

CENTRAL COAST REGIONAL DISTRICT

REQUEST FOR PROPOSALS: THORSEN CREEK LANDFILL OPERATIONS CONTRACT

July 2026

*Prepared By:
Nicola Koroluk*



Central Coast Regional District
Box 186, 626 Cliff Street
Bella Coola, BC
V0T 1C0

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SECTION 1 - REQUEST FOR PROPOSALS

The Central Coast Regional District (CCRD) invites proposals from qualified machine operators to perform all heavy machine operations at Thorsen Creek Landfill, located in the vicinity of Thorsen Creek, Bella Coola, BC. It is the intent of this Request for Proposals (RFP) to identify a lead proponent and negotiate a contract for provision of landfill equipment and its operation at Thorsen Creek Landfill. The initial term of the contract is five (5) years, commencing January 1, 2027 and ending December 31, 2032. Contract rates are subject to annual Consumer Price Index (CPI) adjustment in each year of the contract, including any extension years.

Please reference Schedule A for a detailed list of contract specifications. Work associated with this contract includes but is not limited to:

- Two (2) days per week, coordinate with transfer station attendant to relocate the contents of the 4-yard bins of putrescible waste from the transfer station to the active face at the landfill;
- Coordinate with the transfer station attendant to receive waste on closed days, as needed,
- Operate the Site on any special levy, community clean-up, or other additional operating days designated by the CCRD, as described in Schedule A,
- Coordinate with transfer station attendant the transfer of the 30 yard roll off bins of metal, construction/demo debris, and wood/cardboard from Transfer Station to appropriate sites at landfill;
- Compaction and cover of all putrescible wastes at the end of each day of operation with approved cover material; and
- Maintenance of all parts of the access roads/drop-off areas not otherwise maintained by others.
- Maintain the electric fence around the landfill.

The minimum equipment required by the proponent for this contract is:

- A combination of a 25 tonne (or larger) tracked excavator, front-end loader & dump truck, or
- A 25 tonne (or larger) tracked excavator and a suitable combination of equipment capable of achieving compaction of waste, transport/spreading of cover material, burning of wood and cardboard piles, organization/mounding of metal pile and snow removal.

Proposals will be submitted by email, in pdf format, to ops@ccrd.ca no later than 4:00 p.m., local time, Friday, August 28, 2026. The email subject line should read: "2027 TC Landfill RFP Operations Proposal". Proposals will be evaluated by a minimum of three CCRD staff with the intention of identifying a lead proponent and entering into negotiations with the lead proponent to confirm contract terms. If satisfactory terms cannot be reached within a reasonable amount of time, then CCRD may cease negotiations, and either engage the next highest scoring proponent in negotiations or cancel the RFP process.

RFP packages may be obtained from the Central Coast Regional District office at 626 Cliff Street, Bella Coola, B.C., or on the CCRD website at [Central Coast Regional District \(CCRD\)](http://Central Coast Regional District (CCRD)) . Interested parties are asked to register with the CCRD to receive any additional information or addendums that may be issued prior to the closing date. Registration can be completed by email at ops@ccrd.ca.

The CCRD will not be responsible for any costs incurred by a proponent in preparing a proposal.

The highest scoring proposal will not necessarily be accepted. The Central Coast Regional District unequivocally reserves the right to waive formalities in or reject any or all proposals, or accept the proposal deemed most favorable in the interest of the Central Coast Regional District.

There will be **no** mandatory pre-bid meeting or site visit, however interested bidders are strongly encouraged to contact the CCRD Operations Department to schedule a site visit prior to submitting a proposal.

All inquiries must be directed only to the Solid Waste Coordinator, Nicola Koroluk by at 250-982-0081 or by email at ops@ccrd.ca. Deadline for inquiries is August 21, 2026 by 4:00 p.m.

SECTION 2 - INSTRUCTIONS TO PROPONENTS

Submission of Proposals

1. Proponents must submit proposals by email, in pdf format, to ops@ccrd.ca no later than 4:00 p.m., local time, Friday, August 28, 2026. The email subject line should read: "2027 TCWRC RFP Operations Proposal". Proposals received after the Closing Time will not be considered. They will be returned to the proponent(s) unopened.
2. **Proposals must be submitted on the SECTION 3 - Proposal Form** supplied in this document.
The Proposal Form shall be dated, shall show the full legal name and business address of the Proponent and shall be signed with the usual signature of the person or persons authorized to bind the Proponent. The name of each signatory shall be clearly imprinted below the signature.
3. Proponents must be sure to fill out and enclose all three pages of the Proposal Form.
4. Proponents may be required after the opening of proposals to submit evidence of their resources and their ability to carry out the Work specified under the Contract.
5. Before submitting a proposal, the Proponent shall carefully examine the documents and the site of the Works and shall fully inform him/herself as to the existing conditions and limitations which may influence the proposal and affect the execution of the Works.
6. Should any proponent find discrepancies or omissions in the RFP documents, or should any other questions arise concerning the Work as required under the Contract, proponents should at once, request explanation, clarification or interpretation, BEFORE submitting their proposal.
7. A Proponent who has already submitted a proposal may submit a further proposal at any time up to the Closing Time. The last proposal received from a proponent prior to the Closing Time shall supersede and invalidate any and all proposals previously submitted by the proponent. A proponent may withdraw its proposal at any time up to the Closing Time.
8. Any party owing monies to the CCRD must settle all debts before any proposal documents will be considered.

Mandatory Components

Proponent's Qualifications

1. The following mandatory criteria must be met or exceeded and documented within the contents of the Proposal Form:
 - (a) Contractor can provide the following equipment:
 - A tracked excavator with a weight classification of at least 25 tonnes and equipped with a digging bucket, clean up bucket and hydraulic thumb; a front-end wheel loader with bucket, a dump truck capable of moving cover material and metals and snow removal equipment; OR
 - A tracked excavator with a weight classification of at least 25 tonnes and equipped with a digging bucket, clean up bucket and hydraulic thumb and a combination of equipment capable of achieving compaction of waste, transport/spreading of cover material, burning or wood and cardboard piles, organization/mounding of metal pile and snow removal.
 - (b) Provision of WorkSafe BC coverage and in good standing with WorkSafe BC.
 - (c) The Contractor's superintendent or designate capable of operating heavy equipment, fire response and repairing/troubleshooting electric fence issues, must be capable of responding to landfill emergencies within (1) hour of notification from the regional district or other first responders.
2. The following are preferred qualifications and will form a portion of the proposal evaluation criteria in relation to Contractor Experience:
 - (a) The proponent has at least three (3) years' experience, within the past ten (10) years, operating heavy equipment in landfill operations at a provincially permitted landfill, OR in comparable heavy

construction or earthmoving operations – such as quarry or aggregate/gravel pit operations, road or site construction, or similar work involving excavation, material handling, grading and compaction.

- (b) The Proponent's proposed Superintendent, or designate, has successfully completed the **SWANA Landfill Operations Basics Course** (or another course acceptable to the Ministry), or commits to completing such training within six (6) months of the contract award.
- (c) The proponent's proposed superintendent or designate has demonstrated proven performance over a period of 3 years of landfill operations at a provincially permitted landfill, or in comparable heavy construction or earthmoving operations as described above, in the past 10 years.

Sub-contractors

1. When Sub-Contractors are engaged, the Contractor shall, for the purposes of the Workers Compensation Act, and for the duration of the Work of this Contract be the "prime contractor" for the "Work site", and do everything that is reasonably practicable to establish and maintain a system or process that will ensure compliance with the Act and its regulations, as required to ensure the health and safety of all persons at the "Work site".
2. Proponents shall list any proposed Sub-contractors in the area provided on the Proposal Form. The CCRD reserves the right, without any liability to the CCRD to reject any proposed Sub-contractor and to require the Proponent to substitute another Sub-contractor that is acceptable to the CCRD.
3. Sub-contractors identified in the Proposal shall not be changed without the written consent of the CCRD.

Insurance Coverage

1. As a condition of award of the Contract, and prior to any commencement of work, the successful proponent shall provide Certificates of Insurance to cover Comprehensive General Liability as specified in Part 8 of the attached sample contract. This is currently set at \$5 million.

Pricing Requirements

1. The proposed pricing shall be expressed in Canadian currency, and shall be all inclusive, including but not limited to all labour, materials, equipment, freight, customs and excise duties, and taxes, save and except only GST.
2. There is no guarantee of extensions to the contract beyond the initial five-year term, and as such, proponents are cautioned to submit pricing based on this.
3. The Regional District will entertain a maximum annual increase in contract rates with respect to Consumer Price Index increase. The CPI increase will be based on the British Columbia Consumer Price Index for all-items (monthly, not seasonally adjusted) as posted by Statistics Canada for the previous 12-month period ending September 30th of the current contract year. For clarity, the CPI adjustment applies in each year of the contract, including any extension years.
4. If by mutual agreement, the Regional District and Contractor agree to extend the contract as described in Section 1, the Contractor and Regional District will seek to have the contract extension completed by October 31, 2029.

Addenda

1. If there are to be any changes in the defined scope of work or specifications, registered proponents will be informed, prior to the close of the period allowed for receiving proposals, by means of an Addendum, a written communication issued by the CCRD. All Addenda shall become a part of the RFP Documentation.

Evaluation of Proposals

1. All proposals submitted in accordance with the Instructions to Proponents will be evaluated by CCRD staff to determine which proposals meet the all-mandatory criteria. Those meeting the mandatory criteria will then be scored with the following points awarded for each criteria:

(a)

Criteria	Possible Score	Contractor Score
Pricing	40	
Contractor Experience	40	
Dedicated Equipment	20	
Total Possible score	100	

2. Proponents will be ranked based on the above criteria and then the Contractor with the highest score will be contacted in order to enter into 'frontrunner' negotiations. At the frontrunner negotiation stage, the CCRD reserves the right to request references or other documentation in support of the proposal. This is an opportunity for both the Regional District and Proponent to finalize contract details. If both parties are satisfied, then a contract will be executed by the respective parties. If the two parties fail to reach an agreement within a period of time acceptable to the Regional District, then next highest ranked proponent will be contacted to initiate 'frontrunner' negotiations.

