2023470)						
Bromide	24959-67-9	E235.Br-L	0.05	mg/L	<0.050	----
Anions and Nutrients (QCLot: 2024615)						
Kjeldahl nitrogen, total [TKN]	----	E318	0.05	mg/L	<0.050	----
Anions and Nutrients (QCLot: 2024617)						
Ammonia, total (as N)	7664-41-7	E298	0.005	mg/L	<0.0050	----
Organic / Inorganic Carbon (QCLot: 2024616)						
Carbon, total organic [TOC]	----	E355-L	0.5	mg/L	<0.50	----
Dissolved Metals (QCLot: 2024306)						
Aluminum, dissolved	7429-90-5	E421	0.001	mg/L	<0.0010	----
Antimony, dissolved	7440-36-0	E421	0.0001	mg/L	<0.00010	----



Sub-Matrix: **Water**

Analyte	CAS Number	Method	LOR	Unit	Result	Qualifier
Dissolved Metals (QCLot: 2024306) - continued						
Arsenic, dissolved	7440-38-2	E421	0.0001	mg/L	<0.00010	----
Barium, dissolved	7440-39-3	E421	0.0001	mg/L	<0.00010	----
Beryllium, dissolved	7440-41-7	E421	0.00002	mg/L	<0.000020	----
Bismuth, dissolved	7440-69-9	E421	0.00005	mg/L	<0.000050	----
Boron, dissolved	7440-42-8	E421	0.01	mg/L	<0.010	----
Cadmium, dissolved	7440-43-9	E421	0.000005	mg/L	<0.0000050	----
Calcium, dissolved	7440-70-2	E421	0.05	mg/L	<0.050	----
Cesium, dissolved	7440-46-2	E421	0.00001	mg/L	<0.000010	----
Chromium, dissolved	7440-47-3	E421	0.0005	mg/L	<0.00050	----
Cobalt, dissolved	7440-48-4	E421	0.0001	mg/L	<0.00010	----
Copper, dissolved	7440-50-8	E421	0.0002	mg/L	<0.00020	----
Iron, dissolved	7439-89-6	E421	0.01	mg/L	<0.010	----
Lead, dissolved	7439-92-1	E421	0.00005	mg/L	<0.000050	----
Lithium, dissolved	7439-93-2	E421	0.001	mg/L	<0.0010	----
Magnesium, dissolved	7439-95-4	E421	0.005	mg/L	<0.0050	----
Manganese, dissolved	7439-96-5	E421	0.0001	mg/L	<0.00010	----
Molybdenum, dissolved	7439-98-7	E421	0.00005	mg/L	<0.000050	----
Nickel, dissolved	7440-02-0	E421	0.0005	mg/L	<0.00050	----
Phosphorus, dissolved	7723-14-0	E421	0.05	mg/L	<0.050	----
Potassium, dissolved	7440-09-7	E421	0.05	mg/L	<0.050	----
Rubidium, dissolved	7440-17-7	E421	0.0002	mg/L	<0.00020	----
Selenium, dissolved	7782-49-2	E421	0.00005	mg/L	<0.000050	----
Silicon, dissolved	7440-21-3	E421	0.05	mg/L	<0.050	----
Silver, dissolved	7440-22-4	E421	0.00001	mg/L	<0.000010	----
Sodium, dissolved	7440-23-5	E421	0.05	mg/L	<0.050	----
Strontium, dissolved	7440-24-6	E421	0.0002	mg/L	<0.00020	----
Sulfur, dissolved	7704-34-9	E421	0.5	mg/L	<0.50	----
Tellurium, dissolved	13494-80-9	E421	0.0002	mg/L	<0.00020	----
Thallium, dissolved	7440-28-0	E421	0.00001	mg/L	<0.000010	----
Thorium, dissolved	7440-29-1	E421	0.0001	mg/L	<0.00010	----
Tin, dissolved	7440-31-5	E421	0.0001	mg/L	<0.00010	----
Titanium, dissolved	7440-32-6	E421	0.0003	mg/L	<0.00030	----
Tungsten, dissolved	7440-33-7	E421	0.0001	mg/L	<0.00010	----
Uranium, dissolved	7440-61-1	E421	0.00001	mg/L	<0.000010	----
Vanadium, dissolved	7440-62-2	E421	0.0005	mg/L	<0.00050	----



Sub-Matrix: **Water**

Analyte	CAS Number	Method	LOR	Unit	Result	Qualifier
Dissolved Metals (QCLot: 2024306) - continued						
Zinc, dissolved	7440-66-6	E421	0.001	mg/L	<0.0010	----
Zirconium, dissolved	7440-67-7	E421	0.0002	mg/L	<0.00020	----
Dissolved Metals (QCLot: 2029768)						
Mercury, dissolved	7439-97-6	E509	0.000005	mg/L	<0.0000050	----



Laboratory Control Sample (LCS) Report

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

Sub-Matrix: Water

					Laboratory Control Sample (LCS) Report				
					Spike	Recovery (%)	Recovery Limits (%)		
Analyte	CAS Number	Method	LOR	Unit	Target Concentration	LCS	Low	High	Qualifier
Physical Tests (QCLot: 2023461)									
pH	----	E108	----	pH units	7 pH units	100	98.0	102	----
Physical Tests (QCLot: 2023462)									
Conductivity	----	E100	1	µS/cm	147 µS/cm	100	90.0	110	----
Physical Tests (QCLot: 2023463)									
Alkalinity, total (as CaCO3)	----	E290	1	mg/L	500 mg/L	105	85.0	115	----
Physical Tests (QCLot: 2028925)									
Solids, total suspended [TSS]	----	E160	3	mg/L	150 mg/L	106	85.0	115	----
Physical Tests (QCLot: 2028926)									
Solids, total suspended [TSS]	----	E160	3	mg/L	150 mg/L	107	85.0	115	----
Physical Tests (QCLot: 2028928)									
Solids, total dissolved [TDS]	----	E162	10	mg/L	1000 mg/L	102	85.0	115	----
Physical Tests (QCLot: 2028929)									
Solids, total dissolved [TDS]	----	E162	10	mg/L	1000 mg/L	104	85.0	115	----
Anions and Nutrients (QCLot: 2023464)									
Nitrate (as N)	14797-55-8	E235.NO3-L	0.005	mg/L	2.5 mg/L	101	90.0	110	----
Anions and Nutrients (QCLot: 2023465)									
Nitrite (as N)	14797-65-0	E235.NO2-L	0.001	mg/L	0.5 mg/L	98.0	90.0	110	----
Anions and Nutrients (QCLot: 2023466)									
Chloride	16887-00-6	E235.Cl	0.5	mg/L	100 mg/L	101	90.0	110	----
Anions and Nutrients (QCLot: 2023468)									
Sulfate (as SO4)	14808-79-8	E235.SO4	0.3	mg/L	100 mg/L	102	90.0	110	----
Anions and Nutrients (QCLot: 2023469)									
Fluoride	16984-48-8	E235.F	0.02	mg/L	1 mg/L	98.4	90.0	110	----
Anions and Nutrients (QCLot: 2023470)									
Bromide	24959-67-9	E235.Br-L	0.05	mg/L	0.5 mg/L	106	85.0	115	----
Anions and Nutrients (QCLot: 2024615)									
Kjeldahl nitrogen, total [TKN]	----	E318	0.05	mg/L	4 mg/L	99.8	75.0	125	----
Anions and Nutrients (QCLot: 2024617)									
Ammonia, total (as N)	7664-41-7	E298	0.005	mg/L	0.2 mg/L	95.7	85.0	115	----
Organic / Inorganic Carbon (QCLot: 2024616)									



Sub-Matrix: Water					Laboratory Control Sample (LCS) Report				
					Spike	Recovery (%)	Recovery Limits (%)		Qualifier
					Target Concentration	LCS	Low	High	
Analyte	CAS Number	Method	LOR	Unit	Target Concentration	LCS	Low	High	Qualifier
Organic / Inorganic Carbon (QCLot: 2024616) - continued									
Carbon, total organic [TOC]	----	E355-L	0.5	mg/L	8.57 mg/L	98.1	80.0	120	----
Dissolved Metals (QCLot: 2024306)									
Aluminum, dissolved	7429-90-5	E421	0.001	mg/L	2 mg/L	102	80.0	120	----
Antimony, dissolved	7440-36-0	E421	0.0001	mg/L	1 mg/L	93.9	80.0	120	----
Arsenic, dissolved	7440-38-2	E421	0.0001	mg/L	1 mg/L	102	80.0	120	----
Barium, dissolved	7440-39-3	E421	0.0001	mg/L	0.25 mg/L	102	80.0	120	----
Beryllium, dissolved	7440-41-7	E421	0.00002	mg/L	0.1 mg/L	96.7	80.0	120	----
Bismuth, dissolved	7440-69-9	E421	0.00005	mg/L	1 mg/L	102	80.0	120	----
Boron, dissolved	7440-42-8	E421	0.01	mg/L	1 mg/L	90.4	80.0	120	----
Cadmium, dissolved	7440-43-9	E421	0.000005	mg/L	0.1 mg/L	101	80.0	120	----
Calcium, dissolved	7440-70-2	E421	0.05	mg/L	50 mg/L	97.1	80.0	120	----
Cesium, dissolved	7440-46-2	E421	0.00001	mg/L	0.05 mg/L	96.4	80.0	120	----
Chromium, dissolved	7440-47-3	E421	0.0005	mg/L	0.25 mg/L	99.9	80.0	120	----
Cobalt, dissolved	7440-48-4	E421	0.0001	mg/L	0.25 mg/L	100	80.0	120	----
Copper, dissolved	7440-50-8	E421	0.0002	mg/L	0.25 mg/L	99.5	80.0	120	----
Iron, dissolved	7439-89-6	E421	0.01	mg/L	1 mg/L	99.2	80.0	120	----
Lead, dissolved	7439-92-1	E421	0.00005	mg/L	0.5 mg/L	100	80.0	120	----
Lithium, dissolved	7439-93-2	E421	0.001	mg/L	0.25 mg/L	94.6	80.0	120	----
Magnesium, dissolved	7439-95-4	E421	0.005	mg/L	50 mg/L	99.3	80.0	120	----
Manganese, dissolved	7439-96-5	E421	0.0001	mg/L	0.25 mg/L	101	80.0	120	----
Molybdenum, dissolved	7439-98-7	E421	0.00005	mg/L	0.25 mg/L	99.7	80.0	120	----
Nickel, dissolved	7440-02-0	E421	0.0005	mg/L	0.5 mg/L	97.6	80.0	120	----
Phosphorus, dissolved	7723-14-0	E421	0.05	mg/L	10 mg/L	105	80.0	120	----
Potassium, dissolved	7440-09-7	E421	0.05	mg/L	50 mg/L	99.1	80.0	120	----
Rubidium, dissolved	7440-17-7	E421	0.0002	mg/L	0.1 mg/L	102	80.0	120	----
Selenium, dissolved	7782-49-2	E421	0.00005	mg/L	1 mg/L	98.5	80.0	120	----
Silicon, dissolved	7440-21-3	E421	0.05	mg/L	10 mg/L	100	80.0	120	----
Silver, dissolved	7440-22-4	E421	0.00001	mg/L	0.1 mg/L	89.5	80.0	120	----
Sodium, dissolved	7440-23-5	E421	0.05	mg/L	50 mg/L	96.9	80.0	120	----
Strontium, dissolved	7440-24-6	E421	0.0002	mg/L	0.25 mg/L	100	80.0	120	----
Sulfur, dissolved	7704-34-9	E421	0.5	mg/L	50 mg/L	92.3	80.0	120	----
Tellurium, dissolved	13494-80-9	E421	0.0002	mg/L	0.1 mg/L	98.0	80.0	120	----
Thallium, dissolved	7440-28-0	E421	0.00001	mg/L	1 mg/L	97.2	80.0	120	----
Thorium, dissolved	7440-29-1	E421	0.0001	mg/L	0.1 mg/L	103	80.0	120	----
Tin, dissolved	7440-31-5	E421	0.0001	mg/L	0.5 mg/L	97.3	80.0	120	----



Sub-Matrix: Water					Laboratory Control Sample (LCS) Report				
					Spike	Recovery (%)	Recovery Limits (%)		
					Target Concentration	LCS	Low	High	Qualifier
Analyte	CAS Number	Method	LOR	Unit	Target Concentration	LCS	Low	High	Qualifier
Dissolved Metals (QCLot: 2024306) - continued									
Titanium, dissolved	7440-32-6	E421	0.0003	mg/L	0.25 mg/L	99.1	80.0	120	----
Tungsten, dissolved	7440-33-7	E421	0.0001	mg/L	0.1 mg/L	100	80.0	120	----
Uranium, dissolved	7440-61-1	E421	0.00001	mg/L	0.005 mg/L	104	80.0	120	----
Vanadium, dissolved	7440-62-2	E421	0.0005	mg/L	0.5 mg/L	100	80.0	120	----
Zinc, dissolved	7440-66-6	E421	0.001	mg/L	0.5 mg/L	97.9	80.0	120	----
Zirconium, dissolved	7440-67-7	E421	0.0002	mg/L	0.1 mg/L	97.5	80.0	120	----
Mercury, dissolved	7439-97-6	E509	0.000005	mg/L	0 mg/L	98.5	80.0	120	----



Matrix Spike (MS) Report

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

Laboratory sample ID					Matrix Spike (MS) Report					
					Spike		Recovery (%)	Recovery Limits (%)		Qualifier
					Concentration	Target	MS	Low	High	
Client sample ID	Analyte	CAS Number	Method							
Anions and Nutrients (QCLot: 2023464)										
VA25B2544-001	Anonymous	Nitrate (as N)	14797-55-8	E235.NO3-L	2.55 mg/L	2.5 mg/L	102	75.0	125	----
Anions and Nutrients (QCLot: 2023465)										
VA25B2524-002	Anonymous	Nitrite (as N)	14797-65-0	E235.NO2-L	0.481 mg/L	0.5 mg/L	96.3	75.0	125	----
Anions and Nutrients (QCLot: 2023466)										
VA25B2524-002	Anonymous	Chloride	16887-00-6	E235.Cl	100 mg/L	100 mg/L	100	75.0	125	----
Anions and Nutrients (QCLot: 2023468)										
VA25B2524-002	Anonymous	Sulfate (as SO4)	14808-79-8	E235.SO4	99.0 mg/L	100 mg/L	99.0	75.0	125	----
Anions and Nutrients (QCLot: 2023469)										
VA25B2544-001	Anonymous	Fluoride	16984-48-8	E235.F	1.02 mg/L	1 mg/L	102	75.0	125	----
Anions and Nutrients (QCLot: 2023470)										
VA25B2544-001	Anonymous	Bromide	24959-67-9	E235.Br-L	0.524 mg/L	0.5 mg/L	105	75.0	125	----
Anions and Nutrients (QCLot: 2024615)										
KS2501991-006	Anonymous	Kjeldahl nitrogen, total [TKN]	----	E318	2.54 mg/L	2.5 mg/L	102	70.0	130	----
Anions and Nutrients (QCLot: 2024617)										
KS2501991-002	Anonymous	Ammonia, total (as N)	7664-41-7	E298	0.0938 mg/L	0.1 mg/L	93.8	75.0	125	----
Organic / Inorganic Carbon (QCLot: 2024616)										
KS2501991-002	Anonymous	Carbon, total organic [TOC]	----	E355-L	5.17 mg/L	5 mg/L	103	70.0	130	----
Dissolved Metals (QCLot: 2024306)										
VA25B2607-001	Anonymous	Aluminum, dissolved	7429-90-5	E421	ND mg/L	----	ND	70.0	130	----
		Antimony, dissolved	7440-36-0	E421	0.0186 mg/L	0.02 mg/L	93.3	70.0	130	----
		Arsenic, dissolved	7440-38-2	E421	0.0204 mg/L	0.02 mg/L	102	70.0	130	----
		Barium, dissolved	7440-39-3	E421	ND mg/L	----	ND	70.0	130	----
		Beryllium, dissolved	7440-41-7	E421	0.0398 mg/L	0.04 mg/L	99.6	70.0	130	----
		Bismuth, dissolved	7440-69-9	E421	0.00971 mg/L	0.01 mg/L	97.1	70.0	130	----
		Boron, dissolved	7440-42-8	E421	0.092 mg/L	0.1 mg/L	92.4	70.0	130	----
		Cadmium, dissolved	7440-43-9	E421	ND mg/L	----	ND	70.0	130	----
		Calcium, dissolved	7440-70-2	E421	ND mg/L	----	ND	70.0	130	----
		Cesium, dissolved	7440-46-2	E421	0.00960 mg/L	0.01 mg/L	96.0	70.0	130	----
		Chromium, dissolved	7440-47-3	E421	0.0400 mg/L	0.04 mg/L	100	70.0	130	----
		Cobalt, dissolved	7440-48-4	E421	0.0200 mg/L	0.02 mg/L	100	70.0	130	----
		Copper, dissolved	7440-50-8	E421	ND mg/L	----	ND	70.0	130	----
		Iron, dissolved	7439-89-6	E421	1.98 mg/L	2 mg/L	99.1	70.0	130	----
		Lead, dissolved	7439-92-1	E421	0.0196 mg/L	0.02 mg/L	98.0	70.0	130	----
		Lithium, dissolved	7439-93-2	E421	0.0933 mg/L	0.1 mg/L	93.3	70.0	130	----



Sub-Matrix: Water					Matrix Spike (MS) Report					
					Spike		Recovery (%)	Recovery Limits (%)		
Laboratory sample ID	Client sample ID	Analyte	CAS Number	Method	Concentration	Target	MS	Low	High	Qualifier
Dissolved Metals (QCLot: 2024306) - continued										
VA25B2607-001	Anonymous	Magnesium, dissolved	7439-95-4	E421	ND mg/L	----	ND	70.0	130	----
		Manganese, dissolved	7439-96-5	E421	ND mg/L	----	ND	70.0	130	----
		Molybdenum, dissolved	7439-98-7	E421	0.0194 mg/L	0.02 mg/L	97.0	70.0	130	----
		Nickel, dissolved	7440-02-0	E421	0.0392 mg/L	0.04 mg/L	98.0	70.0	130	----
		Phosphorus, dissolved	7723-14-0	E421	10.2 mg/L	10 mg/L	102	70.0	130	----
		Potassium, dissolved	7440-09-7	E421	3.92 mg/L	4 mg/L	98.1	70.0	130	----
		Rubidium, dissolved	7440-17-7	E421	0.0200 mg/L	0.02 mg/L	100	70.0	130	----
		Selenium, dissolved	7782-49-2	E421	0.0420 mg/L	0.04 mg/L	105	70.0	130	----
		Silicon, dissolved	7440-21-3	E421	9.72 mg/L	10 mg/L	97.2	70.0	130	----
		Silver, dissolved	7440-22-4	E421	0.00380 mg/L	0.004 mg/L	95.0	70.0	130	----
		Sodium, dissolved	7440-23-5	E421	1.98 mg/L	2 mg/L	99.1	70.0	130	----
		Strontium, dissolved	7440-24-6	E421	ND mg/L	----	ND	70.0	130	----
		Sulfur, dissolved	7704-34-9	E421	19.5 mg/L	20 mg/L	97.3	70.0	130	----
		Tellurium, dissolved	13494-80-9	E421	0.0406 mg/L	0.04 mg/L	101	70.0	130	----
		Thallium, dissolved	7440-28-0	E421	0.00384 mg/L	0.004 mg/L	96.1	70.0	130	----
		Thorium, dissolved	7440-29-1	E421	0.0158 mg/L	0.02 mg/L	78.8	70.0	130	----
		Tin, dissolved	7440-31-5	E421	0.0192 mg/L	0.02 mg/L	96.1	70.0	130	----
		Titanium, dissolved	7440-32-6	E421	0.0399 mg/L	0.04 mg/L	99.8	70.0	130	----
		Tungsten, dissolved	7440-33-7	E421	0.0196 mg/L	0.02 mg/L	97.8	70.0	130	----
		Uranium, dissolved	7440-61-1	E421	0.00403 mg/L	0.004 mg/L	101	70.0	130	----
		Vanadium, dissolved	7440-62-2	E421	0.0994 mg/L	0.1 mg/L	99.4	70.0	130	----
		Zinc, dissolved	7440-66-6	E421	ND mg/L	----	ND	70.0	130	----
		Zirconium, dissolved	7440-67-7	E421	0.0398 mg/L	0.04 mg/L	99.4	70.0	130	----
Dissolved Metals (QCLot: 2029768)										
VA25B2628-001	MW1-95	Mercury, dissolved	7439-97-6	E509	0.0000859 mg/L	0 mg/L	85.9	70.0	130	----



COC Number: **22 - 70750578**

Canada Toll Free: 1 800 668 9878

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

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

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

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

FEB 2022 FROM

CERTIFICATE OF ANALYSIS

Work Order	: VA25C7679	Laboratory	: ALS Environmental - Vancouver
Client	: Masse Environmental Consultants Ltd.	Account Manager	: Can Dang
Contact	: Ico de Zwart	Address	: 8081 Lougheed Highway
Address	: 812 Vernon Street		: Burnaby BC Canada V5A 1W9
	: Nelson British Columbia Canada V1L 4G4	E-mail	: Can.Dang@ALSGlobal.com
Telephone	: ----	Telephone	: +1 604 253 4188
Project	: 2016-503 - Nakusp	Date Samples Received	: 17-Oct-2025 11:40
PO	: ----	Date Analysis Commenced	: 17-Oct-2025
C-O-C number	: 22-20251016	Issue Date	: 27-Oct-2025 09:24
Sampler	: ----		
Site	: RDCK		
Quote number	: ----		
No. of samples received	: 4		
No. of samples analysed	: 4		

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

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Surrogate Control Limits

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

Signatories

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

<i>Signatories</i>	<i>Position</i>	<i>Laboratory Department</i>
Chau Tran	Analyst	Metals, Burnaby, British Columbia
Janice Leung	Supervisor - Organics Instrumentation	Organics, Burnaby, British Columbia
Kimia Taheri	Lab Assistant	Metals, Burnaby, British Columbia
Maqsood UIHassan	Laboratory Analyst	Organics, Calgary, Alberta
Monica Ko	Supervisor - Inorganic	Inorganics, Burnaby, British Columbia



General Comments

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

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

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

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

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

Unit	Description
-	no units
mg/L	milligrams per litre
pH units	pH units
µg/L	micrograms per litre
µS/cm	microsiemens per centimetre

<: less than.

>: greater than.

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

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

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

Qualifiers

Qualifier	Description
DLCI	Detection Limit Raised: Chromatographic interference due to co-elution.



Analytical Results

Sub-Matrix: Groundwater
 (Matrix: Water)

Client sample ID					MW1-95 (E225548)	MW2-95 (E225549)	MW5-06 (E265110)	MW17-07 (E309170)	----
Client sampling date / time					14-Oct-2025 16:30	15-Oct-2025 09:30	14-Oct-2025 13:30	15-Oct-2025 13:15	----
Analyte	CAS Number	Method/Lab	LOR	Unit	VA25C7679-001	VA25C7679-002	VA25C7679-003	VA25C7679-004	----
					Result	Result	Result	Result	----
Physical Tests									
Alkalinity, total (as CaCO ₃)	----	E290/VA	1.0	mg/L	187	132	179	60.3	----
Conductivity	----	E100/VA	2.0	µS/cm	402	287	372	129	----
Hardness (as CaCO ₃), dissolved	----	EC100/VA	0.60	mg/L	164	129	185	57.6	----
pH	----	E108/VA	0.10	pH units	7.77	7.07	8.07	7.61	----
Solids, total dissolved [TDS]	----	E162/VA	10	mg/L	288	237	238	129	----
Solids, total suspended [TSS]	----	E160/VA	3.0	mg/L	328	1480	281	1710	----
Anions and Nutrients									
Ammonia, total (as N)	7664-41-7	E298/VA	0.0050	mg/L	0.0137	0.0154	0.0060	<0.0050	----
Bromide	24959-67-9	E235.Br-L/VA	0.050	mg/L	<0.050	<0.050	<0.050	<0.050	----
Chloride	16887-00-6	E235.Cl/VA	0.50	mg/L	5.47	4.28	1.42	2.20	----
Fluoride	16984-48-8	E235.F/VA	0.020	mg/L	<0.024 ^{DLCI}	0.029	0.576	0.076	----
Kjeldahl nitrogen, total [TKN]	----	E318/VA	0.050	mg/L	1.04	0.552	0.218	0.544	----
Nitrate (as N)	14797-55-8	E235.NO3-L/VA	0.0050	mg/L	2.23	0.999	0.330	0.313	----
Nitrite (as N)	14797-65-0	E235.NO2-L/VA	0.0010	mg/L	0.0013	<0.0010	<0.0010	0.0127	----
Sulfate (as SO ₄)	14808-79-8	E235.SO4/VA	0.30	mg/L	11.8	7.31	14.7	1.68	----
Organic / Inorganic Carbon									
Carbon, total organic [TOC]	----	E355-L/VA	0.50	mg/L	46.8	27.6	7.56	12.3	----
Dissolved Metals									
Aluminum, dissolved	7429-90-5	E421/VA	1.0	µg/L	5.0	39.3	15.3	12.0	----
Antimony, dissolved	7440-36-0	E421/VA	0.10	µg/L	<0.10	<0.10	<0.10	<0.10	----
Arsenic, dissolved	7440-38-2	E421/VA	0.10	µg/L	<0.10	<0.10	<0.10	<0.10	----



Analytical Results

Sub-Matrix: Groundwater
 (Matrix: Water)

Client sample ID					MW1-95 (E225548) ----	MW2-95 (E225549) ----	MW5-06 (E265110) ----	MW17-07 (E309170) ----	----
Client sampling date / time					14-Oct-2025 16:30	15-Oct-2025 09:30	14-Oct-2025 13:30	15-Oct-2025 13:15	----
Analyte	CAS Number	Method/Lab	LOR	Unit	VA25C7679-001	VA25C7679-002	VA25C7679-003	VA25C7679-004	----
					Result	Result	Result	Result	----
Dissolved Metals									
Barium, dissolved	7440-39-3	E421/VA	0.10	µg/L	886	925	77.4	385	----
Beryllium, dissolved	7440-41-7	E421/VA	0.100	µg/L	<0.100	0.142	<0.100	<0.100	----
Bismuth, dissolved	7440-69-9	E421/VA	0.050	µg/L	<0.050	<0.050	<0.050	<0.050	----
Boron, dissolved	7440-42-8	E421/VA	10	µg/L	144	51	<10	<10	----
Cadmium, dissolved	7440-43-9	E421/VA	0.0050	µg/L	0.0365	0.0409	0.0450	0.0074	----
Calcium, dissolved	7440-70-2	E421/VA	50	µg/L	45300	34400	67200	16100	----
Cesium, dissolved	7440-46-2	E421/VA	0.010	µg/L	<0.010	<0.010	<0.010	<0.010	----
Chromium, dissolved	7440-47-3	E421/VA	0.50	µg/L	1.81	1.76	<0.50	2.94	----
Cobalt, dissolved	7440-48-4	E421/VA	0.10	µg/L	<0.10	<0.10	2.24	<0.10	----
Copper, dissolved	7440-50-8	E421/VA	0.20	µg/L	2.25	1.40	2.44	0.25	----
Iron, dissolved	7439-89-6	E421/VA	10	µg/L	<10	36	23	30	----
Lead, dissolved	7439-92-1	E421/VA	0.050	µg/L	<0.050	0.114	<0.050	<0.050	----
Lithium, dissolved	7439-93-2	E421/VA	1.0	µg/L	12.5	13.9	5.5	5.9	----
Magnesium, dissolved	7439-95-4	E421/VA	5.0	µg/L	12300	10400	4090	4220	----
Manganese, dissolved	7439-96-5	E421/VA	0.10	µg/L	1.65	5.34	22.7	1.70	----
Mercury, dissolved	7439-97-6	E509/VA	0.0050	µg/L	<0.0050	<0.0050	<0.0050	<0.0050	----
Molybdenum, dissolved	7439-98-7	E421/VA	0.050	µg/L	<0.050	<0.050	0.225	<0.050	----
Nickel, dissolved	7440-02-0	E421/VA	0.50	µg/L	3.54	4.36	1.80	0.77	----
Phosphorus, dissolved	7723-14-0	E421/VA	50	µg/L	<50	<50	<50	<50	----
Potassium, dissolved	7440-09-7	E421/VA	50	µg/L	1590	1080	1290	586	----
Rubidium, dissolved	7440-17-7	E421/VA	0.20	µg/L	1.72	1.40	0.39	1.05	----



Analytical Results

Sub-Matrix: Groundwater
 (Matrix: Water)

Client sample ID					MW1-95 (E225548) ----	MW2-95 (E225549) ----	MW5-06 (E265110) ----	MW17-07 (E309170) ----	----
Client sampling date / time					14-Oct-2025 16:30	15-Oct-2025 09:30	14-Oct-2025 13:30	15-Oct-2025 13:15	----
Analyte	CAS Number	Method/Lab	LOR	Unit	VA25C7679-001	VA25C7679-002	VA25C7679-003	VA25C7679-004	----
					Result	Result	Result	Result	----
Dissolved Metals									
Selenium, dissolved	7782-49-2	E421/VA	0.050	µg/L	<0.050	<0.050	0.152	<0.050	----
Silicon, dissolved	7440-21-3	E421/VA	50	µg/L	22000	23600	10400	18700	----
Silver, dissolved	7440-22-4	E421/VA	0.010	µg/L	<0.010	<0.010	<0.010	<0.010	----
Sodium, dissolved	7440-23-5	E421/VA	50	µg/L	9180	5550	3790	2380	----
Strontium, dissolved	7440-24-6	E421/VA	0.20	µg/L	539	487	834	377	----
Sulfur, dissolved	7704-34-9	E421/VA	500	µg/L	4480	2760	5480	560	----
Tellurium, dissolved	13494-80-9	E421/VA	0.20	µg/L	<0.20	<0.20	<0.20	<0.20	----
Thallium, dissolved	7440-28-0	E421/VA	0.010	µg/L	<0.010	<0.010	<0.010	<0.010	----
Thorium, dissolved	7440-29-1	E421/VA	0.10	µg/L	<0.10	<0.10	<0.10	<0.10	----
Tin, dissolved	7440-31-5	E421/VA	0.10	µg/L	0.18	0.10	0.19	0.11	----
Titanium, dissolved	7440-32-6	E421/VA	0.30	µg/L	<0.30	0.43	<0.30	<0.30	----
Tungsten, dissolved	7440-33-7	E421/VA	0.10	µg/L	<0.10	<0.10	<0.10	<0.10	----
Uranium, dissolved	7440-61-1	E421/VA	0.010	µg/L	0.590	0.373	0.507	0.179	----
Vanadium, dissolved	7440-62-2	E421/VA	0.50	µg/L	1.02	1.07	<0.50	0.97	----
Zinc, dissolved	7440-66-6	E421/VA	1.0	µg/L	16.5	15.8	6.7	6.1	----
Zirconium, dissolved	7440-67-7	E421/VA	0.20	µg/L	<0.20	<0.20	<0.20	<0.20	----
Dissolved mercury filtration location	----	EP509/VA	-	-	Field	Field	Field	Field	----
Dissolved metals filtration location	----	EP421/VA	-	-	Field	Field	Field	Field	----
Volatile Organic Compounds									
Chlorobenzene	108-90-7	E611C/VA	0.50	µg/L	<0.50	<0.50	----	----	----
Chloromethane	74-87-3	E611C/VA	5.0	µg/L	<5.0	<5.0	----	----	----



Analytical Results

Sub-Matrix: Groundwater
 (Matrix: Water)

					Client sample ID	MW1-95 (E225548) ----	MW2-95 (E225549) ----	MW5-06 (E265110) ----	MW17-07 (E309170) ----	----
Client sampling date / time						14-Oct-2025 16:30	15-Oct-2025 09:30	14-Oct-2025 13:30	15-Oct-2025 13:15	----
Analyte	CAS Number	Method/Lab	LOR	Unit	VA25C7679-001	VA25C7679-002	VA25C7679-003	VA25C7679-004	----	----
					Result	Result	Result	Result	----	----
Volatile Organic Compounds										
Dichlorobenzene, 1,2-	95-50-1	E611C/VA	0.50	µg/L	<0.50	<0.50	----	----	----	----
Dichlorobenzene, 1,3-	541-73-1	E611C/VA	0.50	µg/L	<0.50	<0.50	----	----	----	----
Dichlorobenzene, 1,4-	106-46-7	E611C/VA	0.50	µg/L	<0.50	<0.50	----	----	----	----
Dichloropropane, 1,2-	78-87-5	E611C/VA	0.50	µg/L	<0.50	<0.50	----	----	----	----
Dichloropropylene, cis-1,3-	10061-01-5	E611C/VA	0.50	µg/L	<0.50	<0.50	----	----	----	----
Dichloropropylene, cis+trans-1,3-	542-75-6	E611C/VA	0.75	µg/L	<0.75	<0.75	----	----	----	----
Tetrachloroethane, 1,1,1,2-	630-20-6	E611C/VA	0.50	µg/L	<0.50	<0.50	----	----	----	----
Tetrachloroethane, 1,1,2,2-	79-34-5	E611C/VA	0.20	µg/L	<0.20	<0.20	----	----	----	----
Trichloroethane, 1,1,2-	79-00-5	E611C/VA	0.50	µg/L	<0.50	<0.50	----	----	----	----
Trichlorofluoromethane	75-69-4	E611C/VA	0.50	µg/L	<0.50	<0.50	----	----	----	----
Volatile Organic Compounds [Drycleaning]										
Carbon tetrachloride	56-23-5	E611C/VA	0.50	µg/L	<0.50	<0.50	----	----	----	----
Chloroethane	75-00-3	E611C/VA	0.50	µg/L	<0.50	<0.50	----	----	----	----
Dichloroethane, 1,1-	75-34-3	E611C/VA	0.50	µg/L	<0.50	<0.50	----	----	----	----
Dichloroethane, 1,2-	107-06-2	E611C/VA	0.50	µg/L	<0.50	<0.50	----	----	----	----
Dichloroethylene, 1,1-	75-35-4	E611C/VA	0.50	µg/L	<0.50	<0.50	----	----	----	----
Dichloroethylene, cis-1,2-	156-59-2	E611C/VA	0.50	µg/L	<0.50	<0.50	----	----	----	----
Dichloroethylene, trans-1,2-	156-60-5	E611C/VA	0.50	µg/L	<0.50	<0.50	----	----	----	----
Dichloromethane	75-09-2	E611C/VA	1.0	µg/L	<1.0	<1.0	----	----	----	----
Dichloropropylene, trans-1,3-	10061-02-6	E611C/VA	0.50	µg/L	<0.50	<0.50	----	----	----	----
Tetrachloroethylene	127-18-4	E611C/VA	0.50	µg/L	<0.50	<0.50	----	----	----	----



Analytical Results

Sub-Matrix: Groundwater
 (Matrix: Water)