SECTION 3 - PROPOSAL FORM**THORSEN CREEK WASTE & RECYCLING CENTRE
OPERATION CONTRACT****Proposal Submitted By:**

_____	)	Name and address of Proponent
_____	)	
_____	)	
_____	)	
_____	)	

To:

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

PART 1 - PRICING.

I/We, propose the following pricing (in Canadian Dollars) to perform the duties as described in the RFP Package for Operation of Thorsen Creek Waste and Recycling Centre and for Force Account Work (Hourly work requested by CCRD over and above contractual obligations) for the period commencing January 1, 2027 and extending until December 31, 2032.

ITEM NO	DESCRIPTION OF WORKS /SERVICES	TENDERED RATE/PRICE (GST EXCLUDED)
1.	Monthly fee for operation of Thorsen Creek Landfill and Transfer Station (in accordance with sample contract)	\$ / month
2.	Special levy / additional operating day designated by the CCRD - per day, all found price	\$ / day
3.	Force Account Rate _____ Dozer – all found price	\$ / hour
4.	Force Account Rate _____ Front End Loader - all found price	\$ / hour
5.	Force Account Rate _____ Excavator – all found price	\$ / hour
6.	Force Account Rate _____ Dump Truck – all found price	\$ / hour
7.	Force Account Rate - Superintendent – all found price	\$ / hour
8.	Force Account Rate - General Labourer – all found price	\$ / hour
9.	Authorized supplies and expenses – Material costs/expenses on individual items valued at more than \$100 to be substantiated with copies of receipts . Cost is deemed to be the net pre-tax amount.	At cost

PART 2 – CONTRACTOR EXPERIENCE

Contractor Personnel	Number of Years of Relevant Experience (landfill, quarry, or comparable heavy construction)	Details (include relevant experience and location of key personnel)
Contractor/Business		
Superintendent Name: _____ _____		
Attendant Name: _____ _____		
Attendant Name: _____ _____		
Subcontractor Name: _____ _____		

PART 3 – CONTRACTOR EQUIPMENT DEDICATED TO LANDFILL SITE

Type of Proposed Equipment	Details (Make, Model, Year, Hours, Condition, Leased or Owned, Current Location)

PART 4 – SUB-CONTRACTORS (IF ANY)

Name of Sub-contractor	Description of Sub-contractor Role

I acknowledge that I have read and understood the requirements and specifications within the sample contract included with the RFP Package, and that the information included in my proposal is accurate and free of any misrepresentation.

Dated: _____

Signature _____

Name (Printed) _____

Position _____

WorkSafe BC No. _____ (I/We certify I/we are a member in good standing)

GST Registration No. _____

Section 4 Example Contract Containing Contract Specifications



THORSEN CREEK LANDFILL OPERATOR CONTRACT

THIS AGREEMENT is made XX, 2026

BETWEEN:

CENTRAL COAST REGIONAL DISTRICT

626 Cliff Street
Box 186,
Bella Coola, BC V0T 1C0

(**"CCRD"**)

AND:

TBA
Address

(**"Contractor"**)

BACKGROUND

- A. CCRD is a regional district established and incorporated pursuant to the *Local Government Act*.
- B. Contractor, doing business as **XXXX**.
- C. The Contractor responded to Request for Proposal: Contractor Regional District Thorsen Creek Landfill Operations Contract – Month xx, Year (File No. RFP **OPS-XXXX-XX**), and has agreed to provide landfill operation services as described therein for the CCRD on the terms and conditions set out herein.

TERMS OF AGREEMENT

In consideration of the premises and the covenants, agreements, representations, warranties, and payments contained in this Agreement, the parties agree as follows:

PART 1 - DEFINITIONS

1. In this Agreement:

- a. **"Additional Contracted Equipment"** means equipment not owned by the Contractor that the Contractor must hire in order to conduct landfill operations at the Thorsen Creek Landfill in accordance with landfill requirements.

- b. **“Agreement”** means this agreement, including the appendixes hereto;
 - c. **“Equipment”** means the equipment and specifications for equipment listed in Appendix “D”;
 - d. **“Notice”** means notice in writing delivered to either party as set out in sections 52 and 54;
 - e. **“Services”** means the landfill specifications set out in Schedule A
 - f. **“Term”** means the term set out in section 3;
2. The following Appendixes and Schedules will be read with and form part of this Agreement:
- Appendix “A” Thorsen Creek site Map;
 - Appendix “B” Operational Certificate MR-422;
 - Appendix “C” Design Operations and Closure Plan;
 - Appendix “D” BYLAW 551 Solid Waste Disposal Rates and Charges;
 - Appendix “E” Equipment and Supplies; and
 - Schedule “A” Landfill Operation Specifications

PART 2 - TERM

- 3. Subject to sections 4, 5, and 6, the term of this Agreement is for the period commencing on January 1, 2027 and terminating on December 31, 2032.
- 4. The CCRD may terminate this Agreement by Notice immediately if the CCRD has set a time limit for compliance, rectification, or both pursuant to sections 24 and 25 and the Contractor fails to comply or rectify the non-compliance within the time limit.
- 5. Either party may terminate this Agreement without cause, however, Notice of such termination must be given at least 6, (six), months prior to termination.
- 6. CCRD reserves the right at its exclusive option to terminate this Agreement by written notice effective immediately without further liability of any kind in either of the following circumstances:
 - a. the Contractor is adjudged bankrupt or makes a general assignment for the benefit of creditors, or a receiver, trustee in bankruptcy or similar officer is appointed to take charge of all or part of its property; or,
 - b. any Force Majeure event which lasts longer than 30 days.

PART 3 – SERVICES

- 7. The Contractor agrees to provide the Services as described herein and will carry out the Services as well as any other duties and responsibilities that the parties may agree to or the CCRD may direct and require by providing Contractor with Notice thereof. Such additional duties and responsibilities shall be included in the definition of Services and confirmation if such changes, and the terms thereof, shall be added as an additional Appendix to this Agreement.

8. The Contractor will perform the Services with such degree of care, skill, and diligence as would reasonably be expected from a person or entity performing services similar in scope, nature, and complexity as the Services in accordance with industry practices and standards in the Province of British Columbia.
9. The Contractor shall provide all necessary equipment, materials, labour, supervision and perform all work, and fulfil everything as set forth and in strict accordance with this Agreement.
10. The Contractor shall, at their own expense, procure all permits, certificates, and licenses required by law for the execution of the Services, and shall comply with all Federal, Provincial and local laws, regulations, and bylaws affecting the execution of the Services.
11. The Contractor shall operate in accordance with WorkSafe BC regulations and other applicable policies of the CCRD.
12. The CCRD reserves the right to request monthly or weekly meetings to address issues or concerns. Problems and concerns should be addressed contemporaneously via email during the month or week as they arise. The discussions at weekly or monthly meetings will be documented in writing. If there are no issues during the month, or week, either party can request to postpone the meeting to the next period meeting by written mutual agreement.
13. The CCRD reserves the right to request to meet the Contractor prior to beginning Services to review all site locations, expectations, and responsibilities during the Term.
14. Nothing contained in this Agreement shall be construed as delegating authority to the Contractor or authorizing the Contractor to hold itself out as an employee of the CCRD. The relationship set out in this Agreement is purely contractual.
15. The Contractor agrees to conduct themselves as appropriate in all situations and generally not to do anything that would adversely affect the interests of the CCRD.
16. The Contractor agrees to be subject to and comply with the CCRD's policies, rules, and bylaws, as amended from time to time. The Contractor is responsible to inform themselves of the details of the CCRD's policies, rules, and bylaws and amendments thereto. If there is conflict between this Agreement and any such policy, rule, or bylaw, this Agreement shall prevail to the extent of the inconsistency.

PERSONNEL

17. The Contractor shall ensure that properly trained personnel are available during operating hours who, in the absence of the Contractor, possess sufficient skills, qualifications, and experience to operate the Equipment and carry out the full scope of the Services as required.
18. The CCRD reserves the right, without any liability to the CCRD, to notify the Contractor regarding any sub-contractors or employees of the Contractor who have failed to comply with the requirements of this Agreement and to require the Contractor to substitute another sub-contractor or employee that is acceptable to the CCRD.

EQUIPMENT

19. Except as specified herein, the Contractor shall provide the Equipment required for the execution of the Work prior to December 1, 2026, and at that time, shall provide the CCRD with the particulars of the Equipment so acquired including make, model, model year, VIN, and accessory equipment.

20. The Contractor will ensure that the Equipment shall be available during the days of operation, and without limiting the generality of the foregoing, shall be available on an on call basis. In case of breakdowns, the Contractor will ensure there is a back-up plan and supporting equipment available to keep landfill operations going without interruption.
21. All Equipment provided by the Contractor shall be capable of performing the Services in accordance with this Agreement
22. The Contractor will ensure their employees are trained in the safe use of Equipment.

SAFETY

23. The Contractor shall be solely and completely responsible for ensuring safety of all employees, persons, and property, (including CCRD staff, CCRD employees, CCRD sub-trades, and the public), relating to their performance of the Services and shall:
 - a. hold at least one documented safety meeting each month;
 - b. provide an annual training safety course for all employees;
 - c. provide the CCRD with documents regarding the training referenced herein;
 - d. equip all vehicles with appropriate warning lights and back-up signals; and,
 - e. report hazards immediately.

PART 4 - NON-COMPLIANCE

24. If the Contractor fails to observe, perform, or comply with any provision of this Agreement, then the CCRD may, at its sole discretion:
 - a. allow the Contractor to continue to provide the Services with a time limit for compliance, rectification, or both; or,
 - b. suspend all or part of the Services, including payments in whole or in part, and give the Contractor a time limit for compliance, rectification, or both.
25. If the CCRD has set a time limit for compliance, rectification, or both and believes that the Contractor has failed to meet the time limit, the CCRD may employ whatever means necessary to rectify that non-compliance, including performance of the Contractor's obligations on the Contractor's behalf and/or termination of this Agreement in accordance with the provisions of PART 2, and the Contractor shall pay an amount equal to all costs reasonably incurred by the CCRD in rectifying the non-compliance.