					Client sample ID	MW1-95 (E225548) ----	MW2-95 (E225549) ----	MW5-06 (E265110) ----	MW17-07 (E309170) ----	----
Client sampling date / time						14-Oct-2025 16:30	15-Oct-2025 09:30	14-Oct-2025 13:30	15-Oct-2025 13:15	----
Analyte	CAS Number	Method/Lab	LOR	Unit	VA25C7679-001	VA25C7679-002	VA25C7679-003	VA25C7679-004	----	----
					Result	Result	Result	Result	----	----
Volatile Organic Compounds [Drycleaning]										
Trichloroethane, 1,1,1-	71-55-6	E611C/VA	0.50	µg/L	<0.50	<0.50	----	----	----	----
Trichloroethylene	79-01-6	E611C/VA	0.50	µg/L	<0.50	<0.50	----	----	----	----
Vinyl chloride	75-01-4	E611C/VA	0.40	µg/L	<0.40	<0.40	----	----	----	----
Volatile Organic Compounds [Fuels]										
Benzene	71-43-2	E611C/VA	0.50	µg/L	<0.50	<0.50	----	----	----	----
Ethylbenzene	100-41-4	E611C/VA	0.50	µg/L	<0.50	<0.50	----	----	----	----
Methyl-tert-butyl ether [MTBE]	1634-04-4	E611C/VA	0.50	µg/L	<0.50	<0.50	----	----	----	----
Styrene	100-42-5	E611C/VA	0.50	µg/L	<0.50	<0.50	----	----	----	----
Toluene	108-88-3	E611C/VA	0.40	µg/L	<0.40	<0.40	----	----	----	----
Xylene, m+p-	179601-23-1	E611C/VA	0.40	µg/L	<0.40	<0.40	----	----	----	----
Xylene, o-	95-47-6	E611C/VA	0.30	µg/L	<0.30	<0.30	----	----	----	----
Xylenes, total	1330-20-7	E611C/VA	0.50	µg/L	<0.50	<0.50	----	----	----	----
Volatile Organic Compounds [THMs]										
Bromodichloromethane	75-27-4	E611C/VA	0.50	µg/L	<0.50	<0.50	----	----	----	----
Bromoform	75-25-2	E611C/VA	0.50	µg/L	<0.50	<0.50	----	----	----	----
Chloroform	67-66-3	E611C/VA	0.50	µg/L	<0.50	<0.50	----	----	----	----
Dibromochloromethane	124-48-1	E611C/VA	0.50	µg/L	<0.50	<0.50	----	----	----	----
Volatile Organic Compounds Surrogates										
Bromofluorobenzene, 4-	460-00-4	E611C/VA	1.0	%	95.0	94.7	----	----	----	----
Difluorobenzene, 1,4-	540-36-3	E611C/VA	1.0	%	104	103	----	----	----	----



Analytical Results

Sub-Matrix: Groundwater
 (Matrix: Water)

Sub-Matrix: Groundwater (Matrix: Water)					Client sample ID	MW1-95 (E225548) ----	MW2-95 (E225549) ----	MW5-06 (E265110) ----	MW17-07 (E309170) ----	----
Client sampling date / time					14-Oct-2025 16:30	15-Oct-2025 09:30	14-Oct-2025 13:30	15-Oct-2025 13:15	----	
Analyte	CAS Number	Method/Lab	LOR	Unit	VA25C7679-001	VA25C7679-002	VA25C7679-003	VA25C7679-004	----	
					Result	Result	Result	Result	----	
Polycyclic Aromatic Hydrocarbons										
Acenaphthene	83-32-9	E641A/CG	0.010	µg/L	<0.010	<0.010	----	----	----	
Acenaphthylene	208-96-8	E641A/CG	0.010	µg/L	<0.010	<0.010	----	----	----	
Acridine	260-94-6	E641A/CG	0.010	µg/L	<0.010	<0.010	----	----	----	
Anthracene	120-12-7	E641A/CG	0.010	µg/L	<0.010	<0.010	----	----	----	
Benz(a)anthracene	56-55-3	E641A/CG	0.010	µg/L	<0.010	<0.010	----	----	----	
Benzo(a)pyrene	50-32-8	E641A/CG	0.0050	µg/L	<0.0050	<0.0050	----	----	----	
Benzo(b+j)fluoranthene	n/a	E641A/CG	0.010	µg/L	<0.010	<0.010	----	----	----	
Benzo(b+j+k)fluoranthene	n/a	E641A/CG	0.015	µg/L	<0.015	<0.015	----	----	----	
Benzo(g,h,i)perylene	191-24-2	E641A/CG	0.010	µg/L	<0.010	<0.010	----	----	----	
Benzo(k)fluoranthene	207-08-9	E641A/CG	0.010	µg/L	<0.010	<0.010	----	----	----	
Chrysene	218-01-9	E641A/CG	0.010	µg/L	<0.010	<0.010	----	----	----	
Dibenz(a,h)anthracene	53-70-3	E641A/CG	0.0050	µg/L	<0.0050	<0.0050	----	----	----	
Fluoranthene	206-44-0	E641A/CG	0.010	µg/L	<0.010	<0.010	----	----	----	
Fluorene	86-73-7	E641A/CG	0.010	µg/L	<0.010	<0.010	----	----	----	
Indeno(1,2,3-c,d)pyrene	193-39-5	E641A/CG	0.010	µg/L	<0.010	<0.010	----	----	----	
Methylnaphthalene, 1-	90-12-0	E641A/CG	0.010	µg/L	<0.010	<0.010	----	----	----	
Methylnaphthalene, 1+2-	----	E641A/CG	0.015	µg/L	<0.015	<0.015	----	----	----	
Methylnaphthalene, 2-	91-57-6	E641A/CG	0.010	µg/L	<0.010	<0.010	----	----	----	
Naphthalene	91-20-3	E641A/CG	0.050	µg/L	<0.050	<0.050	----	----	----	
Phenanthrene	85-01-8	E641A/CG	0.020	µg/L	<0.020	<0.020	----	----	----	
Pyrene	129-00-0	E641A/CG	0.010	µg/L	<0.010	<0.010	----	----	----	



Analytical Results

Sub-Matrix: Groundwater
 (Matrix: Water)

Sub-Matrix: Groundwater (Matrix: Water)					Client sample ID	MW1-95 (E225548) ----	MW2-95 (E225549) ----	MW5-06 (E265110) ----	MW17-07 (E309170) ----	----
Client sampling date / time					14-Oct-2025 16:30	15-Oct-2025 09:30	14-Oct-2025 13:30	15-Oct-2025 13:15	----	
Analyte	CAS Number	Method/Lab	LOR	Unit	VA25C7679-001	VA25C7679-002	VA25C7679-003	VA25C7679-004	----	
					Result	Result	Result	Result	----	
Polycyclic Aromatic Hydrocarbons										
Quinoline	91-22-5	E641A/CG	0.050	µg/L	<0.050	<0.050	----	----	----	
B(a)P total potency equivalents [B(a)P TPE]	----	E641A/CG	0.010	µg/L	<0.010	<0.010	----	----	----	
PAHs, high molecular weight (BC AWQ)	n/a	E641A/CG	0.030	µg/L	<0.030	<0.030	----	----	----	
PAHs, low molecular weight (BC AWQ)	n/a	E641A/CG	0.060	µg/L	<0.060	<0.060	----	----	----	
PAHs, total (CCME sewer 18)	n/a	E641A/CG	0.070	µg/L	<0.070	<0.070	----	----	----	
PAHs, total (EPA 16)	n/a	E641A/CG	0.065	µg/L	<0.065	<0.065	----	----	----	
Polycyclic Aromatic Hydrocarbons Surrogates										
Chrysene-d12	1719-03-5	E641A/CG	0.1	%	95.5	86.2	----	----	----	
Naphthalene-d8	1146-65-2	E641A/CG	0.1	%	92.7	77.7	----	----	----	
Phenanthrene-d10	1517-22-2	E641A/CG	0.1	%	105	89.2	----	----	----	

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



Quality Control Interpretive Report

Work Order : VA25C7679

Client : Masse Environmental Consultants Ltd.
Contact : Ico de Zwart
Address : 812 Vernon Street
Nelson BC Canada V1L 4G4
Telephone : ----
Project : 2016-503 - Nakusp
PO : ----
C-O-C number : 22-20251016
Sampler : ----
Site : RDCK
Quote number : ----
No. of samples received : 4
No. of samples analysed : 4

Laboratory : ALS Environmental - Vancouver
Account Manager : Can Dang
Address : 8081 Lougheed Highway
Burnaby British Columbia Canada V5A 1W9
Telephone : +1 604 253 4188
Date Samples Received : 17-Oct-2025 11:40
Issue Date : 05-Nov-2025 04:01

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

Key

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

Workorder Comments

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



Summary of Outliers

Outliers : Quality Control Samples

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

Outliers: Reference Material (RM) Samples

- No Reference Material (RM) Sample outliers occur.

Outliers : Analysis Holding Time Compliance (Breaches)

- Analysis Holding Time Outliers exist.

Outliers : Frequency of Quality Control Samples

- No Quality Control Sample Frequency Outliers occur.



Analysis Holding Time Compliance

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

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

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

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

Matrix: Water

Evaluation: ✖ = Holding time exceedance; ✔ = Within Holding Time

Analyte Group : Analytical Method					Extraction / Preparation				Analysis			
Container						Holding Times				Holding Times		
Client sample ID						Rec	Actual			Rec	Actual	
	ALS Sample ID	QC Lot	Method	Sampling Date	Preparation Date				Analysis Date			
Anions and Nutrients : Ammonia by Fluorescence												
Amber glass total (sulfuric acid)												
MW1-95 (E225548)	001	2291564	E298	14-Oct-2025	22-Oct-2025	28 days	8 days	✓	25-Oct-2025	28 days	10 days	✓
MW2-95 (E225549)	002	2291564	E298	15-Oct-2025	22-Oct-2025	28 days	7 days	✓	25-Oct-2025	28 days	9 days	✓
MW5-06 (E265110)	003	2291564	E298	14-Oct-2025	22-Oct-2025	28 days	8 days	✓	25-Oct-2025	28 days	10 days	✓
MW17-07 (E309170)	004	2291564	E298	15-Oct-2025	22-Oct-2025	28 days	7 days	✓	25-Oct-2025	28 days	9 days	✓
Anions and Nutrients : Bromide in Water by IC (Low Level)												
HDPE												
MW1-95 (E225548)	001	2283712	E235.Br-L	14-Oct-2025	18-Oct-2025	28 days	3 days	✓	18-Oct-2025	28 days	3 days	✓
MW2-95 (E225549)	002	2283712	E235.Br-L	15-Oct-2025	18-Oct-2025	28 days	2 days	✓	18-Oct-2025	28 days	2 days	✓
MW5-06 (E265110)	003	2283712	E235.Br-L	14-Oct-2025	18-Oct-2025	28 days	3 days	✓	18-Oct-2025	28 days	3 days	✓
MW17-07 (E309170)	004	2283712	E235.Br-L	15-Oct-2025	18-Oct-2025	28 days	2 days	✓	18-Oct-2025	28 days	2 days	✓
Anions and Nutrients : Chloride in Water by IC												
HDPE												
MW1-95 (E225548)	001	2283711	E235.Cl	14-Oct-2025	18-Oct-2025	28 days	3 days	✓	18-Oct-2025	28 days	3 days	✓
MW2-95 (E225549)	002	2283711	E235.Cl	15-Oct-2025	18-Oct-2025	28 days	2 days	✓	18-Oct-2025	28 days	2 days	✓



Matrix: Water

Evaluation: ✖ = Holding time exceedance; ✔ = Within Holding Time

Analyte Group : Analytical Method		ALS Sample ID	QC Lot	Method	Sampling Date	Extraction / Preparation			Analysis				
Container						Preparation Date	Holding Times		Eval	Analysis Date	Holding Times		Eval
Client sample ID							Rec	Actual			Rec	Actual	
Anions and Nutrients : Chloride in Water by IC													
HDPE													
MW5-06 (E265110)	003	2283711	E235.Cl	14-Oct-2025	18-Oct-2025	28 days	3 days	✓	18-Oct-2025	28 days	3 days	✓	
MW17-07 (E309170)	004	2283711	E235.Cl	15-Oct-2025	18-Oct-2025	28 days	2 days	✓	18-Oct-2025	28 days	2 days	✓	
Anions and Nutrients : Fluoride in Water by IC													
HDPE													
MW1-95 (E225548)	001	2283710	E235.F	14-Oct-2025	18-Oct-2025	28 days	3 days	✓	18-Oct-2025	28 days	3 days	✓	
MW2-95 (E225549)	002	2283710	E235.F	15-Oct-2025	18-Oct-2025	28 days	2 days	✓	18-Oct-2025	28 days	2 days	✓	
MW5-06 (E265110)	003	2283710	E235.F	14-Oct-2025	18-Oct-2025	28 days	3 days	✓	18-Oct-2025	28 days	3 days	✓	
MW17-07 (E309170)	004	2283710	E235.F	15-Oct-2025	18-Oct-2025	28 days	2 days	✓	18-Oct-2025	28 days	2 days	✓	
Anions and Nutrients : Nitrate in Water by IC (Low Level)													
HDPE													
MW1-95 (E225548)	001	2283713	E235.NO3-L	14-Oct-2025	18-Oct-2025	3 days	3 days	✓	18-Oct-2025	3 days	3 days	✓	
MW2-95 (E225549)	002	2283713	E235.NO3-L	15-Oct-2025	18-Oct-2025	3 days	2 days	✓	18-Oct-2025	3 days	2 days	✓	
MW5-06 (E265110)	003	2283713	E235.NO3-L	14-Oct-2025	18-Oct-2025	3 days	3 days	✓	18-Oct-2025	3 days	3 days	✓	
MW17-07 (E309170)	004	2283713	E235.NO3-L	15-Oct-2025	18-Oct-2025	3 days	2 days	✓	18-Oct-2025	3 days	2 days	✓	
Anions and Nutrients : Nitrite in Water by IC (Low Level)													
HDPE													
MW1-95 (E225548)	001	2283714	E235.NO2-L	14-Oct-2025	18-Oct-2025	3 days	3 days	✓	18-Oct-2025	3 days	3 days	✓	
MW2-95 (E225549)	002	2283714	E235.NO2-L	15-Oct-2025	18-Oct-2025	3 days	2 days	✓	18-Oct-2025	3 days	2 days	✓	
MW5-06 (E265110)	003	2283714	E235.NO2-L	14-Oct-2025	18-Oct-2025	3 days	3 days	✓	18-Oct-2025	3 days	3 days	✓	



Matrix: Water

Evaluation: ✖ = Holding time exceedance; ✔ = Within Holding Time

Analyte Group : Analytical Method	ALS Sample ID	QC Lot	Method	Sampling Date	Extraction / Preparation				Analysis			
Container					Preparation Date	Holding Times		Eval	Analysis Date	Holding Times		Eval
						Rec	Actual			Rec	Actual	
Client sample ID												
Anions and Nutrients : Nitrite in Water by IC (Low Level)												
HDPE												
MW17-07 (E309170)	004	2283714	E235.NO2-L	15-Oct-2025	18-Oct-2025	3 days	2 days	✓	18-Oct-2025	3 days	2 days	✓
Anions and Nutrients : Sulfate in Water by IC												
HDPE												
MW1-95 (E225548)	001	2283715	E235.SO4	14-Oct-2025	18-Oct-2025	28 days	3 days	✓	18-Oct-2025	28 days	3 days	✓
MW2-95 (E225549)	002	2283715	E235.SO4	15-Oct-2025	18-Oct-2025	28 days	2 days	✓	18-Oct-2025	28 days	2 days	✓
MW5-06 (E265110)	003	2283715	E235.SO4	14-Oct-2025	18-Oct-2025	28 days	3 days	✓	18-Oct-2025	28 days	3 days	✓
MW17-07 (E309170)	004	2283715	E235.SO4	15-Oct-2025	18-Oct-2025	28 days	2 days	✓	18-Oct-2025	28 days	2 days	✓
Anions and Nutrients : Total Kjeldahl Nitrogen by Fluorescence (Low Level)												
Amber glass total (sulfuric acid)												
MW1-95 (E225548)	001	2291566	E318	14-Oct-2025	22-Oct-2025	28 days	8 days	✓	24-Oct-2025	28 days	10 days	✓
MW2-95 (E225549)	002	2291566	E318	15-Oct-2025	22-Oct-2025	28 days	7 days	✓	24-Oct-2025	28 days	9 days	✓
MW5-06 (E265110)	003	2291566	E318	14-Oct-2025	22-Oct-2025	28 days	8 days	✓	24-Oct-2025	28 days	10 days	✓
MW17-07 (E309170)	004	2291566	E318	15-Oct-2025	22-Oct-2025	28 days	7 days	✓	24-Oct-2025	28 days	9 days	✓
Dissolved Metals : Dissolved Mercury in Water by CVAAS												
Glass vial - dissolved (lab preserved)												
MW1-95 (E225548)	001	2295860	E509	14-Oct-2025	24-Oct-2025	28 days	9 days	✓	24-Oct-2025	28 days	9 days	✓
MW2-95 (E225549)	002	2295860	E509	15-Oct-2025	24-Oct-2025	28 days	8 days	✓	24-Oct-2025	28 days	8 days	✓
MW5-06 (E265110)	003	2295860	E509	14-Oct-2025	24-Oct-2025	28 days	9 days	✓	24-Oct-2025	28 days	9 days	✓
MW17-07 (E309170)	004	2295860	E509	15-Oct-2025	24-Oct-2025	28 days	8 days	✓	24-Oct-2025	28 days	8 days	✓



Matrix: Water

Evaluation: ✖ = Holding time exceedance; ✔ = Within Holding Time

Analyte Group : Analytical Method	ALS Sample ID	QC Lot	Method	Sampling Date	Extraction / Preparation				Analysis			
Container					Preparation Date	Holding Times		Eval	Analysis Date	Holding Times		Eval
						Rec	Actual			Rec	Actual	
Client sample ID												
Dissolved Metals : Dissolved Metals in Water by CRC ICPMS												
HDPE - dissolved (lab preserved)												
MW1-95 (E225548)	001	2285211	E421	14-Oct-2025	23-Oct-2025	180 days	8 days	✓	25-Oct-2025	180 days	10 days	✓
MW1-95 (E225548)	001	2285211	E421	14-Oct-2025	23-Oct-2025	180 days	8 days	✓	25-Oct-2025	180 days	10 days	✓
MW2-95 (E225549)	002	2285211	E421	15-Oct-2025	23-Oct-2025	180 days	8 days	✓	25-Oct-2025	180 days	9 days	✓
MW5-06 (E265110)	003	2285211	E421	14-Oct-2025	23-Oct-2025	180 days	8 days	✓	25-Oct-2025	180 days	10 days	✓
MW17-07 (E309170)	004	2285211	E421	15-Oct-2025	23-Oct-2025	180 days	7 days	✓	25-Oct-2025	180 days	9 days	✓
Organic / Inorganic Carbon : Total Organic Carbon (Non-Purgeable) by Combustion (Low Level)												
Amber glass total (sulfuric acid)												
MW1-95 (E225548)	001	2291562	E355-L	14-Oct-2025	22-Oct-2025	28 days	8 days	✓	23-Oct-2025	28 days	9 days	✓
MW2-95 (E225549)	002	2291562	E355-L	15-Oct-2025	22-Oct-2025	28 days	7 days	✓	23-Oct-2025	28 days	8 days	✓
MW5-06 (E265110)	003	2291562	E355-L	14-Oct-2025	22-Oct-2025	28 days	8 days	✓	23-Oct-2025	28 days	9 days	✓
MW17-07 (E309170)	004	2291562	E355-L	15-Oct-2025	22-Oct-2025	28 days	7 days	✓	23-Oct-2025	28 days	8 days	✓
Physical Tests : Alkalinity Species by Titration												
HDPE												
MW1-95 (E225548)	001	2283707	E290	14-Oct-2025	18-Oct-2025	14 days	3 days	✓	18-Oct-2025	14 days	4 days	✓
MW2-95 (E225549)	002	2283707	E290	15-Oct-2025	18-Oct-2025	14 days	2 days	✓	18-Oct-2025	14 days	2 days	✓
MW5-06 (E265110)	003	2283707	E290	14-Oct-2025	18-Oct-2025	14 days	3 days	✓	18-Oct-2025	14 days	4 days	✓
MW17-07 (E309170)	004	2283707	E290	15-Oct-2025	18-Oct-2025	14 days	2 days	✓	18-Oct-2025	14 days	2 days	✓



Matrix: Water

Evaluation: ✖ = Holding time exceedance; ✔ = Within Holding Time

Analyte Group : Analytical Method	ALS Sample ID	QC Lot	Method	Sampling Date	Extraction / Preparation				Analysis			
Container					Preparation Date	Holding Times		Eval	Analysis Date	Holding Times		Eval
						Rec	Actual			Rec	Actual	
Client sample ID												
Physical Tests : Conductivity in Water												
HDPE												
MW1-95 (E225548)	001	2283708	E100	14-Oct-2025	18-Oct-2025	28 days	3 days	✓	18-Oct-2025	28 days	4 days	✓
MW2-95 (E225549)	002	2283708	E100	15-Oct-2025	18-Oct-2025	28 days	2 days	✓	18-Oct-2025	28 days	2 days	✓
MW5-06 (E265110)	003	2283708	E100	14-Oct-2025	18-Oct-2025	28 days	3 days	✓	18-Oct-2025	28 days	4 days	✓
MW17-07 (E309170)	004	2283708	E100	15-Oct-2025	18-Oct-2025	28 days	2 days	✓	18-Oct-2025	28 days	2 days	✓
Physical Tests : pH by Meter												
HDPE												
MW1-95 (E225548)	001	2283706	E108	14-Oct-2025	18-Oct-2025	0.25 hrs	78 hrs	✗ EHTR-FM	18-Oct-2025	0.25 hrs	87 hrs	✗ EHTR-FM
MW2-95 (E225549)	002	2283706	E108	15-Oct-2025	18-Oct-2025	0.25 hrs	61 hrs	✗ EHTR-FM	18-Oct-2025	0.25 hrs	70 hrs	✗ EHTR-FM
MW5-06 (E265110)	003	2283706	E108	14-Oct-2025	18-Oct-2025	0.25 hrs	81 hrs	✗ EHTR-FM	18-Oct-2025	0.25 hrs	90 hrs	✗ EHTR-FM
MW17-07 (E309170)	004	2283706	E108	15-Oct-2025	18-Oct-2025	0.25 hrs	57 hrs	✗ EHTR-FM	18-Oct-2025	0.25 hrs	66 hrs	✗ EHTR-FM
Physical Tests : TDS by Gravimetry												
HDPE												
MW1-95 (E225548)	001	2288872	E162	14-Oct-2025	----	----	----		21-Oct-2025	7 days	7 days	✓
MW2-95 (E225549)	002	2288872	E162	15-Oct-2025	----	----	----		21-Oct-2025	7 days	6 days	✓
MW5-06 (E265110)	003	2288872	E162	14-Oct-2025	----	----	----		21-Oct-2025	7 days	7 days	✓
MW17-07 (E309170)	004	2288872	E162	15-Oct-2025	----	----	----		21-Oct-2025	7 days	6 days	✓



Matrix: Water

Evaluation: ✖ = Holding time exceedance; ✔ = Within Holding Time

Analyte Group : Analytical Method	ALS Sample ID	QC Lot	Method	Sampling Date	Extraction / Preparation				Analysis			
Container					Preparation Date	Holding Times		Eval	Analysis Date	Holding Times		Eval
						Rec	Actual			Rec	Actual	
Client sample ID												
Physical Tests : TSS by Gravimetry												
HDPE												
MW1-95 (E225548)	001	2288861	E160	14-Oct-2025	----	----	----		21-Oct-2025	7 days	7 days	✓
MW2-95 (E225549)	002	2288861	E160	15-Oct-2025	----	----	----		21-Oct-2025	7 days	6 days	✓
MW5-06 (E265110)	003	2288861	E160	14-Oct-2025	----	----	----		21-Oct-2025	7 days	7 days	✓
MW17-07 (E309170)	004	2288861	E160	15-Oct-2025	----	----	----		21-Oct-2025	7 days	6 days	✓
Polycyclic Aromatic Hydrocarbons : PAHs in Water by Hexane LVI GC-MS												
Amber glass/Teflon lined cap (sodium bisulfate)												
MW1-95 (E225548)	001	2293893	E641A	14-Oct-2025	23-Oct-2025	14 days	9 days	✓	23-Oct-2025	40 days	0 days	✓
MW2-95 (E225549)	002	2294171	E641A	15-Oct-2025	23-Oct-2025	14 days	8 days	✓	23-Oct-2025	40 days	0 days	✓
Volatile Organic Compounds : VOCs (BC List) by Headspace GC-MS												
Glass vial (sodium bisulfate)												
MW1-95 (E225548)	001	2291326	E611C	14-Oct-2025	22-Oct-2025	14 days	8 days	✓	23-Oct-2025	14 days	9 days	✓
MW2-95 (E225549)	002	2291326	E611C	15-Oct-2025	22-Oct-2025	14 days	7 days	✓	23-Oct-2025	14 days	8 days	✓
Volatile Organic Compounds [Drycleaning] : VOCs (BC List) by Headspace GC-MS												
Glass vial (sodium bisulfate)												
MW1-95 (E225548)	001	2291326	E611C	14-Oct-2025	22-Oct-2025	14 days	8 days	✓	23-Oct-2025	14 days	9 days	✓
MW2-95 (E225549)	002	2291326	E611C	15-Oct-2025	22-Oct-2025	14 days	7 days	✓	23-Oct-2025	14 days	8 days	✓
Volatile Organic Compounds [Fuels] : VOCs (BC List) by Headspace GC-MS												
Glass vial (sodium bisulfate)												
MW1-95 (E225548)	001	2291326	E611C	14-Oct-2025	22-Oct-2025	14 days	8 days	✓	23-Oct-2025	14 days	9 days	✓



Matrix: Water

Evaluation: ✖ = Holding time exceedance; ✔ = Within Holding Time

Analyte Group : Analytical Method	ALS Sample ID	QC Lot	Method	Sampling Date	Extraction / Preparation				Analysis			
Container					Preparation Date	Holding Times		Eval	Analysis Date	Holding Times		Eval
						Rec	Actual			Rec	Actual	
Client sample ID												
Volatile Organic Compounds [Fuels] : VOCs (BC List) by Headspace GC-MS												
Glass vial (sodium bisulfate)												
MW2-95 (E225549)	002	2291326	E611C	15-Oct-2025	22-Oct-2025	14 days	7 days	✓	23-Oct-2025	14 days	8 days	✓
Volatile Organic Compounds [THMs] : VOCs (BC List) by Headspace GC-MS												
Glass vial (sodium bisulfate)												
MW1-95 (E225548)	001	2291326	E611C	14-Oct-2025	22-Oct-2025	14 days	8 days	✓	23-Oct-2025	14 days	9 days	✓
MW2-95 (E225549)	002	2291326	E611C	15-Oct-2025	22-Oct-2025	14 days	7 days	✓	23-Oct-2025	14 days	8 days	✓

Legend & Qualifier Definitions

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

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



Quality Control Parameter Frequency Compliance

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

Matrix: Water

Evaluation: ✖ = QC frequency outside specification; ✔ = QC frequency within specification

Quality Control Sample Type			Count		Frequency (%)		
Analytical Methods	Method	QC Lot #	QC	Regular	Actual	Expected	Evaluation
Laboratory Duplicates (DUP)							
Conductivity in Water	E100	2283708	1	9	11.1	5.0	✔
pH by Meter	E108	2283706	1	9	11.1	5.0	✔
TSS by Gravimetry	E160	2288861	1	20	5.0	5.0	✔
TDS by Gravimetry	E162	2288872	1	20	5.0	5.0	✔
Bromide in Water by IC (Low Level)	E235.Br-L	2283712	1	17	5.9	5.0	✔
Chloride in Water by IC	E235.Cl	2283711	1	17	5.9	5.0	✔
Fluoride in Water by IC	E235.F	2283710	1	17	5.9	5.0	✔
Nitrite in Water by IC (Low Level)	E235.NO2-L	2283714	1	17	5.9	5.0	✔
Nitrate in Water by IC (Low Level)	E235.NO3-L	2283713	1	17	5.9	5.0	✔
Sulfate in Water by IC	E235.SO4	2283715	1	17	5.9	5.0	✔
Alkalinity Species by Titration	E290	2283707	1	9	11.1	5.0	✔
Ammonia by Fluorescence	E298	2291564	1	20	5.0	5.0	✔
Total Kjeldahl Nitrogen by Fluorescence (Low Level)	E318	2291566	1	12	8.3	5.0	✔
Total Organic Carbon (Non-Purgeable) by Combustion (Low Level)	E355-L	2291562	1	16	6.2	5.0	✔
Dissolved Metals in Water by CRC ICPMS	E421	2285211	1	20	5.0	5.0	✔
Dissolved Mercury in Water by CVAAS	E509	2295860	1	20	5.0	5.0	✔
VOCs (BC List) by Headspace GC-MS	E611C	2291326	1	16	6.2	5.0	✔
Laboratory Control Samples (LCS)							
Conductivity in Water	E100	2283708	1	9	11.1	5.0	✔
pH by Meter	E108	2283706	1	9	11.1	5.0	✔
TSS by Gravimetry	E160	2288861	1	20	5.0	5.0	✔
TDS by Gravimetry	E162	2288872	1	20	5.0	5.0	✔
Bromide in Water by IC (Low Level)	E235.Br-L	2283712	1	17	5.9	5.0	✔
Chloride in Water by IC	E235.Cl	2283711	1	17	5.9	5.0	✔
Fluoride in Water by IC	E235.F	2283710	1	17	5.9	5.0	✔
Nitrite in Water by IC (Low Level)	E235.NO2-L	2283714	1	17	5.9	5.0	✔
Nitrate in Water by IC (Low Level)	E235.NO3-L	2283713	1	17	5.9	5.0	✔



Matrix: Water

Evaluation: ✖ = QC frequency outside specification; ✔ = QC frequency within specification

Quality Control Sample Type			Count		Frequency (%)		
Analytical Methods	Method	QC Lot #	QC	Regular	Actual	Expected	Evaluation
Laboratory Control Samples (LCS)							
Sulfate in Water by IC	E235.SO4	2283715	1	17	5.9	5.0	✔
Alkalinity Species by Titration	E290	2283707	1	9	11.1	5.0	✔
Ammonia by Fluorescence	E298	2291564	1	20	5.0	5.0	✔
Total Kjeldahl Nitrogen by Fluorescence (Low Level)	E318	2291566	1	12	8.3	5.0	✔
Total Organic Carbon (Non-Purgeable) by Combustion (Low Level)	E355-L	2291562	1	16	6.2	5.0	✔
Dissolved Metals in Water by CRC ICPMS	E421	2285211	1	20	5.0	5.0	✔
Dissolved Mercury in Water by CVAAS	E509	2295860	1	20	5.0	5.0	✔
VOCs (BC List) by Headspace GC-MS	E611C	2291326	1	16	6.2	5.0	✔
PAHs in Water by Hexane LVI GC-MS	E641A	2293893	2	39	5.1	5.0	✔
Method Blanks (MB)							
Conductivity in Water	E100	2283708	1	9	11.1	5.0	✔
TSS by Gravimetry	E160	2288861	1	20	5.0	5.0	✔
TDS by Gravimetry	E162	2288872	1	20	5.0	5.0	✔
Bromide in Water by IC (Low Level)	E235.Br-L	2283712	1	17	5.9	5.0	✔
Chloride in Water by IC	E235.Cl	2283711	1	17	5.9	5.0	✔
Fluoride in Water by IC	E235.F	2283710	1	17	5.9	5.0	✔
Nitrite in Water by IC (Low Level)	E235.NO2-L	2283714	1	17	5.9	5.0	✔
Nitrate in Water by IC (Low Level)	E235.NO3-L	2283713	1	17	5.9	5.0	✔
Sulfate in Water by IC	E235.SO4	2283715	1	17	5.9	5.0	✔
Alkalinity Species by Titration	E290	2283707	1	9	11.1	5.0	✔
Ammonia by Fluorescence	E298	2291564	1	20	5.0	5.0	✔
Total Kjeldahl Nitrogen by Fluorescence (Low Level)	E318	2291566	1	12	8.3	5.0	✔
Total Organic Carbon (Non-Purgeable) by Combustion (Low Level)	E355-L	2291562	1	16	6.2	5.0	✔
Dissolved Metals in Water by CRC ICPMS	E421	2285211	1	20	5.0	5.0	✔
Dissolved Mercury in Water by CVAAS	E509	2295860	1	20	5.0	5.0	✔
VOCs (BC List) by Headspace GC-MS	E611C	2291326	1	16	6.2	5.0	✔
PAHs in Water by Hexane LVI GC-MS	E641A	2293893	2	39	5.1	5.0	✔
Matrix Spikes (MS)							
Bromide in Water by IC (Low Level)	E235.Br-L	2283712	1	17	5.9	5.0	✔
Chloride in Water by IC	E235.Cl	2283711	1	17	5.9	5.0	✔



Matrix: Water

Evaluation: ✖ = QC frequency outside specification; ✔ = QC frequency within specification

Quality Control Sample Type			Count		Frequency (%)		
<i>Analytical Methods</i>	<i>Method</i>	<i>QC Lot #</i>	<i>QC</i>	<i>Regular</i>	<i>Actual</i>	<i>Expected</i>	<i>Evaluation</i>
Matrix Spikes (MS)							
Fluoride in Water by IC	E235.F	2283710	1	17	5.9	5.0	✔
Nitrite in Water by IC (Low Level)	E235.NO2-L	2283714	1	17	5.9	5.0	✔
Nitrate in Water by IC (Low Level)	E235.NO3-L	2283713	1	17	5.9	5.0	✔
Sulfate in Water by IC	E235.SO4	2283715	1	17	5.9	5.0	✔
Ammonia by Fluorescence	E298	2291564	1	20	5.0	5.0	✔
Total Kjeldahl Nitrogen by Fluorescence (Low Level)	E318	2291566	1	12	8.3	5.0	✔
Total Organic Carbon (Non-Purgeable) by Combustion (Low Level)	E355-L	2291562	1	16	6.2	5.0	✔
Dissolved Metals in Water by CRC ICPMS	E421	2285211	1	20	5.0	5.0	✔
Dissolved Mercury in Water by CVAAS	E509	2295860	1	20	5.0	5.0	✔
VOCs (BC List) by Headspace GC-MS	E611C	2291326	1	16	6.2	5.0	✔



Methodology References and Summaries

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

Analytical Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
Alkalinity Species by Titration	E290 ALS Environmental - Vancouver	Water	APHA 2320 B (mod)	Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.
Ammonia by Fluorescence	E298 ALS Environmental - Vancouver	Water	Method Fialab 100, 2018	Ammonia in water is determined by automated continuous flow analysis with membrane diffusion and fluorescence detection, after reaction with OPA (ortho-phthalaldehyde). This method is approved under US EPA 40 CFR Part 136 (May 2021)
Bromide in Water by IC (Low Level)	E235.Br-L ALS Environmental - Vancouver	Water	EPA 300.1 (mod)	Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.
Chloride in Water by IC	E235.Cl ALS Environmental - Vancouver	Water	EPA 300.1 (mod)	Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.
Conductivity in Water	E100 ALS Environmental - Vancouver	Water	APHA 2510 (mod)	Conductivity, also known as Electrical Conductivity (EC) or Specific Conductance, is measured by immersion of a conductivity cell with platinum electrodes into a water sample. Conductivity measurements are temperature-compensated to 25°C.
Conductivity Screen (Internal Use Only)	ES100 ALS Environmental - Vancouver	Water	APHA 2510 (mod)	Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.
Dissolved Hardness (Calculated)	EC100 ALS Environmental - Vancouver	Water	APHA 2340B	"Hardness (as CaCO ₃), dissolved" is calculated from the sum of dissolved Calcium and Magnesium concentrations, expressed in CaCO ₃ equivalents. "Total Hardness" refers to the sum of Calcium and Magnesium Hardness. Hardness is normally or preferentially calculated from dissolved Calcium and Magnesium concentrations, because it is a property of water due to dissolved divalent cations.
Dissolved Mercury in Water by CVAAS	E509 ALS Environmental - Vancouver	Water	APHA 3030B/EPA 1631E (mod)	Water samples are filtered (0.45 µm), preserved with HCl, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS.
Dissolved Metals in Water by CRC ICPMS	E421 ALS Environmental - Vancouver	Water	APHA 3030B/EPA 6020B (mod)	Water samples are filtered (0.45 µm), preserved with nitric acid, and analyzed by Collision/Reaction Cell ICPMS. Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.
Fluoride in Water by IC	E235.F ALS Environmental - Vancouver	Water	EPA 300.1 (mod)	Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.
Nitrate in Water by IC (Low Level)	E235.NO3-L ALS Environmental - Vancouver	Water	EPA 300.1 (mod)	Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.
Nitrite in Water by IC (Low Level)	E235.NO2-L ALS Environmental - Vancouver	Water	EPA 300.1 (mod)	Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.