PART 5 – INDEPENDENT CONTRACTOR

26. The status of the Contractor in providing the Services under this Agreement shall be that of an independent contractor and nothing contained in this Agreement shall be construed or interpreted so as to constitute an employment relationship, a partnership, or a joint venture.
27. The Contractor shall be entitled to pursue work with others during the term of this Agreement providing such work does not interfere with the provision of Services under this Agreement and does not constitute a conflict of interest.
28. The Contractor acknowledges and agrees that this Agreement expires at the end of the Term as set out in Part 2 and that upon expiry, no further obligations will be owed by the CCRD to the Contractor.

29. The Contractor is fully responsible for the planning, organization, and delivery of all aspects of the Services subject only to any reasonable instructions given to it by the CCRD from time to time.

PART 6 - COMPENSATION

30. During the Term, the CCRD will pay the Contractor the fees set out in Schedule X.
31. For services outside of the landfill facility, payment will be made in accordance with machine rates in Appendix D separately from the regular fee.
32. The Contractor shall provide the equipment listed in Appendix "X" herein and shall track the monthly use of equipment and accessory equipment. The Contractor shall provide a written report within 3 days of the end of each month of the equipment and accessory equipment used for that previous month.
33. If the Contractor hires Additional Contracted Equipment, the CCRD shall only be required to pay the actual costs of such hiring upon submission of the invoice for services from the owner of such Additional Contracted Equipment and upon provision of a written report from the Contractor verifying the necessity of hiring the Additional Contracted Equipment.
34. The hourly rate for equipment and accessory equipment used during the first year of the Term shall be as set out in Appendix "D". The rates set out in Appendix "X" for equipment and accessory equipment shall be adjusted in January of each successive year of the Term based on the British Columbia Blue Book Rates for that year.
35. The applicable British Columbia Blue Book Vehicle Hire Rates for fuel adjustments for each month of the Term, as promulgated from time to time, shall be added to the hourly compensation set out in Appendix "X"
36. The yearly fixed fee will be reviewed in January of each year of the Term and on mutual agreement shall be adjusted up or down based on:
- a. changes to the scope of the work undertaken during the previous year;
 - b. exceptional circumstances;
 - c. actual equipment usage during the previous year; and,
 - d. changes in insurance costs.

PART 7 - COVENANTS

37. The Contractor represents and warrants that they possess the necessary qualifications, skills, experience, resources, and expertise to provide the Services to the standards set out in section 8, and acknowledges and agrees that the CCRD has entered into this Agreement based on such representations and warranties.
38. The Contractor acknowledges that in the performance of its responsibilities hereunder, the Contractor may have access to confidential information and records, and the Contractor shall maintain strict confidentiality concerning any information, data, reports, instructions, or directions received from or delivered by the CCRD in connection with the providing of any Services under this Agreement.

PART 8 - INSURANCE

39. Without restricting the indemnification requirements contained in this Agreement, the Contractor shall, at its own expense, provide and maintain, during the term of this Agreement, the following insurance coverage:
- a. Commercial General Liability as described in section 42,
 - b. Automobile Liability as described in section 43; and,
 - c. Pollution Liability as described in section 44.
40. All such insurance must be primary and not require the sharing of any loss by any insurer of the CCRD and the CCRD shall be an additional insured in such policies.
41. Insurance shall be placed with Insurers registered in and licensed to underwrite such insurance in Canada. All such insurance shall be at no expense to the CCRD. If the CCRD requires additional Insurance Coverage to be obtained by the Contractor, the additional expense of such additional insurance shall be borne by the CCRD.
42. Commercial General Liability insurance, in an amount not less than \$5 million inclusive per occurrence against bodily injury, personal injury, and property damage and including liability assumed under the Agreement. Such policy(s) of insurance shall include, but not be limited to:
- a. Products and Completed Operations Liability;
 - b. Owner's and Contractor's Protective Liability;
 - c. Contingent Employer's Liability;
 - d. Blanket Written Contractual Liability;
 - e. Personal Injury Liability;
 - f. Non-Owned Automobile Liability;
 - g. Cross Liability;
 - h. Employees as Additional Insureds; and,
 - i. Broad Form Property Damage;
43. Automobile Liability insurance on all vehicles owned, operated, or licensed by the Contractor in an amount not less than \$2 million inclusive per occurrence.
44. Pollution liability insurance coverage in an amount not less than \$2 million inclusive per occurrence.
45. Under this Agreement, the Contractor will provide and maintain WorkSafeBC coverage throughout the Term for all employees and shall be the named Prime contractor, and will ensure that any subcontractor used in the undertaking of the required Services is also covered through their own WorkSafe BC insurance or covered under the Contractor's own WorkSafe BC account.
46. The Contractor shall, prior to the commencement of Services and before any payments are made under this Agreement, file with the CCRD evidence of insurance coverages in the form of a completed Certificates of Insurance. When requested by the CCRD, the Contractor shall provide certified copies of required insurance policies.
47. The insurance policies, except for ICBC Automobile Liability Insurance, shall provide that the insurance shall not be cancelled or materially changed so as to affect the coverage provided under the Agreement, without the Insurer giving at least thirty (30) days prior written notice to the CCRD.

48. Failure to provide the required insurance documentation shall result in termination of this Agreement.
49. If the insurance policies expire prior to the end of the Agreement Term, the Contractor shall provide the CCRD evidence of insurance renewal in the form of a completed Certificate of Insurance, at least ten (10) days prior to the expiry date of the policies listed in this and Schedule.
50. The Contractor shall ensure that all its subcontractors performing Services under this Agreement carry insurance in the form and limits specified in this Part.

PART 9 - INDEMNITY

51. The Contractor will indemnify, release, and save harmless the CCRD and its elected and appointed officials, officers, employees, agents, contractors, successors and assigns, (the "Indemnified Parties"), from any and all liabilities, actions, damages, claims, losses, orders, fines, penalties, costs and expenses, including the full amount of all legal fees and expenses that may be brought against, or suffered or incurred by the Indemnified Parties, in any way directly or indirectly arising from or in connection with the performance of the Services, activities, actions or omissions of the Contractor or any of its employees, subcontractors, agents, licenses, servants, invitees or anyone for whom the Contractor is in law responsible, in relation to the Services or in connection with this Agreement. The indemnities set out in this paragraph do not include indemnifications for negligence or wilful or malicious misconduct on the part of the Indemnified parties or a person for whom the CCRD is responsible at law. This section will survive termination of this Agreement.

NOTICES

52. Any notice permitted or required to be given by a party hereunder shall be given in writing, and may be delivered by hand, sent by facsimile transmission or email, or forwarded by ordinary or registered mail to the addresses, fax numbers and email addresses set forth below, or to such other addresses as may from time to time be provide by the parties in writing.
53. Any notice delivered by hand or sent by facsimile or email shall be deemed to be given and received at the time of sending. Any notice that is sent by ordinary or registered mail shall be deemed to have been received by the party to whom it is addressed on the fourth (4th) business day (Saturdays, Sundays and statutory holidays excluded) following the date of posting, provided that Canada Post service is not interrupted by strike or lock-out at the time of posting or within four (4) business days thereafter, in which case the notice shall only be effective once it is actually delivered.
54. Notices under this Agreement are to be delivered as follows:

To the CCRD:
Central Coast Regional District
626 Cliff Street
Box 186
Bella Coola, BC V0T 1C0

Attention: Nicola Koroluk Solid Waste Coordinator
Email: nkoroluk@ccrd.ca

To the Contractor:

TBA

Address

Attention:

Fax:

Email:

PART 10 – DISPUTE RESOLUTION

55. If the parties to this Agreement are unable to agree on the interpretation or application of any provision in the Agreement, or are unable to resolve any other issue relating to this Agreement, the parties agree to the following process in the order it is set out:
- a. the party initiating the process will send written notice to the other party; and,
 - b. the parties will promptly, diligently and in good faith take all reasonable measures to negotiate an acceptable resolution to the disagreement or dispute;
56. If the parties are unable to negotiate a resolution within 30 days of the date the written notice was sent advising of the dispute, the parties may request the assistance of a skilled mediator agreed to by the parties within 30 days written notice of a request to appoint a mediator by any party, failing which the mediator will be appointed by the B.C. International Commercial Arbitration Centre (BCICAC), and unless the parties agree otherwise, this mediation will follow BCICAC rules and will terminate 60 days after the appointment of the mediator.
57. If the parties are unable to resolve the dispute under section 56 the parties agree to refer the matter to a single arbitrator under the Commercial Arbitration Act or any successor legislation and to accept the arbitration ruling as final and binding. If the parties are unable to agree on a single arbitrator within 60 days following the end of mediation, the BCICAC will appoint an arbitrator. The arbitration will follow the rules of the Commercial Arbitration Act unless the parties agree otherwise.
58. Unless otherwise agreed by the parties or ordered by an arbitrator, each party will pay an equal share of the costs for the dispute resolution process.
59. Despite any other provision of this Agreement, no party will interrupt or terminate this Agreement during any attempt to resolve issues through the dispute resolution process set out in this part.

ENTIRE AGREEMENT

60. This Agreement constitutes the entire agreement between the parties with respect to the provision of the Services and there are no representations or warranties, express or implied, statutory or otherwise and no collateral agreements other than as expressly set forth or referred to in this Agreement.
61. The parties may, by written agreement, amend this Agreement.

TIME OF THE ESSENCE

62. Time will be the essence of this Agreement.

APPLICABLE LAW

63. This Agreement will be governed by and interpreted in accordance with the laws of British Columbia.

64. If any portion of this Agreement is held invalid by a court of competent jurisdiction, the invalid portion shall be severed and the decision that it is invalid should not affect the validity of the remainder of this Agreement.

SUCCESSORS AND ASSIGNS

65. This Agreement will enure to the benefit of and be binding upon the parties and their respective successors and assigns.

HEADINGS

66. The headings appearing in this Agreement are inserted for convenience of reference only and will not affect the interpretation of this Agreement.

AS EVIDENCE OF THEIR AGREEMENT the parties have executed this Agreement as of the day and year first above written.

TBA dba TBA by its authorized
signatory

Name,

$$\begin{pmatrix}) \\) \\) \\) \\) \\) \end{pmatrix}$$

Witness

**SIGNED BY CENTRAL COAST
REGIONAL DISTRICT**

$$\begin{pmatrix}) \\) \\) \\) \\) \\) \\) \\) \\) \end{pmatrix}$$

Curtis Slingerland, CAO

Alsid Prime, Corporate Officer

APPENDIX “A” THORSEN CREEK SITE MAP;

APPENDIX “B” OPERATIONAL CERTIFICATE MR-422;

Operational Certificate
MR-4223

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

Central Coast Regional District

P.O. Box 186

Bella Coola BC V0T 1C0

is authorised to discharge refuse to land and air contaminants to air from municipal solid waste sources located near Bella Coola, British Columbia, subject to the conditions listed below. Contravention of any of these conditions is a violation of the *Environmental Management Act* and may result in prosecution.

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

1. AUTHORISED DISCHARGES

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

1.1.1. Rate of Discharge

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

1.1.2. Characteristics of the Discharge

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

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

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

1.1.3. Authorised Works

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

1.1.4. Location of the Point of Discharge

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

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

1.2.1. Rate of Discharge

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

1.2.2. Characteristics of the Discharge

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

1.2.3. Location of the Point of Discharge

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

2. GENERAL REQUIREMENTS

2.1. Maintenance of Works and Emergency Procedures

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

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

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

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

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

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

2.2. Process Modifications

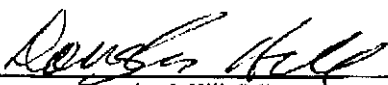
The Operational Certificate Holder shall have written approval from the Director prior to implementing changes to the authorised works that may result in discharges exceeding the characteristics authorised under this Operational Certificate.

2.3. Site Access

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

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2.4. Landfill Operation

- 2.4.1. The Operational Certificate Holder shall develop the landfill in a strip shaped cell pattern. The width of each strip cell shall not exceed 6 metres and the height shall not exceed 2 metres.
- 2.4.2. Refuse placed in the active putrescible waste cell shall be compacted at the end of each operating day. The top surface and the working face of the active putrescible waste cell shall be covered with a minimum of 15 cm of clean fill no less than once per week. Suitable alternatives to cover material on the surface of the working face may be used if approved by the Director
- 2.4.3. Final cover of the landfill surface shall be with a layer of compacted soil no less than 1 metre deep plus a minimum of 0.15 metres of topsoil with appropriate vegetation established. The final surface of the landfill shall be crowned to promote runoff of surface waters and to prevent ponding
- 2.4.4. Provision of surface water diversion works and site restoration as required, shall be carried out to the satisfaction of the Director.
- 2.4.5. Vegetation shall be removed from the surface of the entire site annually.

2.5. Litter Control

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

2.6. Segregation of Recyclable Materials

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

2.7. Electric Fencing

2.7.1. Bear Proof Containment of Putrescibles

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

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

2.7.2. Electric Fence Design, Construction and Maintenance

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

2.7.3. Period of Operation

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

2.7.4. Minimum Voltage

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

2.7.5. Gate Operation

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

2.7.6. Fence Inspections

The entire perimeter of the electric fencing shall be inspected at least once every seven days and the voltage of the fencing measured at several points along the fencing and at each gate using a proper electric fence voltmeter compatible with the brand of the fence charging unit. Any results less than the minimum 6,000 volts or any problems which affect operation of the fence shall be immediately investigated and corrected. In addition, the Director shall be notified as per section 2.1 in the event that the voltage is not maintained above 6,000 volts.

In cases of low voltage or signs of penetration attempts, inspections shall be increased from once per week to once per day until proper voltage is

3. MONITORING AND REPORTING REQUIREMENTS

3.1. Water Sampling and Analysis

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

3.2. Sampling Procedure

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

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

3.3. Analytical Procedures

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

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

3.4. Quality Assurance

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

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

3.5. Reporting

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

TABLE 1 - Monitoring Sites and Frequencies

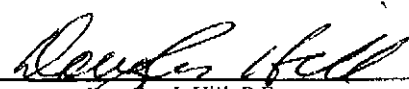
Site Code	Site Name	Water Quality Sample Frequency
E239642	Noohalk Creek upstream of highway 20	field parameters only: once in late winter all parameters: once in early summer
E245136	Noohalk Creek upstream of landfill	field parameters only: once in late winter all parameters: once in early summer

TABLE 2 - Water Quality Parameters

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

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APPENDIX “C” DESIGN OPERATIONS AND CLOSURE PLAN;

FINAL REPORT

THORSEN CREEK LANDFILL DESIGN, OPERATIONS AND CLOSURE PLAN

Presented to:

Central Coast Regional District

PO Box 186, 626 Cliff Street

Bella Coola, BC



Project No. 133800052

Date: November 15, 2024

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APPENDICES

APPENDIX A: 2022 Environmental Monitoring Summary Report

APPENDIX B: Fire Safety & Emergency Response Plan

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

1. INTRODUCTION

1.1 Background

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

1.2 Scope of Work

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

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

1.3 Regulatory Setting

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

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

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

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

2. SITE DESCRIPTION

2.1 Location and Historic Use

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

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

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

Commercial cardboard is burned at the TCWRC.

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

2.2 Access and Layout

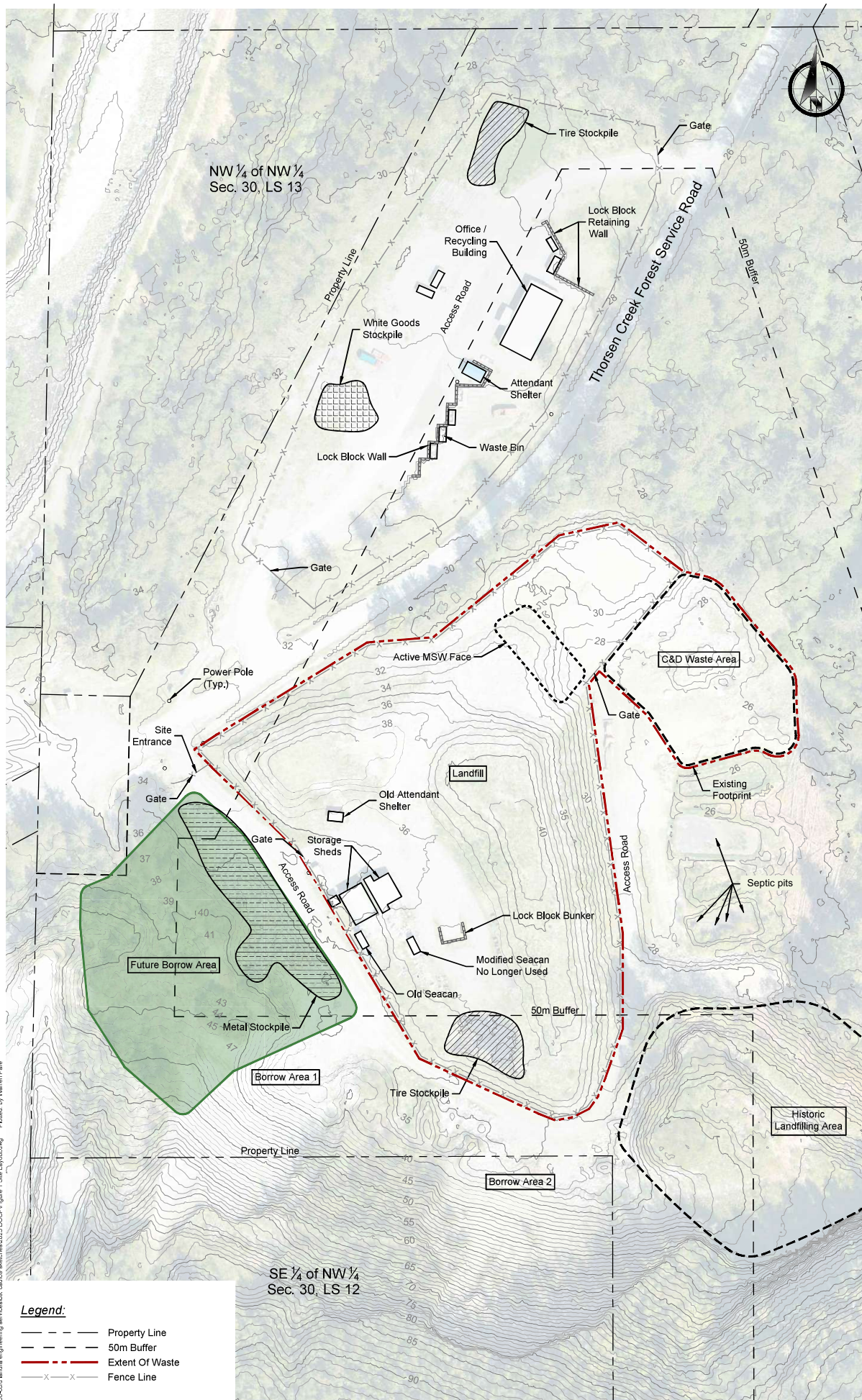
The Thorsen Creek Landfill is located at the end of Thorsen Creek Road, approximately 6 km east of Bella Coola. The current site layout and facility components are shown in Figure 1 (next page). There are two separate facilities at the TCWRC, a transfer station and a landfill. The transfer station and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