PAHs in Water by Hexane LVI GC-MS	E641A ALS Environmental - Vancouver	Water	EPA 8270E (mod)	Polycyclic Aromatic Hydrocarbons (PAHs) are analyzed by large-volume injection (LVI) GC-MS. Totals and sub-totals (e.g., ΣPAH, low and high MW PAHs) are reported as the sum of the individual target compounds detected; the detection limit for any sum is calculated by the root-sum-of-squares (RSS) of the individual analyte limits (per CCME Vol. 4 Analytical Methods). Benzo[a]pyrene total potency equivalents (B[a]P-TEQ/TPEQ) are calculated in accordance with CCME using the published potency-equivalency factors; non-detects are assigned one-half of the limit of reporting (LOR) in the TEQ calculation.
pH by Meter	E108 ALS Environmental - Vancouver	Water	APHA 4500-H (mod)	pH is determined by potentiometric measurement with a pH electrode, and is conducted at ambient laboratory temperature (normally 20 ± 5°C). For high accuracy test results, pH should be measured in the field within the recommended 15 minute hold time.
Sulfate in Water by IC	E235.SO4 ALS Environmental - Vancouver	Water	EPA 300.1 (mod)	Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.
TDS by Gravimetry	E162 ALS Environmental - Vancouver	Water	APHA 2540 C (mod)	Total Dissolved Solids (TDS) are determined by filtering a sample through a glass fibre filter, with evaporation of the filtrate at 180 ± 2°C for 16 hours or to constant weight, with gravimetric measurement of the residue.
Total Kjeldahl Nitrogen by Fluorescence (Low Level)	E318 ALS Environmental - Vancouver	Water	Method Fialab 100, 2018	TKN in water is determined by automated continuous flow analysis with membrane diffusion and fluorescence detection, after reaction with OPA (ortho-phthalaldehyde). This method is approved under US EPA 40 CFR Part 136 (May 2021).
Total Organic Carbon (Non-Purgeable) by Combustion (Low Level)	E355-L ALS Environmental - Vancouver	Water	APHA 5310 B (mod)	Total Organic Carbon (Non-Purgeable), also known as NPOC (total), is a direct measurement of TOC after an acidified sample has been purged to remove carbonate-based Inorganic Carbon (IC). Analysis is by high temperature combustion with infrared detection of CO ₂ . Forms of carbon associated with inorganic or organic molecules (e.g. SCN and CN) are included in NPOC if they are not removed by purging under acidic conditions. Notably, NPOC excludes most volatile organic compounds and free cyanide. For samples where the majority of Total Carbon is inorganic, this method provides greater accuracy and reliability versus the TOC by subtraction method (TC minus TIC).
TSS by Gravimetry	E160 ALS Environmental - Vancouver	Water	APHA 2540 D (mod)	Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, following by drying of the filter at 104 ± 1°C, with gravimetric measurement of the filtered solids. Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.
VOCs (BC List) by Headspace GC-MS	E611C ALS Environmental - Vancouver	Water	EPA 8260D (mod)	Volatile Organic Compounds (VOCs) are analyzed by static headspace GC-MS. Samples are prepared in headspace vials and are heated and agitated on the headspace autosampler, causing VOCs to partition between the aqueous phase and the headspace in accordance with Henry's law. Total Xylenes is the sum of m,p-Xylene & o-Xylene. Total BTEX is the sum of Benzene, Toluene, Ethylbenzene, & Total Xylenes. Total BTEX+Styrene is the sum of Total BTEX & Styrene. Total Trihalomethanes [THMs] is the sum of Bromodichloromethane, Bromoform, Chloroform, & Dibromochloromethane.
Preparation Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
Digestion for TKN in water	EP318 ALS Environmental - Vancouver	Water	APHA 4500-Norg D (mod)	Samples are digested at high temperature using Sulfuric Acid with Copper catalyst, which converts organic nitrogen sources to Ammonia, which is then quantified by the analytical method as TKN. This method is unsuitable for samples containing high levels of nitrate. If nitrate exceeds TKN concentration by ten times or more, results may be biased low.
Dissolved Mercury Water Filtration	EP509 ALS Environmental - Vancouver	Water	APHA 3030B	Water samples are filtered (0.45 µm), and preserved with HCl.
Dissolved Metals Water Filtration	EP421 ALS Environmental - Vancouver	Water	APHA 3030B	Water samples are filtered (0.45 µm), and preserved with HNO ₃ .



PHCs and PAHs Hexane Extraction	EP601 ALS Environmental - Vancouver	Water	EPA 3511 (mod)	Petroleum Hydrocarbons (PHCs) and Polycyclic Aromatic Hydrocarbons (PAHs) are extracted using a hexane liquid-liquid extraction.
Preparation for Ammonia	EP298 ALS Environmental - Vancouver	Water		Sample preparation for Preserved Nutrients Water Quality Analysis.
Preparation for Autotitrator	EP108-TITR ALS Environmental - Vancouver	Water		Sample preparation for parameters analysed by Autotitrator
Preparation for Ion Chromatography	EP235-IC ALS Environmental - Vancouver	Water		Sample preparation for ion chromatography
Preparation for Total Organic Carbon by Combustion	EP355 ALS Environmental - Vancouver	Water		Preparation for Total Organic Carbon by Combustion
VOCs Preparation for Headspace Analysis	EP581 ALS Environmental - Vancouver	Water	EPA 5021A (mod)	Samples are prepared in headspace vials and are heated and agitated on the headspace autosampler. An aliquot of the headspace is then injected into a GC-MS-FID.

QUALITY CONTROL REPORT

Work Order	: VA25C7679	Page	: 1 of 19
Client	: Masse Environmental Consultants Ltd.	Laboratory	: ALS Environmental - Vancouver
Contact	: Ico de Zwart	Account Manager	: Can Dang
Address	: 812 Vernon Street Nelson BC Canada V1L 4G4	Address	: 8081 Lougheed Highway Burnaby, British Columbia Canada V5A 1W9
Telephone	: ----	Telephone	: +1 604 253 4188
Project	: 2016-503 - Nakusp	Date Samples Received	: 17-Oct-2025 11:40
PO	: ----	Date Analysis Commenced	: 17-Oct-2025
C-O-C number	: 22-20251016	Issue Date	: 27-Oct-2025 09:24
Sampler	: ----		
Site	: RDCK		
Quote number	: ----		
No. of samples received	: 4		
No. of samples analysed	: 4		

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

This Quality Control Report contains the following information:

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

Signatories

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

Signatories	Position	Laboratory Department
Chau Tran	Analyst	Vancouver Metals, Burnaby, British Columbia
Janice Leung	Supervisor - Organics Instrumentation	Vancouver Organics, Burnaby, British Columbia
Kimia Taheri	Lab Assistant	Vancouver Metals, Burnaby, British Columbia
Maqsood UlHassan	Laboratory Analyst	Calgary Organics, Calgary, Alberta
Monica Ko	Supervisor - Inorganic	Vancouver Inorganics, Burnaby, British Columbia



General Comments

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

Key :

Anonymous = Refers to samples which are not part of this work order, but which formed part of the QC process lot.

CAS Number = Chemical Abstracts Service number is a unique identifier assigned to discrete substances.

DQO = Data Quality Objective.

LOR = Limit of Reporting (detection limit).

RPD = Relative Percent Difference

= Indicates a QC result that did not meet the ALS DQO.

Workorder Comments

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

Page : 3 of 19
 Work Order : VA25C7679
 Client : Masse Environmental Consultants Ltd.
 Project : 2016-503 - Nakusp



Laboratory Duplicate (DUP) Report

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

Sub-Matrix: Water					Laboratory Duplicate (DUP) Report						
Laboratory sample ID	Client sample ID	Analyte	CAS Number	Method	LOR	Unit	Original Result	Duplicate Result	RPD(%) or Difference	Duplicate Limits	Qualifier
Physical Tests (QC Lot: 2283706)											
VA25C7568-001	Anonymous	pH	----	E108	0.10	pH units	8.33	8.34	0.120%	4%	----
Physical Tests (QC Lot: 2283707)											
VA25C7568-001	Anonymous	Alkalinity, total (as CaCO ₃)	----	E290	1.0	mg/L	380	383	0.734%	20%	----
Physical Tests (QC Lot: 2283708)											
VA25C7568-001	Anonymous	Conductivity	----	E100	2.0	µS/cm	1820	1820	0.275%	10%	----
Physical Tests (QC Lot: 2288861)											
VA25C7579-003	Anonymous	Solids, total suspended [TSS]	----	E160	3.0	mg/L	<3.0	<3.0	0	Diff <2x LOR	----
Physical Tests (QC Lot: 2288872)											
VA25C7579-003	Anonymous	Solids, total dissolved [TDS]	----	E162	20	mg/L	217	221	2.06%	20%	----
Anions and Nutrients (QC Lot: 2283710)											
FJ2503211-001	Anonymous	Fluoride	16984-48-8	E235.F	0.020	mg/L	0.141	0.141	0.0006	Diff <2x LOR	----
Anions and Nutrients (QC Lot: 2283711)											
FJ2503211-001	Anonymous	Chloride	16887-00-6	E235.Cl	0.50	mg/L	0.80	0.78	0.02	Diff <2x LOR	----
Anions and Nutrients (QC Lot: 2283712)											
FJ2503211-001	Anonymous	Bromide	24959-67-9	E235.Br-L	0.050	mg/L	<0.050	<0.050	0	Diff <2x LOR	----
Anions and Nutrients (QC Lot: 2283713)											
FJ2503211-001	Anonymous	Nitrate (as N)	14797-55-8	E235.NO3-L	0.0050	mg/L	0.121	0.122	0.568%	20%	----
Anions and Nutrients (QC Lot: 2283714)											
FJ2503211-001	Anonymous	Nitrite (as N)	14797-65-0	E235.NO2-L	0.0010	mg/L	<0.0010	<0.0010	0	Diff <2x LOR	----
Anions and Nutrients (QC Lot: 2283715)											
FJ2503211-001	Anonymous	Sulfate (as SO ₄)	14808-79-8	E235.SO4	0.30	mg/L	12.8	12.7	0.521%	20%	----
Anions and Nutrients (QC Lot: 2291564)											
FJ2503224-001	Anonymous	Ammonia, total (as N)	7664-41-7	E298	0.0050	mg/L	0.0156	0.0189	0.0033	Diff <2x LOR	----
Anions and Nutrients (QC Lot: 2291566)											
VA25C7679-001	MW1-95 (E225548)	Kjeldahl nitrogen, total [TKN]	----	E318	0.050	mg/L	1.04	1.24	17.2%	20%	----
Organic / Inorganic Carbon (QC Lot: 2291562)											
VA25C7635-001	Anonymous	Carbon, total organic [TOC]	----	E355-L	0.50	mg/L	54.6	55.1	0.757%	20%	----
Dissolved Metals (QC Lot: 2285211)											
VA25C7666-001	Anonymous	Aluminum, dissolved	7429-90-5	E421	0.0010	mg/L	<0.0010	<0.0010	0	Diff <2x LOR	----
		Antimony, dissolved	7440-36-0	E421	0.00010	mg/L	<0.00010	<0.00010	0	Diff <2x LOR	----



Sub-Matrix: Water					Laboratory Duplicate (DUP) Report						
Laboratory sample ID	Client sample ID	Analyte	CAS Number	Method	LOR	Unit	Original Result	Duplicate Result	RPD(%) or Difference	Duplicate Limits	Qualifier
Dissolved Metals (QC Lot: 2285211) - continued											
VA25C7666-001	Anonymous	Arsenic, dissolved	7440-38-2	E421	0.00010	mg/L	0.00010	0.00012	0.00001	Diff <2x LOR	----
		Barium, dissolved	7440-39-3	E421	0.00010	mg/L	0.0145	0.0140	3.47%	20%	----
		Beryllium, dissolved	7440-41-7	E421	0.000100	mg/L	<0.000100	<0.000100	0	Diff <2x LOR	----
		Bismuth, dissolved	7440-69-9	E421	0.000050	mg/L	<0.000050	<0.000050	0	Diff <2x LOR	----
		Boron, dissolved	7440-42-8	E421	0.010	mg/L	<0.010	<0.010	0	Diff <2x LOR	----
		Cadmium, dissolved	7440-43-9	E421	0.0000050	mg/L	<0.0000050	<0.0000050	0	Diff <2x LOR	----
		Calcium, dissolved	7440-70-2	E421	0.050	mg/L	50.4	49.9	1.13%	20%	----
		Cesium, dissolved	7440-46-2	E421	0.000010	mg/L	<0.000010	<0.000010	0	Diff <2x LOR	----
		Chromium, dissolved	7440-47-3	E421	0.00050	mg/L	<0.00050	<0.00050	0	Diff <2x LOR	----
		Cobalt, dissolved	7440-48-4	E421	0.00010	mg/L	<0.00010	<0.00010	0	Diff <2x LOR	----
		Copper, dissolved	7440-50-8	E421	0.00020	mg/L	<0.00020	<0.00020	0	Diff <2x LOR	----
		Iron, dissolved	7439-89-6	E421	0.010	mg/L	<0.010	<0.010	0	Diff <2x LOR	----
		Lead, dissolved	7439-92-1	E421	0.000050	mg/L	<0.000050	<0.000050	0	Diff <2x LOR	----
		Lithium, dissolved	7439-93-2	E421	0.0010	mg/L	0.0011	0.0011	0.000003	Diff <2x LOR	----
		Magnesium, dissolved	7439-95-4	E421	0.0050	mg/L	5.07	5.02	0.973%	20%	----
		Manganese, dissolved	7439-96-5	E421	0.00010	mg/L	0.00125	0.00122	1.98%	20%	----
		Molybdenum, dissolved	7439-98-7	E421	0.000050	mg/L	0.000096	0.000097	0.0000007	Diff <2x LOR	----
		Nickel, dissolved	7440-02-0	E421	0.00050	mg/L	<0.00050	<0.00050	0	Diff <2x LOR	----
		Phosphorus, dissolved	7723-14-0	E421	0.050	mg/L	<0.050	<0.050	0	Diff <2x LOR	----
		Potassium, dissolved	7440-09-7	E421	0.050	mg/L	0.600	0.588	2.04%	20%	----
		Rubidium, dissolved	7440-17-7	E421	0.00020	mg/L	<0.00020	<0.00020	0	Diff <2x LOR	----
		Selenium, dissolved	7782-49-2	E421	0.000050	mg/L	<0.000050	<0.000050	0	Diff <2x LOR	----
		Silicon, dissolved	7440-21-3	E421	0.050	mg/L	4.52	4.38	3.08%	20%	----
		Silver, dissolved	7440-22-4	E421	0.000010	mg/L	<0.000010	<0.000010	0	Diff <2x LOR	----
		Sodium, dissolved	7440-23-5	E421	0.050	mg/L	1.14	1.13	1.42%	20%	----
		Strontium, dissolved	7440-24-6	E421	0.00020	mg/L	0.112	0.114	1.90%	20%	----
		Sulfur, dissolved	7704-34-9	E421	0.50	mg/L	<0.50	<0.50	0	Diff <2x LOR	----
		Tellurium, dissolved	13494-80-9	E421	0.00020	mg/L	<0.00020	<0.00020	0	Diff <2x LOR	----
		Thallium, dissolved	7440-28-0	E421	0.000010	mg/L	<0.000010	<0.000010	0	Diff <2x LOR	----
		Thorium, dissolved	7440-29-1	E421	0.00010	mg/L	<0.00010	<0.00010	0	Diff <2x LOR	----
		Tin, dissolved	7440-31-5	E421	0.00010	mg/L	<0.00010	<0.00010	0	Diff <2x LOR	----
		Titanium, dissolved	7440-32-6	E421	0.00030	mg/L	<0.00030	<0.00030	0	Diff <2x LOR	----
		Tungsten, dissolved	7440-33-7	E421	0.00010	mg/L	<0.00010	<0.00010	0	Diff <2x LOR	----
		Uranium, dissolved	7440-61-1	E421	0.000010	mg/L	0.000164	0.000179	8.43%	20%	----