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

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

2.3 Service Population

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



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

2.4 Climate

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

2.5 Topography and Drainage

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

2.6 Surficial and Bedrock Geology

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

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

2.7 Geotechnical and Seismic Conditions

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

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

2.8 Hydrogeology and Conceptual Site Model

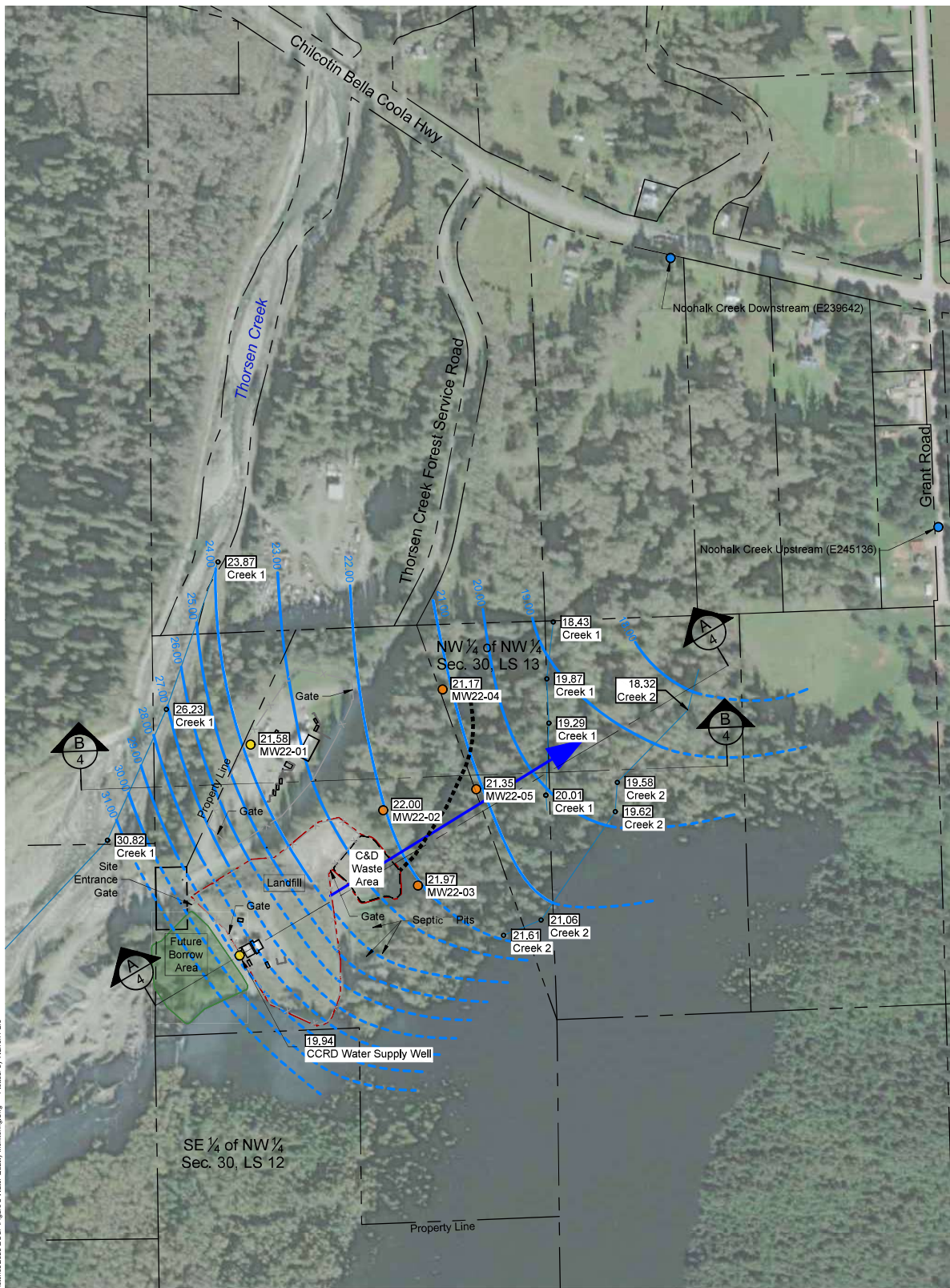
The hydrogeology of the site is a function of the character of the surficial sediments which underlie the landfill site, the sources of recharge and the location of groundwater discharge areas. The original hydrogeological assessment of the Thorsen Creek Landfill was completed by Piteau Associates in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

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

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

2.8.1 Groundwater Setting

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



Legend:

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

2.8.2 Geologic Structure

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

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

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

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

2.8.3 Hydraulic Conductivity

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

2.8.4 Groundwater Flow Direction

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

2.8.5 Groundwater Flux

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

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

The quantity of groundwater flow was calculated as shown below:

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

Where: K = hydraulic conductivity

i = hydraulic gradient

A = cross-sectional area of flow

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

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

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

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

2.8.6 Springs/Groundwater Discharge

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

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

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

2.8.7 Surface Hydrology

Surface water bodies located near the site include the following:

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

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

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

2.8.8 Water Quality and Background

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

2.8.9 Land and Water Use

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

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

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

Table 1: Project area groundwater well locations

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

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

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

Table 2: Project area surface water licence locations

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

3. GROUNDWATER AND SURFACE WATER IMPACT ASSESSMENT

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

3.1.1 Groundwater Quality

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

Table 3: Groundwater monitoring well properties

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

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

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

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

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

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

3.1.2 Surface Water Quality

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

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

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

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

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

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

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

4. WASTE DISPOSAL AND DIVERSION

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

The TCWRC facility includes the following:

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

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

4.1 Waste Disposal

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

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

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

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

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

4.2 Waste Diversion

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

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

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

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

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

5. LANDFILL DESIGN AND PHASING

5.1 Lifespan Analysis, Airspace Analysis and Cell Design

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

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

There is approximately 33.5 months between the two surveys taken. The volume between the two surveys was calculated to be 9,979 m³. Therefore, the annual airspace consumption is calculated to be 3,575 m³.

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

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

Table 4: Annual Volumetric Consumption at the Thorsen Creek Landfill

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

The compaction rate achieved at larger landfills using modern landfill compaction equipment is generally over 800 kg/m³. However, a compaction rate of 500 kg/m³ is considered realistic and on the conservative side when using the current equipment present at the Thorsen Creek Landfill for compaction of mixed MSW and C&D waste.

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

This cover soil volume was checked using the estimated cover soil use from the landfill operations contractor. Assuming one 20yd³ (15.3 m³) truck of cover soil is used per operational day (twice per week), this equates to approximately 1,600 m³ of cover soil used per year.

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

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

The landfill will be developed in phases, focusing on the north portion first, and moving clockwise to fill the landfill to equal heights. Table 5 below indicates the approximate available volumes of each phase and each of its estimated lifespan with an assumed annual volumetric consumption of 3,575 m³. There is an estimated 20 years of landfill lifespan remaining.

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

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

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

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

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

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

With the 3:1 waste to cover ratio, a calculation for the lifespan is shown in Table 7 below. Table 7 below shows the approximate available volumes of each phase and each of its estimated lifespan with an assumed annual volumetric consumption of the ideal rate at 2,364 m³. There is an estimated 30 years of landfill lifespan remaining.

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

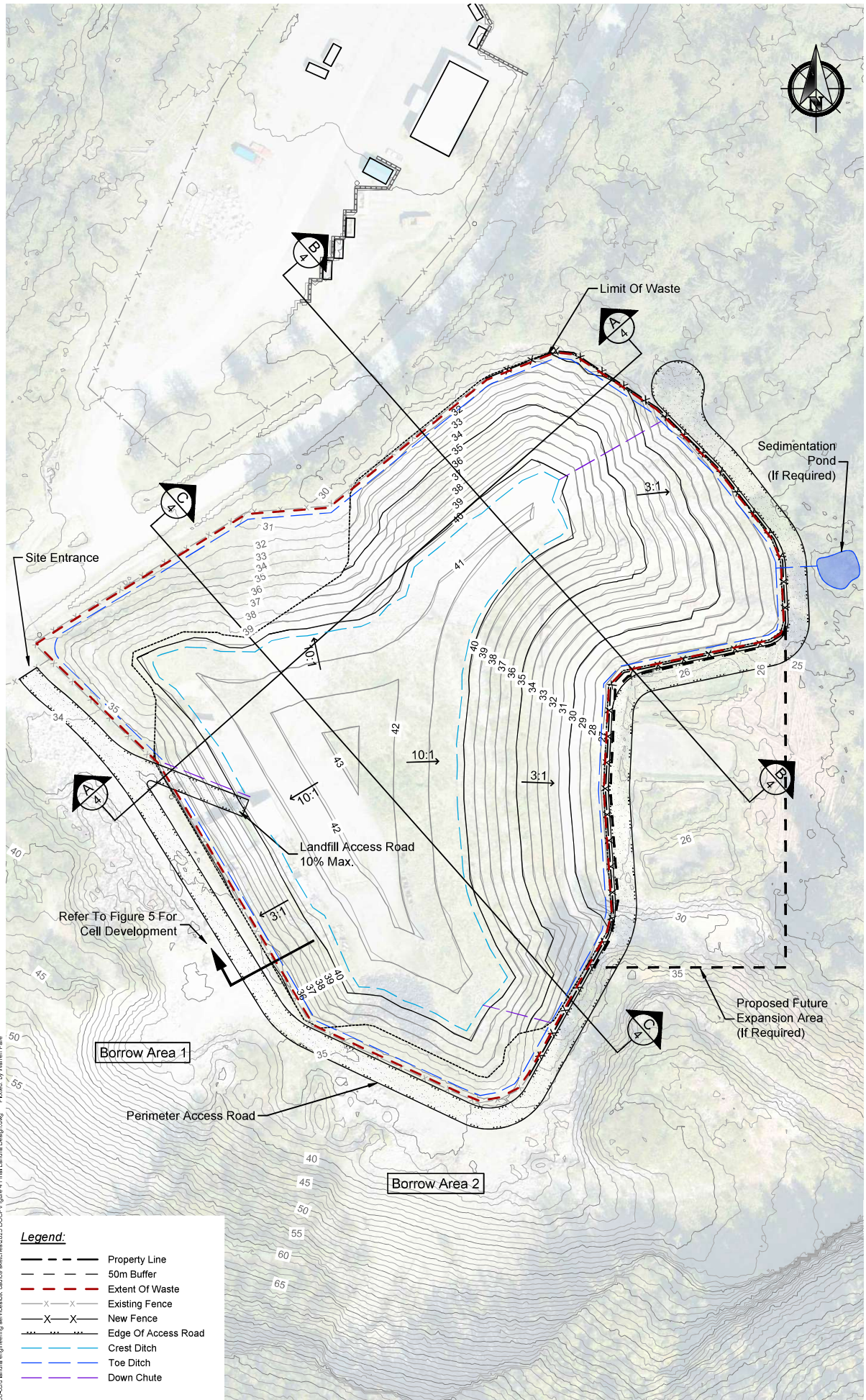
Phase	Fill Volume Available (m ³)	Lifespan (years)
Phase 1	18,000 m ³	7.6 years
Phase 2a	22,000 m ³	9.3 years

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

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

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

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



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5.2 Proposed Future Expansion Area

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

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

This expansion would provide approximately 70,000 m³ in additional space for future landfilling. The 70,000 m³ will give the landfill lifespan approximately 30 additional years at 2,364 m³ annual volumetric consumption for Scenario 2, the 3:1 waste to cover ratio.

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

5.3 Phased Fill Plan

The final contour landfill design is presented in Figure 4. It was developed based on the annual airspace consumption and the general design criteria presented in Section 5.1. The landfill is designed with a remaining capacity of approximately 72,500 m³ (based on September 2020 landfill surface). The highest proposed point of the landfill is a north-to-south ridge at a maximum elevation of 43 masl (top of waste).

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

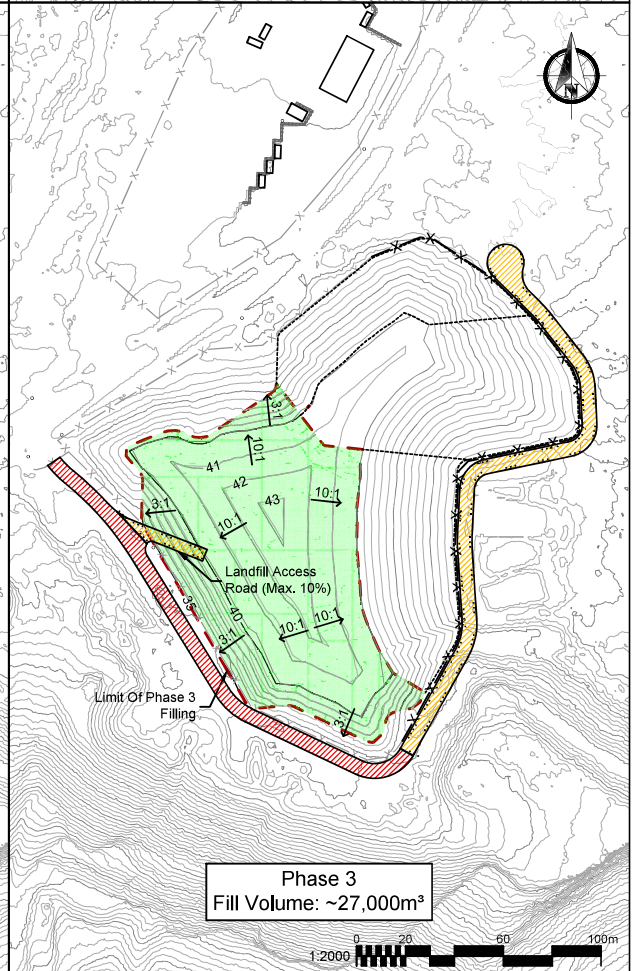
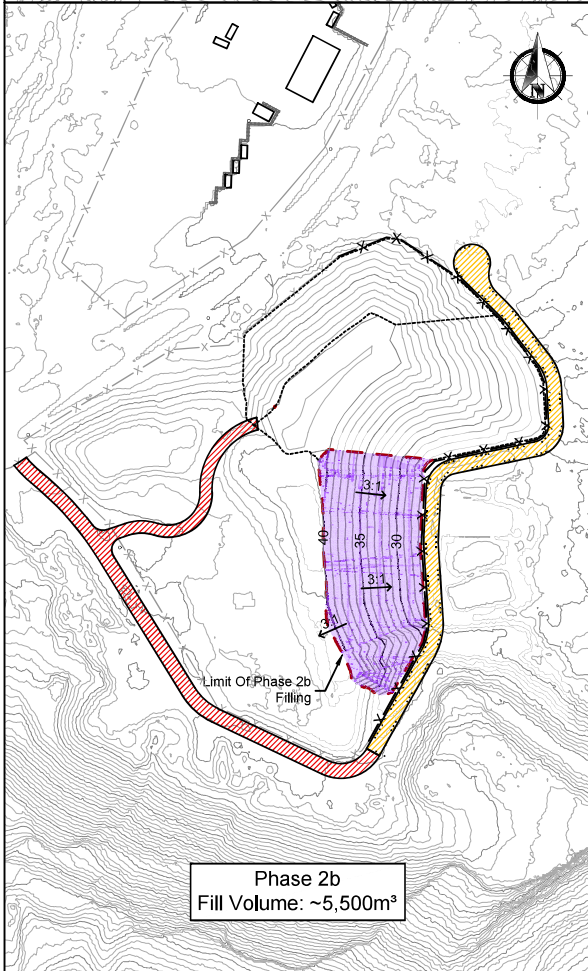
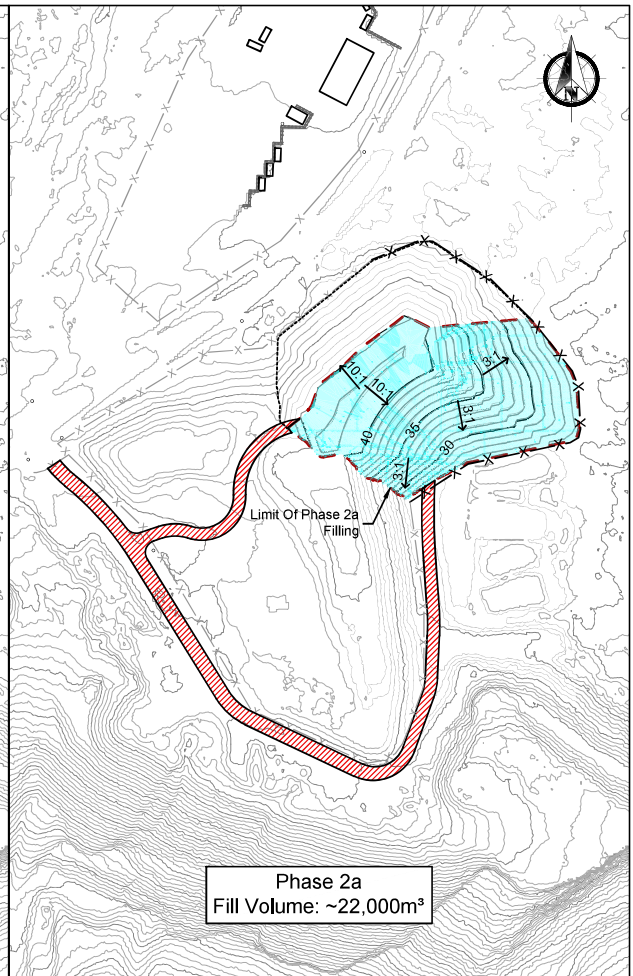
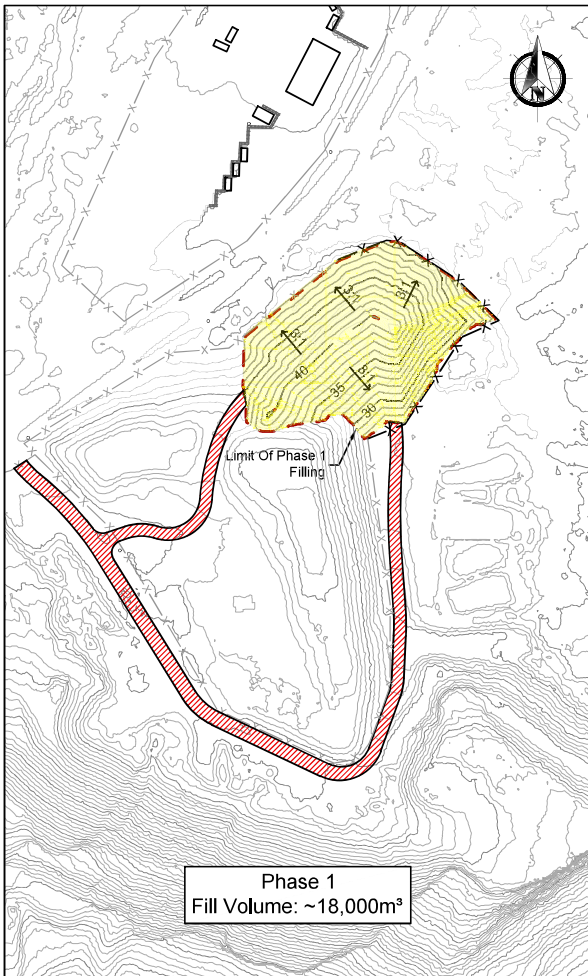
The proposed landfill phasing is shown in Figure 5. The landfill is divided into three major phases (phases 1, 2a-2b, and 3), with approximately 9, 11 and 11 years of capacity respectively (based on Scenario 2). Filling is generally proposed at the north end of the landfill (Phases 1 and 2a), moving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