Sub-Matrix: Water					Laboratory Duplicate (DUP) Report						
Laboratory sample ID	Client sample ID	Analyte	CAS Number	Method	LOR	Unit	Original Result	Duplicate Result	RPD(%) or Difference	Duplicate Limits	Qualifier
Dissolved Metals (QC Lot: 2285211) - continued											
VA25C7666-001	Anonymous	Vanadium, dissolved	7440-62-2	E421	0.00050	mg/L	<0.00050	<0.00050	0	Diff <2x LOR	----
		Zinc, dissolved	7440-66-6	E421	0.0010	mg/L	<0.0010	<0.0010	0	Diff <2x LOR	----
		Zirconium, dissolved	7440-67-7	E421	0.00020	mg/L	<0.00020	<0.00020	0	Diff <2x LOR	----
Dissolved Metals (QC Lot: 2295860)											
VA25C7666-005	Anonymous	Mercury, dissolved	7439-97-6	E509	0.0000050	mg/L	<0.0000050	<0.0000050	0	Diff <2x LOR	----
Volatile Organic Compounds (QC Lot: 2291326)											
VA25C7639-001	Anonymous	Benzene	71-43-2	E611C	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		Bromodichloromethane	75-27-4	E611C	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		Bromoform	75-25-2	E611C	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		Carbon tetrachloride	56-23-5	E611C	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		Chlorobenzene	108-90-7	E611C	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		Chloroethane	75-00-3	E611C	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		Chloroform	67-66-3	E611C	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		Chloromethane	74-87-3	E611C	5.0	µg/L	<5.0	<5.0	0	Diff <2x LOR	----
		Dibromochloromethane	124-48-1	E611C	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		Dichlorobenzene, 1,2-	95-50-1	E611C	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		Dichlorobenzene, 1,3-	541-73-1	E611C	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		Dichlorobenzene, 1,4-	106-46-7	E611C	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		Dichloroethane, 1,1-	75-34-3	E611C	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		Dichloroethane, 1,2-	107-06-2	E611C	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		Dichloroethylene, 1,1-	75-35-4	E611C	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		Dichloroethylene, cis-1,2-	156-59-2	E611C	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		Dichloroethylene, trans-1,2-	156-60-5	E611C	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		Dichloromethane	75-09-2	E611C	1.0	µg/L	<1.0	<1.0	0	Diff <2x LOR	----
		Dichloropropane, 1,2-	78-87-5	E611C	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		Dichloropropylene, cis-1,3-	10061-01-5	E611C	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		Dichloropropylene, trans-1,3-	10061-02-6	E611C	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		Ethylbenzene	100-41-4	E611C	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		Methyl-tert-butyl ether [MTBE]	1634-04-4	E611C	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		Styrene	100-42-5	E611C	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		Tetrachloroethane, 1,1,1,2-	630-20-6	E611C	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		Tetrachloroethane, 1,1,2,2-	79-34-5	E611C	0.20	µg/L	<0.20	<0.20	0	Diff <2x LOR	----
		Tetrachloroethylene	127-18-4	E611C	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		Toluene	108-88-3	E611C	0.40	µg/L	<0.40	<0.40	0	Diff <2x LOR	----



Sub-Matrix: Water					Laboratory Duplicate (DUP) Report						
Laboratory sample ID	Client sample ID	Analyte	CAS Number	Method	LOR	Unit	Original Result	Duplicate Result	RPD(%) or Difference	Duplicate Limits	Qualifier
Volatile Organic Compounds (QC Lot: 2291326) - continued											
VA25C7639-001	Anonymous	Trichloroethane, 1,1,1-	71-55-6	E611C	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		Trichloroethane, 1,1,2-	79-00-5	E611C	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		Trichloroethylene	79-01-6	E611C	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		Trichlorofluoromethane	75-69-4	E611C	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		Vinyl chloride	75-01-4	E611C	0.40	µg/L	<0.40	<0.40	0	Diff <2x LOR	----
		Xylene, m+p-	179601-23-1	E611C	0.40	µg/L	<0.40	<0.40	0	Diff <2x LOR	----
		Xylene, o-	95-47-6	E611C	0.30	µg/L	<0.30	<0.30	0	Diff <2x LOR	----



Method Blank (MB) Report

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

Sub-Matrix: Water

Analyte	CAS Number	Method	LOR	Unit	Result	Qualifier
Physical Tests (QCLot: 2283707)						
Alkalinity, total (as CaCO ₃)	----	E290	1	mg/L	1.1	----
Physical Tests (QCLot: 2283708)						
Conductivity	----	E100	1	µS/cm	1.1	----
Physical Tests (QCLot: 2288861)						
Solids, total suspended [TSS]	----	E160	3	mg/L	<3.0	----
Physical Tests (QCLot: 2288872)						
Solids, total dissolved [TDS]	----	E162	10	mg/L	<10	----
Anions and Nutrients (QCLot: 2283710)						
Fluoride	16984-48-8	E235.F	0.02	mg/L	<0.020	----
Anions and Nutrients (QCLot: 2283711)						
Chloride	16887-00-6	E235.Cl	0.5	mg/L	<0.50	----
Anions and Nutrients (QCLot: 2283712)						
Bromide	24959-67-9	E235.Br-L	0.05	mg/L	<0.050	----
Anions and Nutrients (QCLot: 2283713)						
Nitrate (as N)	14797-55-8	E235.NO ₃ -L	0.005	mg/L	<0.0050	----
Anions and Nutrients (QCLot: 2283714)						
Nitrite (as N)	14797-65-0	E235.NO ₂ -L	0.001	mg/L	<0.0010	----
Anions and Nutrients (QCLot: 2283715)						
Sulfate (as SO ₄)	14808-79-8	E235.SO ₄	0.3	mg/L	<0.30	----
Anions and Nutrients (QCLot: 2291564)						
Ammonia, total (as N)	7664-41-7	E298	0.005	mg/L	<0.0050	----
Anions and Nutrients (QCLot: 2291566)						
Kjeldahl nitrogen, total [TKN]	----	E318	0.05	mg/L	<0.050	----
Organic / Inorganic Carbon (QCLot: 2291562)						
Carbon, total organic [TOC]	----	E355-L	0.5	mg/L	<0.50	----
Dissolved Metals (QCLot: 2285211)						
Aluminum, dissolved	7429-90-5	E421	0.001	mg/L	<0.0010	----
Antimony, dissolved	7440-36-0	E421	0.0001	mg/L	<0.00010	----
Arsenic, dissolved	7440-38-2	E421	0.0001	mg/L	<0.00010	----
Barium, dissolved	7440-39-3	E421	0.0001	mg/L	<0.00010	----
Beryllium, dissolved	7440-41-7	E421	0.00002	mg/L	<0.000020	----
Bismuth, dissolved	7440-69-9	E421	0.00005	mg/L	<0.000050	----



Sub-Matrix: **Water**

Analyte	CAS Number	Method	LOR	Unit	Result	Qualifier
Dissolved Metals (QCLot: 2285211) - continued						
Boron, dissolved	7440-42-8	E421	0.01	mg/L	<0.010	----
Cadmium, dissolved	7440-43-9	E421	0.000005	mg/L	<0.0000050	----
Calcium, dissolved	7440-70-2	E421	0.05	mg/L	<0.050	----
Cesium, dissolved	7440-46-2	E421	0.00001	mg/L	<0.000010	----
Chromium, dissolved	7440-47-3	E421	0.0005	mg/L	<0.00050	----
Cobalt, dissolved	7440-48-4	E421	0.0001	mg/L	<0.00010	----
Copper, dissolved	7440-50-8	E421	0.0002	mg/L	<0.00020	----
Iron, dissolved	7439-89-6	E421	0.01	mg/L	<0.010	----
Lead, dissolved	7439-92-1	E421	0.00005	mg/L	<0.000050	----
Lithium, dissolved	7439-93-2	E421	0.001	mg/L	<0.0010	----
Magnesium, dissolved	7439-95-4	E421	0.005	mg/L	<0.0050	----
Manganese, dissolved	7439-96-5	E421	0.0001	mg/L	<0.00010	----
Molybdenum, dissolved	7439-98-7	E421	0.00005	mg/L	<0.000050	----
Nickel, dissolved	7440-02-0	E421	0.0005	mg/L	<0.00050	----
Phosphorus, dissolved	7723-14-0	E421	0.05	mg/L	<0.050	----
Potassium, dissolved	7440-09-7	E421	0.05	mg/L	<0.050	----
Rubidium, dissolved	7440-17-7	E421	0.0002	mg/L	<0.00020	----
Selenium, dissolved	7782-49-2	E421	0.00005	mg/L	<0.000050	----
Silicon, dissolved	7440-21-3	E421	0.05	mg/L	<0.050	----
Silver, dissolved	7440-22-4	E421	0.00001	mg/L	<0.000010	----
Sodium, dissolved	7440-23-5	E421	0.05	mg/L	<0.050	----
Strontium, dissolved	7440-24-6	E421	0.0002	mg/L	<0.00020	----
Sulfur, dissolved	7704-34-9	E421	0.5	mg/L	<0.50	----
Tellurium, dissolved	13494-80-9	E421	0.0002	mg/L	<0.00020	----
Thallium, dissolved	7440-28-0	E421	0.00001	mg/L	<0.000010	----
Thorium, dissolved	7440-29-1	E421	0.0001	mg/L	<0.00010	----
Tin, dissolved	7440-31-5	E421	0.0001	mg/L	<0.00010	----
Titanium, dissolved	7440-32-6	E421	0.0003	mg/L	<0.00030	----
Tungsten, dissolved	7440-33-7	E421	0.0001	mg/L	<0.00010	----
Uranium, dissolved	7440-61-1	E421	0.00001	mg/L	<0.000010	----
Vanadium, dissolved	7440-62-2	E421	0.0005	mg/L	<0.00050	----
Zinc, dissolved	7440-66-6	E421	0.001	mg/L	<0.0010	----
Zirconium, dissolved	7440-67-7	E421	0.0002	mg/L	<0.00020	----
Dissolved Metals (QCLot: 2295860)						
Mercury, dissolved	7439-97-6	E509	0.000005	mg/L	<0.0000050	----



Sub-Matrix: **Water**

Analyte	CAS Number	Method	LOR	Unit	Result	Qualifier
Volatile Organic Compounds (QCLot: 2291326)						
Benzene	71-43-2	E611C	0.5	µg/L	<0.50	----
Bromodichloromethane	75-27-4	E611C	0.5	µg/L	<0.50	----
Bromoform	75-25-2	E611C	0.5	µg/L	<0.50	----
Carbon tetrachloride	56-23-5	E611C	0.5	µg/L	<0.50	----
Chlorobenzene	108-90-7	E611C	0.5	µg/L	<0.50	----
Chloroethane	75-00-3	E611C	0.5	µg/L	<0.50	----
Chloroform	67-66-3	E611C	0.5	µg/L	<0.50	----
Chloromethane	74-87-3	E611C	5	µg/L	<5.0	----
Dibromochloromethane	124-48-1	E611C	0.5	µg/L	<0.50	----
Dichlorobenzene, 1,2-	95-50-1	E611C	0.5	µg/L	<0.50	----
Dichlorobenzene, 1,3-	541-73-1	E611C	0.5	µg/L	<0.50	----
Dichlorobenzene, 1,4-	106-46-7	E611C	0.5	µg/L	<0.50	----
Dichloroethane, 1,1-	75-34-3	E611C	0.5	µg/L	<0.50	----
Dichloroethane, 1,2-	107-06-2	E611C	0.5	µg/L	<0.50	----
Dichloroethylene, 1,1-	75-35-4	E611C	0.5	µg/L	<0.50	----
Dichloroethylene, cis-1,2-	156-59-2	E611C	0.5	µg/L	<0.50	----
Dichloroethylene, trans-1,2-	156-60-5	E611C	0.5	µg/L	<0.50	----
Dichloromethane	75-09-2	E611C	1	µg/L	<1.0	----
Dichloropropane, 1,2-	78-87-5	E611C	0.5	µg/L	<0.50	----
Dichloropropylene, cis-1,3-	10061-01-5	E611C	0.5	µg/L	<0.50	----
Dichloropropylene, trans-1,3-	10061-02-6	E611C	0.5	µg/L	<0.50	----
Ethylbenzene	100-41-4	E611C	0.5	µg/L	<0.50	----
Methyl-tert-butyl ether [MTBE]	1634-04-4	E611C	0.5	µg/L	<0.50	----
Styrene	100-42-5	E611C	0.5	µg/L	<0.50	----
Tetrachloroethane, 1,1,1,2-	630-20-6	E611C	0.5	µg/L	<0.50	----
Tetrachloroethane, 1,1,2,2-	79-34-5	E611C	0.2	µg/L	<0.20	----
Tetrachloroethylene	127-18-4	E611C	0.5	µg/L	<0.50	----
Toluene	108-88-3	E611C	0.4	µg/L	<0.40	----
Trichloroethane, 1,1,1-	71-55-6	E611C	0.5	µg/L	<0.50	----
Trichloroethane, 1,1,2-	79-00-5	E611C	0.5	µg/L	<0.50	----
Trichloroethylene	79-01-6	E611C	0.5	µg/L	<0.50	----
Trichlorofluoromethane	75-69-4	E611C	0.5	µg/L	<0.50	----
Vinyl chloride	75-01-4	E611C	0.4	µg/L	<0.40	----
Xylene, m+p-	179601-23-1	E611C	0.4	µg/L	<0.40	----
Xylene, o-	95-47-6	E611C	0.3	µg/L	<0.30	----



Sub-Matrix: **Water**

Analyte	CAS Number	Method	LOR	Unit	Result	Qualifier
Polycyclic Aromatic Hydrocarbons (QCLot: 2293893)						
Acenaphthene	83-32-9	E641A	0.01	µg/L	<0.010	----
Acenaphthylene	208-96-8	E641A	0.01	µg/L	<0.010	----
Acridine	260-94-6	E641A	0.01	µg/L	<0.010	----
Anthracene	120-12-7	E641A	0.01	µg/L	<0.010	----
Benz(a)anthracene	56-55-3	E641A	0.01	µg/L	<0.010	----
Benzo(a)pyrene	50-32-8	E641A	0.005	µg/L	<0.0050	----
Benzo(b+j)fluoranthene	n/a	E641A	0.01	µg/L	<0.010	----
Benzo(g,h,i)perylene	191-24-2	E641A	0.01	µg/L	<0.010	----
Benzo(k)fluoranthene	207-08-9	E641A	0.01	µg/L	<0.010	----
Chrysene	218-01-9	E641A	0.01	µg/L	<0.010	----
Dibenz(a,h)anthracene	53-70-3	E641A	0.005	µg/L	<0.0050	----
Fluoranthene	206-44-0	E641A	0.01	µg/L	<0.010	----
Fluorene	86-73-7	E641A	0.01	µg/L	<0.010	----
Indeno(1,2,3-c,d)pyrene	193-39-5	E641A	0.01	µg/L	<0.010	----
Methylnaphthalene, 1-	90-12-0	E641A	0.01	µg/L	<0.010	----
Methylnaphthalene, 2-	91-57-6	E641A	0.01	µg/L	<0.010	----
Naphthalene	91-20-3	E641A	0.05	µg/L	<0.050	----
Phenanthrene	85-01-8	E641A	0.02	µg/L	<0.020	----
Pyrene	129-00-0	E641A	0.01	µg/L	<0.010	----
Quinoline	91-22-5	E641A	0.05	µg/L	<0.050	----
Polycyclic Aromatic Hydrocarbons (QCLot: 2294171)						
Acenaphthene	83-32-9	E641A	0.01	µg/L	<0.010	----
Acenaphthylene	208-96-8	E641A	0.01	µg/L	<0.010	----
Acridine	260-94-6	E641A	0.01	µg/L	<0.010	----
Anthracene	120-12-7	E641A	0.01	µg/L	<0.010	----
Benz(a)anthracene	56-55-3	E641A	0.01	µg/L	<0.010	----
Benzo(a)pyrene	50-32-8	E641A	0.005	µg/L	<0.0050	----
Benzo(b+j)fluoranthene	n/a	E641A	0.01	µg/L	<0.010	----
Benzo(g,h,i)perylene	191-24-2	E641A	0.01	µg/L	<0.010	----
Benzo(k)fluoranthene	207-08-9	E641A	0.01	µg/L	<0.010	----
Chrysene	218-01-9	E641A	0.01	µg/L	<0.010	----
Dibenz(a,h)anthracene	53-70-3	E641A	0.005	µg/L	<0.0050	----
Fluoranthene	206-44-0	E641A	0.01	µg/L	<0.010	----
Fluorene	86-73-7	E641A	0.01	µg/L	<0.010	----
Indeno(1,2,3-c,d)pyrene	193-39-5	E641A	0.01	µg/L	<0.010	----



Sub-Matrix: Water

Analyte	CAS Number	Method	LOR	Unit	Result	Qualifier
Polycyclic Aromatic Hydrocarbons (QCLot: 2294171) - continued						
Methylnaphthalene, 1-	90-12-0	E641A	0.01	µg/L	<0.010	----
Methylnaphthalene, 2-	91-57-6	E641A	0.01	µg/L	<0.010	----
Naphthalene	91-20-3	E641A	0.05	µg/L	<0.050	----
Phenanthrene	85-01-8	E641A	0.02	µg/L	<0.020	----
Pyrene	129-00-0	E641A	0.01	µg/L	<0.010	----
Quinoline	91-22-5	E641A	0.05	µg/L	<0.050	----