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

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

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

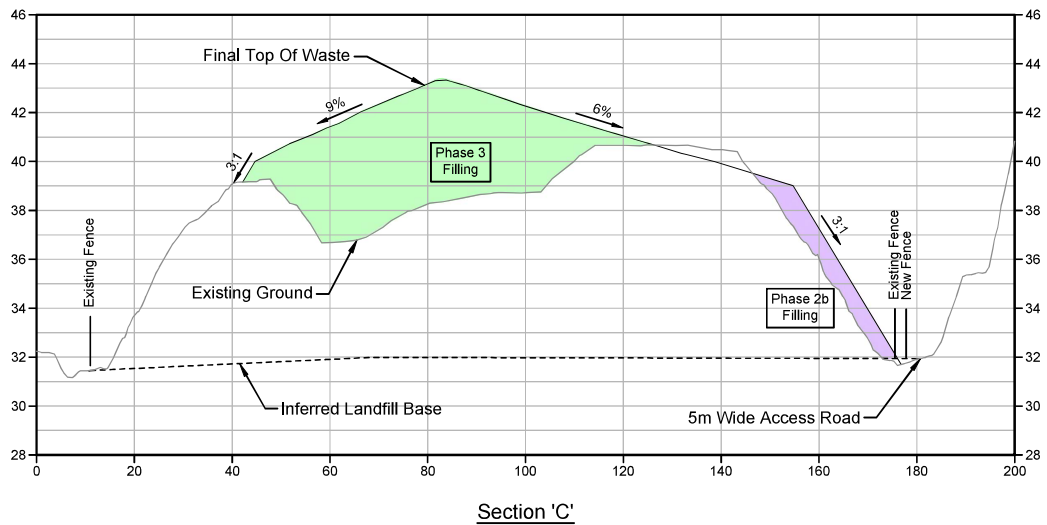
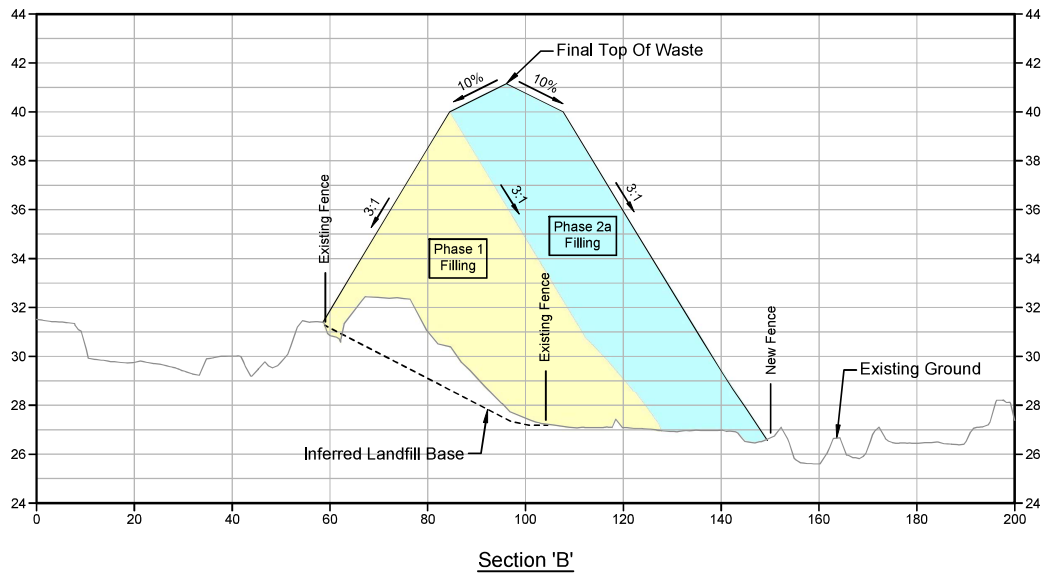
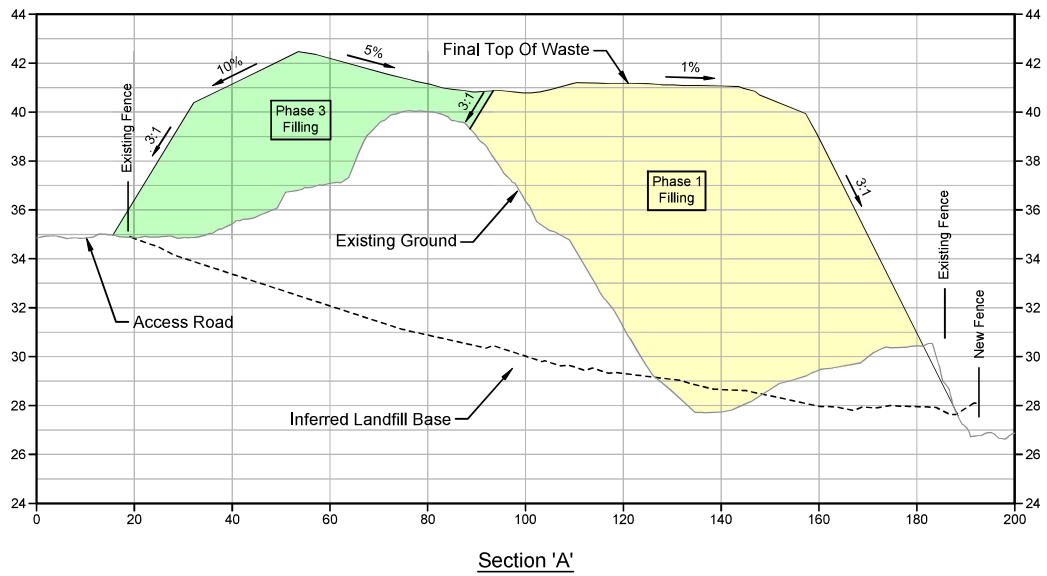
The Phase 3 fill area is generally within the area of the old public drop-off area and will be developed to match the final plateau of the landfill at a maximum proposed elevation of 43 m (top of waste). Prior to filling in Phase 3, the existing tire stockpile and equipment/material storage structures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



Legend:

- New Access Road
- Existing Access Road
- Existing Fence
- New Fence

CCRD Operations & Fill Plan
Figure 5 - Landfill Phasing



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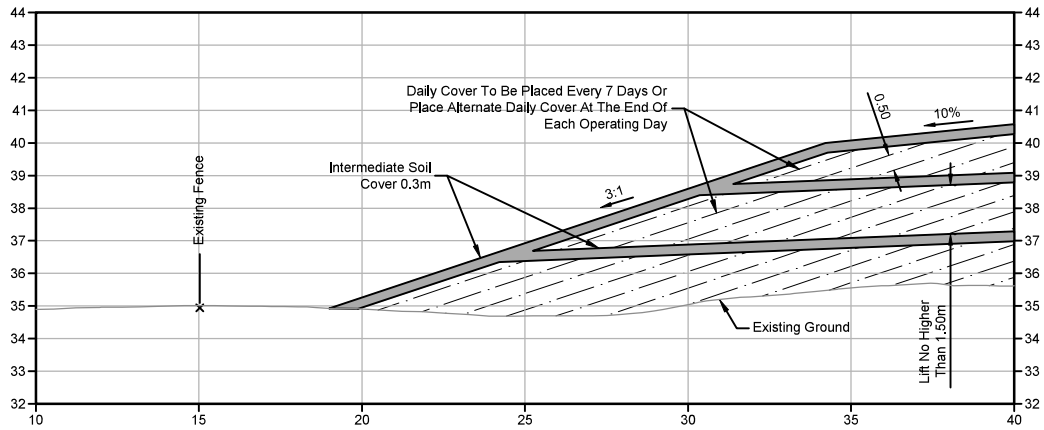
5.4 Detailed Fill Plan

For the purposes of this DOCP, the proposed detailed filling plan for the next 5 years was developed using the annual airspace consumption of 2,364 m³ (3:1 waste to cover ratio). The proposed cell development is shown in Figure 7 and the detailed fill plan is shown in Figure 8.

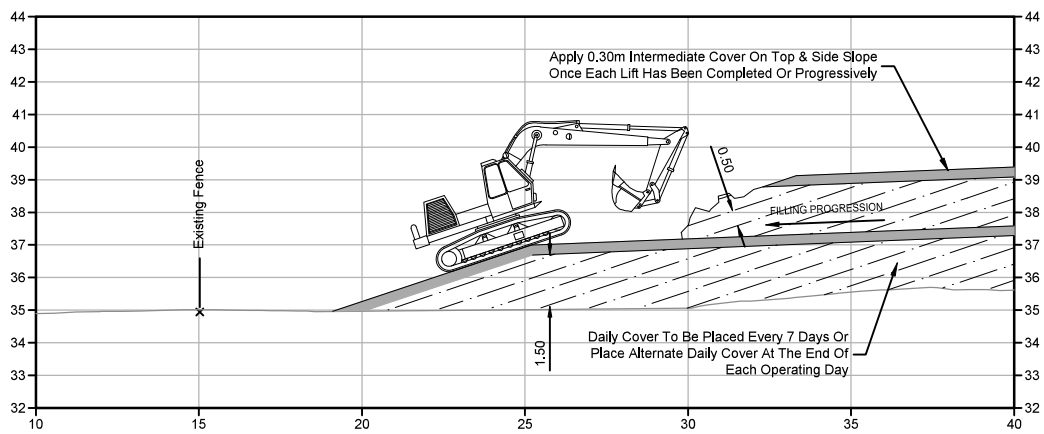
The first year is shown to be developed by piggybacking against the slope and previously filled areas up to elevation 30 masl. Access to this lift can be from the top (push-down) or bottom (push-up). In general, push-down landfilling is more efficient than push-up, but not always possible as filling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

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

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



Detail 1



Detail 2



x:\Proj\2021\1052940-coast landfill engineering services\05_cas\03_alethea\2023 DOOP\Figure 8 Detailed Fill Plan - Year 1-5.dwg Plotted by: Warren Paine

5.5 Materials Management Plan

As described in Section 5.1, the estimated volume of cover soil used per year is 1,800 m³, which equates to approximately 37,800 m³ over the life of the landfill. It is recommended that cover soil use be decreased and a target waste to cover ratio of 3:1 is achieved, at 600 m³ of cover soil needed per year, which equates to 18,000 m³ over the life of the landfill.