Laboratory Control Sample (LCS) Report

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

Sub-Matrix: Water

					Laboratory Control Sample (LCS) Report				
					Spike	Recovery (%)	Recovery Limits (%)		
Analyte	CAS Number	Method	LOR	Unit	Target Concentration	LCS	Low	High	Qualifier
Physical Tests (QCLot: 2283706)									
pH	----	E108	----	pH units	7 pH units	100	98.0	102	----
Physical Tests (QCLot: 2283707)									
Alkalinity, total (as CaCO3)	----	E290	1	mg/L	500 mg/L	99.1	85.0	115	----
Physical Tests (QCLot: 2283708)									
Conductivity	----	E100	1	µS/cm	147 µS/cm	100	90.0	110	----
Physical Tests (QCLot: 2288861)									
Solids, total suspended [TSS]	----	E160	3	mg/L	150 mg/L	102	85.0	115	----
Physical Tests (QCLot: 2288872)									
Solids, total dissolved [TDS]	----	E162	10	mg/L	1000 mg/L	106	85.0	115	----
Anions and Nutrients (QCLot: 2283710)									
Fluoride	16984-48-8	E235.F	0.02	mg/L	1 mg/L	100	90.0	110	----
Anions and Nutrients (QCLot: 2283711)									
Chloride	16887-00-6	E235.Cl	0.5	mg/L	100 mg/L	98.0	90.0	110	----
Anions and Nutrients (QCLot: 2283712)									
Bromide	24959-67-9	E235.Br-L	0.05	mg/L	0.5 mg/L	103	85.0	115	----
Anions and Nutrients (QCLot: 2283713)									
Nitrate (as N)	14797-55-8	E235.NO3-L	0.005	mg/L	2.5 mg/L	98.0	90.0	110	----
Anions and Nutrients (QCLot: 2283714)									
Nitrite (as N)	14797-65-0	E235.NO2-L	0.001	mg/L	0.5 mg/L	97.9	90.0	110	----
Anions and Nutrients (QCLot: 2283715)									
Sulfate (as SO4)	14808-79-8	E235.SO4	0.3	mg/L	100 mg/L	99.7	90.0	110	----
Anions and Nutrients (QCLot: 2291564)									
Ammonia, total (as N)	7664-41-7	E298	0.005	mg/L	0.2 mg/L	97.7	85.0	115	----
Anions and Nutrients (QCLot: 2291566)									
Kjeldahl nitrogen, total [TKN]	----	E318	0.05	mg/L	4 mg/L	107	75.0	125	----
Organic / Inorganic Carbon (QCLot: 2291562)									
Carbon, total organic [TOC]	----	E355-L	0.5	mg/L	8.57 mg/L	99.2	80.0	120	----
Dissolved Metals (QCLot: 2285211)									
Aluminum, dissolved	7429-90-5	E421	0.001	mg/L	2 mg/L	97.4	80.0	120	----



Sub-Matrix: Water

					Laboratory Control Sample (LCS) Report				
					Spike	Recovery (%)	Recovery Limits (%)		
Analyte	CAS Number	Method	LOR	Unit	Target Concentration	LCS	Low	High	Qualifier
Dissolved Metals (QCLot: 2285211) - continued									
Antimony, dissolved	7440-36-0	E421	0.0001	mg/L	1 mg/L	96.1	80.0	120	----
Arsenic, dissolved	7440-38-2	E421	0.0001	mg/L	1 mg/L	103	80.0	120	----
Barium, dissolved	7440-39-3	E421	0.0001	mg/L	0.25 mg/L	100	80.0	120	----
Beryllium, dissolved	7440-41-7	E421	0.00002	mg/L	0.1 mg/L	94.3	80.0	120	----
Bismuth, dissolved	7440-69-9	E421	0.00005	mg/L	1 mg/L	95.8	80.0	120	----
Boron, dissolved	7440-42-8	E421	0.01	mg/L	1 mg/L	91.7	80.0	120	----
Cadmium, dissolved	7440-43-9	E421	0.000005	mg/L	0.1 mg/L	102	80.0	120	----
Calcium, dissolved	7440-70-2	E421	0.05	mg/L	50 mg/L	95.8	80.0	120	----
Cesium, dissolved	7440-46-2	E421	0.00001	mg/L	0.05 mg/L	95.6	80.0	120	----
Chromium, dissolved	7440-47-3	E421	0.0005	mg/L	0.25 mg/L	101	80.0	120	----
Cobalt, dissolved	7440-48-4	E421	0.0001	mg/L	0.25 mg/L	98.2	80.0	120	----
Copper, dissolved	7440-50-8	E421	0.0002	mg/L	0.25 mg/L	101	80.0	120	----
Iron, dissolved	7439-89-6	E421	0.01	mg/L	1 mg/L	100	80.0	120	----
Lead, dissolved	7439-92-1	E421	0.00005	mg/L	0.5 mg/L	96.6	80.0	120	----
Lithium, dissolved	7439-93-2	E421	0.001	mg/L	0.25 mg/L	96.5	80.0	120	----
Magnesium, dissolved	7439-95-4	E421	0.005	mg/L	50 mg/L	98.3	80.0	120	----
Manganese, dissolved	7439-96-5	E421	0.0001	mg/L	0.25 mg/L	101	80.0	120	----
Molybdenum, dissolved	7439-98-7	E421	0.00005	mg/L	0.25 mg/L	98.3	80.0	120	----
Nickel, dissolved	7440-02-0	E421	0.0005	mg/L	0.5 mg/L	101	80.0	120	----
Phosphorus, dissolved	7723-14-0	E421	0.05	mg/L	10 mg/L	101	80.0	120	----
Potassium, dissolved	7440-09-7	E421	0.05	mg/L	50 mg/L	98.0	80.0	120	----
Rubidium, dissolved	7440-17-7	E421	0.0002	mg/L	0.1 mg/L	100	80.0	120	----
Selenium, dissolved	7782-49-2	E421	0.00005	mg/L	1 mg/L	101	80.0	120	----
Silicon, dissolved	7440-21-3	E421	0.05	mg/L	10 mg/L	103	80.0	120	----
Silver, dissolved	7440-22-4	E421	0.00001	mg/L	0.1 mg/L	87.8	80.0	120	----
Sodium, dissolved	7440-23-5	E421	0.05	mg/L	50 mg/L	106	80.0	120	----
Strontium, dissolved	7440-24-6	E421	0.0002	mg/L	0.25 mg/L	94.9	80.0	120	----
Sulfur, dissolved	7704-34-9	E421	0.5	mg/L	50 mg/L	94.4	80.0	120	----
Tellurium, dissolved	13494-80-9	E421	0.0002	mg/L	0.1 mg/L	90.5	80.0	120	----
Thallium, dissolved	7440-28-0	E421	0.00001	mg/L	1 mg/L	95.7	80.0	120	----
Thorium, dissolved	7440-29-1	E421	0.0001	mg/L	0.1 mg/L	93.0	80.0	120	----
Tin, dissolved	7440-31-5	E421	0.0001	mg/L	0.5 mg/L	93.7	80.0	120	----
Titanium, dissolved	7440-32-6	E421	0.0003	mg/L	0.25 mg/L	99.5	80.0	120	----
Tungsten, dissolved	7440-33-7	E421	0.0001	mg/L	0.1 mg/L	94.6	80.0	120	----
Uranium, dissolved	7440-61-1	E421	0.00001	mg/L	0.005 mg/L	96.5	80.0	120	----
Vanadium, dissolved	7440-62-2	E421	0.0005	mg/L	0.5 mg/L	100	80.0	120	----



Sub-Matrix: Water					Laboratory Control Sample (LCS) Report				
					Spike	Recovery (%)	Recovery Limits (%)		Qualifier
					Target Concentration	LCS	Low	High	
Analyte	CAS Number	Method	LOR	Unit	Target Concentration	LCS	Low	High	Qualifier
Dissolved Metals (QCLot: 2285211) - continued									
Zinc, dissolved	7440-66-6	E421	0.001	mg/L	0.5 mg/L	101	80.0	120	----
Zirconium, dissolved	7440-67-7	E421	0.0002	mg/L	0.1 mg/L	97.1	80.0	120	----
Mercury, dissolved	7439-97-6	E509	0.000005	mg/L	0 mg/L	99.7	80.0	120	----
Volatile Organic Compounds (QCLot: 2291326)									
Benzene	71-43-2	E611C	0.5	µg/L	100 µg/L	99.2	70.0	130	----
Bromodichloromethane	75-27-4	E611C	0.5	µg/L	100 µg/L	97.8	70.0	130	----
Bromoform	75-25-2	E611C	0.5	µg/L	100 µg/L	103	70.0	130	----
Carbon tetrachloride	56-23-5	E611C	0.5	µg/L	100 µg/L	96.2	70.0	130	----
Chlorobenzene	108-90-7	E611C	0.5	µg/L	100 µg/L	104	70.0	130	----
Chloroethane	75-00-3	E611C	0.5	µg/L	100 µg/L	106	60.0	140	----
Chloroform	67-66-3	E611C	0.5	µg/L	100 µg/L	98.1	70.0	130	----
Chloromethane	74-87-3	E611C	5	µg/L	100 µg/L	110	60.0	140	----
Dibromochloromethane	124-48-1	E611C	0.5	µg/L	100 µg/L	97.7	70.0	130	----
Dichlorobenzene, 1,2-	95-50-1	E611C	0.5	µg/L	100 µg/L	104	70.0	130	----
Dichlorobenzene, 1,3-	541-73-1	E611C	0.5	µg/L	100 µg/L	102	70.0	130	----
Dichlorobenzene, 1,4-	106-46-7	E611C	0.5	µg/L	100 µg/L	107	70.0	130	----
Dichloroethane, 1,1-	75-34-3	E611C	0.5	µg/L	100 µg/L	100	70.0	130	----
Dichloroethane, 1,2-	107-06-2	E611C	0.5	µg/L	100 µg/L	96.8	70.0	130	----
Dichloroethylene, 1,1-	75-35-4	E611C	0.5	µg/L	100 µg/L	96.5	70.0	130	----
Dichloroethylene, cis-1,2-	156-59-2	E611C	0.5	µg/L	100 µg/L	94.1	70.0	130	----
Dichloroethylene, trans-1,2-	156-60-5	E611C	0.5	µg/L	100 µg/L	93.9	70.0	130	----
Dichloromethane	75-09-2	E611C	1	µg/L	100 µg/L	94.3	70.0	130	----
Dichloropropane, 1,2-	78-87-5	E611C	0.5	µg/L	100 µg/L	99.5	70.0	130	----
Dichloropropylene, cis-1,3-	10061-01-5	E611C	0.5	µg/L	100 µg/L	95.2	70.0	130	----
Dichloropropylene, trans-1,3-	10061-02-6	E611C	0.5	µg/L	100 µg/L	97.2	70.0	130	----
Ethylbenzene	100-41-4	E611C	0.5	µg/L	100 µg/L	103	70.0	130	----
Methyl-tert-butyl ether [MTBE]	1634-04-4	E611C	0.5	µg/L	100 µg/L	104	70.0	130	----
Styrene	100-42-5	E611C	0.5	µg/L	100 µg/L	106	70.0	130	----
Tetrachloroethane, 1,1,1,2-	630-20-6	E611C	0.5	µg/L	100 µg/L	98.3	70.0	130	----
Tetrachloroethane, 1,1,2,2-	79-34-5	E611C	0.2	µg/L	100 µg/L	99.9	70.0	130	----
Tetrachloroethylene	127-18-4	E611C	0.5	µg/L	100 µg/L	97.9	70.0	130	----
Toluene	108-88-3	E611C	0.4	µg/L	100 µg/L	102	70.0	130	----
Trichloroethane, 1,1,1-	71-55-6	E611C	0.5	µg/L	100 µg/L	99.4	70.0	130	----
Trichloroethane, 1,1,2-	79-00-5	E611C	0.5	µg/L	100 µg/L	97.8	70.0	130	----
Trichloroethylene	79-01-6	E611C	0.5	µg/L	100 µg/L	97.9	70.0	130	----



Sub-Matrix: Water					Laboratory Control Sample (LCS) Report				
					Spike	Recovery (%)	Recovery Limits (%)		
Analyte	CAS Number	Method	LOR	Unit	Target Concentration	LCS	Low	High	Qualifier
Volatile Organic Compounds (QCLot: 2291326) - continued									
Trichlorofluoromethane	75-69-4	E611C	0.5	µg/L	100 µg/L	109	60.0	140	----
Vinyl chloride	75-01-4	E611C	0.4	µg/L	100 µg/L	106	60.0	140	----
Xylene, m+p-	179601-23-1	E611C	0.4	µg/L	200 µg/L	104	70.0	130	----
Xylene, o-	95-47-6	E611C	0.3	µg/L	100 µg/L	98.1	70.0	130	----
Polycyclic Aromatic Hydrocarbons (QCLot: 2293893)									
Acenaphthene	83-32-9	E641A	0.01	µg/L	0.25 µg/L	93.9	60.0	130	----
Acenaphthylene	208-96-8	E641A	0.01	µg/L	0.25 µg/L	97.1	60.0	130	----
Acridine	260-94-6	E641A	0.01	µg/L	0.25 µg/L	109	60.0	130	----
Anthracene	120-12-7	E641A	0.01	µg/L	0.25 µg/L	103	60.0	130	----
Benz(a)anthracene	56-55-3	E641A	0.01	µg/L	0.25 µg/L	97.4	60.0	130	----
Benzo(a)pyrene	50-32-8	E641A	0.005	µg/L	0.25 µg/L	99.5	60.0	130	----
Benzo(b+j)fluoranthene	n/a	E641A	0.01	µg/L	0.25 µg/L	103	60.0	130	----
Benzo(g,h,i)perylene	191-24-2	E641A	0.01	µg/L	0.25 µg/L	113	60.0	130	----
Benzo(k)fluoranthene	207-08-9	E641A	0.01	µg/L	0.25 µg/L	103	60.0	130	----
Chrysene	218-01-9	E641A	0.01	µg/L	0.25 µg/L	103	60.0	130	----
Dibenz(a,h)anthracene	53-70-3	E641A	0.005	µg/L	0.25 µg/L	99.7	60.0	130	----
Fluoranthene	206-44-0	E641A	0.01	µg/L	0.25 µg/L	98.2	60.0	130	----
Fluorene	86-73-7	E641A	0.01	µg/L	0.25 µg/L	102	60.0	130	----
Indeno(1,2,3-c,d)pyrene	193-39-5	E641A	0.01	µg/L	0.25 µg/L	94.3	60.0	130	----
Methylnaphthalene, 1-	90-12-0	E641A	0.01	µg/L	0.25 µg/L	79.5	60.0	130	----
Methylnaphthalene, 2-	91-57-6	E641A	0.01	µg/L	0.25 µg/L	77.4	60.0	130	----
Naphthalene	91-20-3	E641A	0.05	µg/L	0.25 µg/L	77.6	50.0	130	----
Phenanthrene	85-01-8	E641A	0.02	µg/L	0.25 µg/L	101	60.0	130	----
Pyrene	129-00-0	E641A	0.01	µg/L	0.25 µg/L	99.2	60.0	130	----
Quinoline	91-22-5	E641A	0.05	µg/L	0.25 µg/L	105	60.0	130	----
Polycyclic Aromatic Hydrocarbons (QCLot: 2294171)									
Acenaphthene	83-32-9	E641A	0.01	µg/L	0.5 µg/L	91.6	60.0	130	----
Acenaphthylene	208-96-8	E641A	0.01	µg/L	0.5 µg/L	91.6	60.0	130	----
Acridine	260-94-6	E641A	0.01	µg/L	0.5 µg/L	96.7	60.0	130	----
Anthracene	120-12-7	E641A	0.01	µg/L	0.5 µg/L	92.9	60.0	130	----
Benz(a)anthracene	56-55-3	E641A	0.01	µg/L	0.5 µg/L	85.0	60.0	130	----
Benzo(a)pyrene	50-32-8	E641A	0.005	µg/L	0.5 µg/L	80.4	60.0	130	----
Benzo(b+j)fluoranthene	n/a	E641A	0.01	µg/L	0.5 µg/L	88.8	60.0	130	----
Benzo(g,h,i)perylene	191-24-2	E641A	0.01	µg/L	0.5 µg/L	94.9	60.0	130	----
Benzo(k)fluoranthene	207-08-9	E641A	0.01	µg/L	0.5 µg/L	87.6	60.0	130	----



Sub-Matrix: Water					Laboratory Control Sample (LCS) Report				
					Spike	Recovery (%)	Recovery Limits (%)		
					Target Concentration	LCS	Low	High	Qualifier
Analyte	CAS Number	Method	LOR	Unit	Target Concentration	LCS	Low	High	Qualifier
Polycyclic Aromatic Hydrocarbons (QCLot: 2294171) - continued									
Chrysene	218-01-9	E641A	0.01	µg/L	0.5 µg/L	92.3	60.0	130	----
Dibenz(a,h)anthracene	53-70-3	E641A	0.005	µg/L	0.5 µg/L	91.0	60.0	130	----
Fluoranthene	206-44-0	E641A	0.01	µg/L	0.5 µg/L	90.2	60.0	130	----
Fluorene	86-73-7	E641A	0.01	µg/L	0.5 µg/L	95.8	60.0	130	----
Indeno(1,2,3-c,d)pyrene	193-39-5	E641A	0.01	µg/L	0.5 µg/L	86.5	60.0	130	----
Methylnaphthalene, 1-	90-12-0	E641A	0.01	µg/L	0.5 µg/L	85.4	60.0	130	----
Methylnaphthalene, 2-	91-57-6	E641A	0.01	µg/L	0.5 µg/L	85.9	60.0	130	----
Naphthalene	91-20-3	E641A	0.05	µg/L	0.5 µg/L	84.1	50.0	130	----
Phenanthrene	85-01-8	E641A	0.02	µg/L	0.5 µg/L	92.9	60.0	130	----
Pyrene	129-00-0	E641A	0.01	µg/L	0.5 µg/L	90.0	60.0	130	----
Quinoline	91-22-5	E641A	0.05	µg/L	0.5 µg/L	98.3	60.0	130	----



Matrix Spike (MS) Report

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

Laboratory sample ID					Matrix Spike (MS) Report					
					Spike		Recovery (%)	Recovery Limits (%)		Qualifier
					Concentration	Target	MS	Low	High	
Client sample ID	Analyte	CAS Number	Method							
Anions and Nutrients (QCLot: 2283710)										
FJ2503214-001	Anonymous	Fluoride	16984-48-8	E235.F	5.10 mg/L	5 mg/L	102	75.0	125	----
Anions and Nutrients (QCLot: 2283711)										
FJ2503214-001	Anonymous	Chloride	16887-00-6	E235.Cl	509 mg/L	500 mg/L	102	75.0	125	----
Anions and Nutrients (QCLot: 2283712)										
FJ2503214-001	Anonymous	Bromide	24959-67-9	E235.Br-L	2.59 mg/L	2.5 mg/L	103	75.0	125	----
Anions and Nutrients (QCLot: 2283713)										
FJ2503214-001	Anonymous	Nitrate (as N)	14797-55-8	E235.NO3-L	12.8 mg/L	12.5 mg/L	103	75.0	125	----
Anions and Nutrients (QCLot: 2283714)										
FJ2503214-001	Anonymous	Nitrite (as N)	14797-65-0	E235.NO2-L	2.52 mg/L	2.5 mg/L	101	75.0	125	----
Anions and Nutrients (QCLot: 2283715)										
FJ2503214-001	Anonymous	Sulfate (as SO4)	14808-79-8	E235.SO4	499 mg/L	500 mg/L	99.9	75.0	125	----
Anions and Nutrients (QCLot: 2291564)										
VA25C7618-001	Anonymous	Ammonia, total (as N)	7664-41-7	E298	ND mg/L	----	ND	75.0	125	----
Anions and Nutrients (QCLot: 2291566)										
VA25C7679-002	MW2-95 (E225549)	Kjeldahl nitrogen, total [TKN]	----	E318	2.48 mg/L	2.5 mg/L	99.1	70.0	130	----
Organic / Inorganic Carbon (QCLot: 2291562)										
VA25C7635-002	Anonymous	Carbon, total organic [TOC]	----	E355-L	5.42 mg/L	5 mg/L	108	70.0	130	----
Dissolved Metals (QCLot: 2285211)										
VA25C7666-003	Anonymous	Aluminum, dissolved	7429-90-5	E421	0.190 mg/L	0.2 mg/L	95.0	70.0	130	----
		Antimony, dissolved	7440-36-0	E421	0.0195 mg/L	0.02 mg/L	97.6	70.0	130	----
		Arsenic, dissolved	7440-38-2	E421	0.0202 mg/L	0.02 mg/L	101	70.0	130	----
		Barium, dissolved	7440-39-3	E421	0.0197 mg/L	0.02 mg/L	98.7	70.0	130	----
		Beryllium, dissolved	7440-41-7	E421	0.0393 mg/L	0.04 mg/L	98.1	70.0	130	----
		Bismuth, dissolved	7440-69-9	E421	0.00950 mg/L	0.01 mg/L	95.0	70.0	130	----
		Boron, dissolved	7440-42-8	E421	0.098 mg/L	0.1 mg/L	98.5	70.0	130	----
		Cadmium, dissolved	7440-43-9	E421	0.00389 mg/L	0.004 mg/L	97.3	70.0	130	----
		Calcium, dissolved	7440-70-2	E421	ND mg/L	----	ND	70.0	130	----
		Cesium, dissolved	7440-46-2	E421	0.00968 mg/L	0.01 mg/L	96.8	70.0	130	----
		Chromium, dissolved	7440-47-3	E421	0.0383 mg/L	0.04 mg/L	95.7	70.0	130	----
		Cobalt, dissolved	7440-48-4	E421	0.0195 mg/L	0.02 mg/L	97.3	70.0	130	----
		Copper, dissolved	7440-50-8	E421	0.0464 mg/L	0.04 mg/L	116	70.0	130	----
		Iron, dissolved	7439-89-6	E421	1.95 mg/L	2 mg/L	97.3	70.0	130	----
		Lead, dissolved	7439-92-1	E421	0.0195 mg/L	0.02 mg/L	97.6	70.0	130	----
		Lithium, dissolved	7439-93-2	E421	0.0954 mg/L	0.1 mg/L	95.4	70.0	130	----



Sub-Matrix: Water					Matrix Spike (MS) Report					
					Spike		Recovery (%)	Recovery Limits (%)		Qualifier
Laboratory sample ID	Client sample ID	Analyte	CAS Number	Method	Concentration	Target	MS	Low	High	
Dissolved Metals (QCLot: 2285211) - continued										
VA25C7666-003	Anonymous	Magnesium, dissolved	7439-95-4	E421	ND mg/L	----	ND	70.0	130	----
		Manganese, dissolved	7439-96-5	E421	0.0198 mg/L	0.02 mg/L	98.9	70.0	130	----
		Molybdenum, dissolved	7439-98-7	E421	0.0201 mg/L	0.02 mg/L	101	70.0	130	----
		Nickel, dissolved	7440-02-0	E421	0.0413 mg/L	0.04 mg/L	103	70.0	130	----
		Phosphorus, dissolved	7723-14-0	E421	10.6 mg/L	10 mg/L	106	70.0	130	----
		Potassium, dissolved	7440-09-7	E421	3.86 mg/L	4 mg/L	96.6	70.0	130	----
		Rubidium, dissolved	7440-17-7	E421	0.0203 mg/L	0.02 mg/L	101	70.0	130	----
		Selenium, dissolved	7782-49-2	E421	0.0405 mg/L	0.04 mg/L	101	70.0	130	----
		Silicon, dissolved	7440-21-3	E421	9.86 mg/L	10 mg/L	98.6	70.0	130	----
		Silver, dissolved	7440-22-4	E421	0.00388 mg/L	0.004 mg/L	97.0	70.0	130	----
		Sodium, dissolved	7440-23-5	E421	2.02 mg/L	2 mg/L	101	70.0	130	----
		Strontium, dissolved	7440-24-6	E421	ND mg/L	----	ND	70.0	130	----
		Sulfur, dissolved	7704-34-9	E421	20.0 mg/L	20 mg/L	99.8	70.0	130	----
		Tellurium, dissolved	13494-80-9	E421	0.0396 mg/L	0.04 mg/L	99.0	70.0	130	----
		Thallium, dissolved	7440-28-0	E421	0.00374 mg/L	0.004 mg/L	93.5	70.0	130	----
		Thorium, dissolved	7440-29-1	E421	0.0198 mg/L	0.02 mg/L	99.0	70.0	130	----
		Tin, dissolved	7440-31-5	E421	0.0193 mg/L	0.02 mg/L	96.7	70.0	130	----
		Titanium, dissolved	7440-32-6	E421	0.0408 mg/L	0.04 mg/L	102	70.0	130	----
		Tungsten, dissolved	7440-33-7	E421	0.0195 mg/L	0.02 mg/L	97.6	70.0	130	----
		Uranium, dissolved	7440-61-1	E421	0.00391 mg/L	0.004 mg/L	97.7	70.0	130	----
		Vanadium, dissolved	7440-62-2	E421	0.0969 mg/L	0.1 mg/L	96.9	70.0	130	----
		Zinc, dissolved	7440-66-6	E421	0.394 mg/L	0.4 mg/L	98.4	70.0	130	----
		Zirconium, dissolved	7440-67-7	E421	0.0409 mg/L	0.04 mg/L	102	70.0	130	----
Dissolved Metals (QCLot: 2295860)										
VA25C7666-006	Anonymous	Mercury, dissolved	7439-97-6	E509	0.0000958 mg/L	0 mg/L	95.8	70.0	130	----
Volatile Organic Compounds (QCLot: 2291326)										
VA25C7639-002	Anonymous	Benzene	71-43-2	E611C	101 µg/L	100 µg/L	101	60.0	140	----
		Bromodichloromethane	75-27-4	E611C	102 µg/L	100 µg/L	102	60.0	140	----
		Bromoform	75-25-2	E611C	87.0 µg/L	100 µg/L	87.0	60.0	140	----
		Carbon tetrachloride	56-23-5	E611C	93.6 µg/L	100 µg/L	93.6	60.0	140	----
		Chlorobenzene	108-90-7	E611C	104 µg/L	100 µg/L	104	60.0	140	----
		Chloroethane	75-00-3	E611C	82.4 µg/L	100 µg/L	82.4	50.0	150	----
		Chloroform	67-66-3	E611C	101 µg/L	100 µg/L	101	60.0	140	----
		Chloromethane	74-87-3	E611C	63.9 µg/L	100 µg/L	63.9	50.0	150	----
		Dibromochloromethane	124-48-1	E611C	96.1 µg/L	100 µg/L	96.1	60.0	140	----
		Dichlorobenzene, 1,2-	95-50-1	E611C	100 µg/L	100 µg/L	100	60.0	140	----
		Dichlorobenzene, 1,3-	541-73-1	E611C	97.0 µg/L	100 µg/L	97.0	60.0	140	----
		Dichlorobenzene, 1,4-	106-46-7	E611C	101 µg/L	100 µg/L	101	60.0	140	----
		Dichloroethane, 1,1-	75-34-3	E611C	102 µg/L	100 µg/L	102	60.0	140	----
		Dichloroethane, 1,2-	107-06-2	E611C	101 µg/L	100 µg/L	101	60.0	140	----
		Dichloroethylene, 1,1-	75-35-4	E611C	84.0 µg/L	100 µg/L	84.0	60.0	140	----
		Dichloroethylene, cis-1,2-	156-59-2	E611C	95.5 µg/L	100 µg/L	95.5	60.0	140	----
		Dichloroethylene, trans-1,2-	156-60-5	E611C	86.4 µg/L	100 µg/L	86.4	60.0	140	----



Sub-Matrix: Water					Matrix Spike (MS) Report					
					Spike		Recovery (%)	Recovery Limits (%)		
Laboratory sample ID	Client sample ID	Analyte	CAS Number	Method	Concentration	Target	MS	Low	High	Qualifier
Volatile Organic Compounds (QCLot: 2291326) - continued										
VA25C7639-002	Anonymous	Dichloromethane	75-09-2	E611C	95.5 µg/L	100 µg/L	95.5	60.0	140	----
		Dichloropropane, 1,2-	78-87-5	E611C	105 µg/L	100 µg/L	105	60.0	140	----
		Dichloropropylene, cis-1,3-	10061-01-5	E611C	93.7 µg/L	100 µg/L	93.7	60.0	140	----
		Dichloropropylene, trans-1,3-	10061-02-6	E611C	92.5 µg/L	100 µg/L	92.5	60.0	140	----
		Ethylbenzene	100-41-4	E611C	97.3 µg/L	100 µg/L	97.3	60.0	140	----
		Methyl-tert-butyl ether [MTBE]	1634-04-4	E611C	104 µg/L	100 µg/L	104	60.0	140	----
		Styrene	100-42-5	E611C	99.4 µg/L	100 µg/L	99.4	60.0	140	----
		Tetrachloroethane, 1,1,1,2-	630-20-6	E611C	99.3 µg/L	100 µg/L	99.3	60.0	140	----
		Tetrachloroethane, 1,1,2,2-	79-34-5	E611C	83.6 µg/L	100 µg/L	83.6	60.0	140	----
		Tetrachloroethylene	127-18-4	E611C	94.6 µg/L	100 µg/L	94.6	60.0	140	----
		Toluene	108-88-3	E611C	98.8 µg/L	100 µg/L	98.8	60.0	140	----
		Trichloroethane, 1,1,1-	71-55-6	E611C	98.0 µg/L	100 µg/L	98.0	60.0	140	----
		Trichloroethane, 1,1,2-	79-00-5	E611C	101 µg/L	100 µg/L	101	60.0	140	----
		Trichloroethylene	79-01-6	E611C	98.0 µg/L	100 µg/L	98.0	60.0	140	----
		Trichlorofluoromethane	75-69-4	E611C	87.3 µg/L	100 µg/L	87.3	50.0	150	----
		Vinyl chloride	75-01-4	E611C	66.2 µg/L	100 µg/L	66.2	50.0	150	----
		Xylene, m+p-	179601-23-1	E611C	208 µg/L	200 µg/L	104	60.0	140	----
		Xylene, o-	95-47-6	E611C	95.5 µg/L	100 µg/L	95.5	60.0	140	----



www.alsglobal.com

Canada Toll Free: 1 800 668 9878

Custody (COC) / Analytical Request Form

COC Number: 22 - 20251016

Page 1 of 1

Report To Contact and company name below will appear on the final report		Reports / Recipients		Turnaround Time (TAT) Requested		AFFIX ALS BARCODE LABEL HERE (ALS use only)	
Company: Masse Environmental Contact: Ico deZwart Phone: 250-505-3479 Company address below will appear on the final report Street: 812 Vernon St. City/Province: Nelson, BC Postal Code: V1L 4G4		Select Report Format: ☒ PDF ☒ EXCEL ☒ EDD (DIGITAL) Merge QC/QCI Reports with COA ☒ YES ☐ NO ☐ N/A ☐ Compare Results to Criteria on Report - provide details below if box checked Select Distribution: ☒ EMAIL ☐ MAIL ☐ FAX Email 1 or Fax: ico@masseenvironmental.com Email 2: chris@masseenvironmental.com Email 3: jenn@masseenvironmental.com		☒ Routine [R] if received by 3pm M-F - no surcharges apply ☐ 4 day [P4] if received by 3pm M-F - 20% rush surcharge minimum ☐ 3 day [P3] if received by 3pm M-F - 25% rush surcharge minimum ☐ 2 day [P2] if received by 3pm M-F - 50% rush surcharge minimum ☐ 1 day [E] if received by 3pm M-F - 100% rush surcharge minimum ☐ Same day [E2] if received by 10am M-S - 200% rush surcharge.			
Invoice To: Same as Report To ☒ YES ☐ NO Copy of Invoice with Report ☒ YES ☐ NO		Invoice Recipients		Additional fees may apply to rush requests on weekends, statutory holidays and for non-routine tests. Date and Time Required for all E&P TATs: dd-mm-yy hh:mm am/pm For all tests with rush TATs requested, please contact your AM to confirm availability.			
Company: Contact:		Select Invoice Distribution: ☒ EMAIL ☐ MAIL ☐ FAX Email 1 or Fax: Email 2:		Analysis Request Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below		SAMPLES ON HOLD EXTENDED STORAGE REQUIRED SUSPECTED HAZARD (see notes)	
Project Information		Oil and Gas Required Fields (client use)		NUMBER OF CONTAINERS pH, cond, TSS, total alk, hardness Chloride, bromide, fluoride, sulfate Ammonia, TKN, nitrate, nitrite TOC Dissolved Metals (incl Hg) VOCs / PAHs			
ALS Account # / Quote #: VA24-MASS200-001 Job #: 2016-503 - Nakusp PO / AFE: LSD:		AFE/Cost Center: Major/Minor Code: Requisitioner: lise@masseenvironmental.com Location:					
ALS Lab Work Order # (ALS use only):		ALS Contact: Can Dang		Sampler:			
ALS Sample # (ALS use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mm-yy)	Time (hh:mm)	Sample Type			
	MW1-95 (E225548)	14-Oct-15	16:30	GW	8	R	R
	MW2-95 (E225549)	15-Oct-15	9:30	GW	8	R	R
	MW3-95 (E225560)			GW		R	R
	MW4-08 (E265109)			GW		R	R
	MW5-08 (E265110)	14-Oct-15	13:30	GW	4	R	R
	MW17-07 (E309170)	15-Oct-15	13:15	GW	4	R	R
	Duplicate			GW		R	R
	Field Blank			GW		R	R
Drinking Water (DW) Samples¹ (client use)		Notes / Specify Limits for result evaluation by selecting from drop-down below (Excel COC only)		SAMPLE RECEIPT DETAILS (ALS use only)			
Are samples taken from a Regulated DW System? ☐ YES ☒ NO				Cooling Method: ☐ NONE ☐ ICE ☒ ICE PACKS ☐ FROZEN ☐ COOLING INITIATED Submission Comments identified on Sample Receipt Notification: ☐ YES ☒ NO Cooler Custody Seals Intact: ☐ YES ☒ N/A Sample Custody Seals Intact: ☐ YES ☒ N/A INITIAL COOLER TEMPERATURES °C: 10 FINAL COOLER TEMPERATURES °C: 10			
Are samples for human consumption/ use? ☐ YES ☒ NO				SHIPMENT RELEASE (client use) Released by: [Signature] Date: 16-Oct-15 Time: 11:00 INITIAL SHIPMENT RECEPTION (ALS use only) Received by: [Signature] Date: 17/10 Time: 11:40			

Environmental Division
Vancouver
Work Order Reference
VA25C7679



Telephone : +1 604 253 4188

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY

YELLOW - CLIENT COPY

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

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

FEB 2022 FRONT