There are currently two areas where soil has been sourced from as shown in Figure 1. Borrow Area 2 is no longer being used as the slope has extended beyond the property line. Borrow Area 1 can be extended to the north and west. An analysis was completed to determine the approximate volume available in the area southwest of the landfill and 30,000 m³ are estimated to be available. It is understood that additional soil can be sourced if the CCRD chooses to excavate down in this area as well.

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

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

6. CLOSURE PLAN

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

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

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

6.1 Landfill Cover Elements

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

6.1.1 Vegetation and Surface Layer

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

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

6.1.2 Cushion/Subsoil Layer

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

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

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

6.1.3 Drainage Layer

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

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

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

6.1.4 Barrier Layer

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

The Landfill Criteria specifies the guidelines for the final cover system. The final cover must at a minimum consist of a 0.6 m thick low permeability soil cover with a hydraulic conductivity of 1×10^{-7} cm/s for landfill sites located in non-arid regions when compacted to 95% of Standard Proctor. Alternatively, a geomembrane liner can be used as a barrier layer.

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

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

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

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

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

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

6.1.5 Landfill Gas Collection/Venting Layer

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

6.1.6 Foundation Layer/Intermediate Cover

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

6.2 Recommended Final Cover System - Geomembrane

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

6.3 Progressive Closure

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

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

7. OPERATIONS PLAN

7.1 Hours of Operation, Staffing and Equipment

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

- 8:30 AM – 5:30 PM

The facility is closed for all Statutory Holidays.

The facility staffing generally includes the following:

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

7.2 Current Tipping Fees and Waste Acceptance

Household garbage contained in black garbage bags can be disposed free of charge. Construction and demolition debris, large items (mattresses, furniture, etc.), yard waste, metals and appliances are accepted at the TCWRC and subject to tipping fees. There is no scale at the Thorsen Creek Landfill and tipping fees are applied based on volume or quantity basis. The applied tipping fees are outlined in bylaw no. 523 titled "Solid Waste Disposal Rates and Charges" available on the CCRD website. Unbagged residential refuse, as well as commercial, institutional, or industrial refuse are charged at \$41 per m³. Clean wood waste and yard and garden waste are also charged at \$41 per m³, while construction and demolition waste and land clearing debris are charged at \$54 per m³. Additional tipping fees are specified in the bylaw no. 523.

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

7.3 Active Face Operating Procedures

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

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

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

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

7.4 Cover Placement

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

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

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

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

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

7.4.1 Geosynthetic Covers

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



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

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

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

7.4.2 Steel Plate Covers

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

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

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

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

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

7.5 Routine Inspections and Maintenance

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

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

7.6 Safety and Training Recommendations

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

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

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

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

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

8. ENVIRONMENTAL CONTROLS

8.1 Surface Water Management Plan

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

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

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

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

8.2 Landfill Gas Management Plan

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

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

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

8.3 Contaminating Lifespan

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

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

Based on the difference in contours from the inferred landfill base and the existing ground, the volume calculated was 72,000 m³. From Section 5.1, the waste to cover ratio currently is 1:1,

thus estimating the waste in the landfill to be 36,000 m³. With the compaction rate assumed at 500 kg/m³, the estimated tonnage is 18,000 tonnes.

Assuming that the landfill development follows the 3:1 waste to cover ratio (by volume) until the site is at maximum capacity (without expanding to the east side), the landfill will occupy an additional ~ 72,500 m³. Of this total volume, 54,400 m³ would be occupied by waste. With the compaction rate assumed at 500 kg/m³, the estimated tonnage is 27,200 tonnes.

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

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

9. ENVIRONMENTAL MONITORING PLAN

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

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

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

9.1 Monitoring Criteria

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

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

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

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

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

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

9.1.1 Indicator Parameters

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

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

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

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

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

9.2 Recommended Monitoring Program

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

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

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

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

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

10. FIRE SAFETY, EMERGENCY RESPONSE PLAN AND CONTINGENCY PLAN

10.1 Fire Safety Plan & Emergency Response Plan

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

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

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

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

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

- In the transfer station building
- In the staff vehicle

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

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

10.2 Contingency Plan

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

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

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

11. FINANCIAL SECURITY PLAN

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

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

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

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

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

11.1 Closure Costs

Activities that are considered in the closure costs include:

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

11.2 Post-Closure Costs

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

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

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

12. RECOMMENDATIONS

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

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

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

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

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

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

13. CLOSURE

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

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

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

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

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APPENDIX A: 2022 Environmental Monitoring Summary Report

Thorsen Creek Landfill

Environmental Monitoring Summary Report 2022

Presented to:

Ken McIlwain

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Report No. **210629400**

November 21, 2024

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APPENDICES

APPENDIX A: Geotechnical Drilling and Monitoring Well Installation Field Logs

APPENDIX B: Laboratory Analytical Results for Groundwater and Surface Water

1. INTRODUCTION

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

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

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

1.1 Program Objectives

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

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

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

1.2 Report Purpose

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

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

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

2. SITE DESCRIPTION

2.1 Location

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



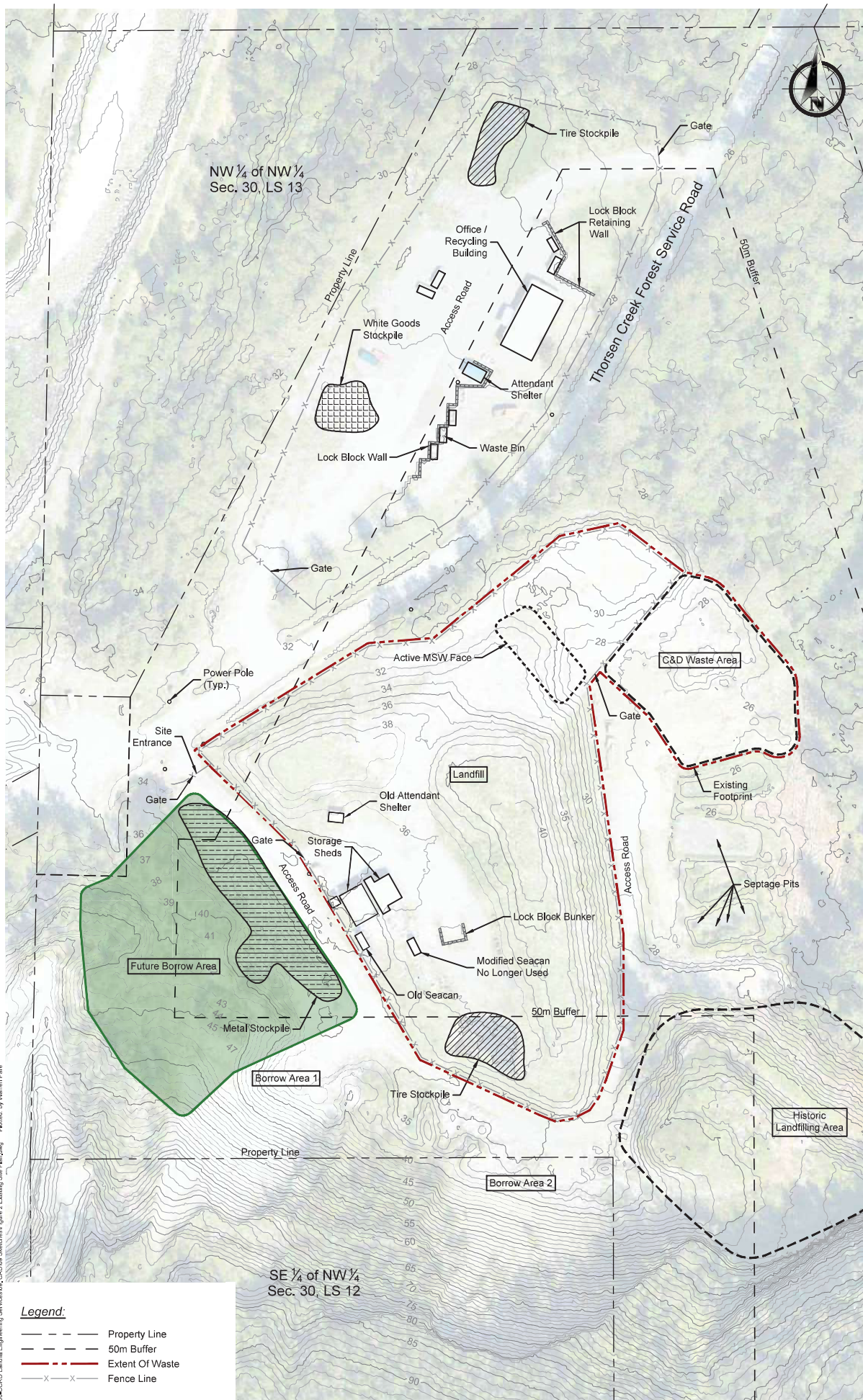
CCRD Operations & Fill Plan
Figure 1 - Location Plan

2.2 Landfill

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

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

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



X:\Proj\2021\12102940\CCRD Landfill Engineering Services\05_CAD\08 Sketches\Figure 2 Existing Site Plan.dwg Plotted by Warren Pate

- Legend:**
- Property Line
 - ... 50m Buffer
 - Extent Of Waste
 - x-x- Fence Line

2.3 Hydrological Conditions

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

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

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

2.4 Geological Conditions

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

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

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

2.5 Hydrogeological Conditions

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

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

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

2.6 Climate

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

2.7 Potential Receptors

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

Surface water bodies located near the site include the following:

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

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

Groundwater wells located near the site include the following:

Table 1: Project area groundwater well locations

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

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

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

Table 2: Project area surface water licence locations

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

3. MONITORING REQUIREMENTS

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

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

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

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

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

Table 3: Monitoring Program Summary for Groundwater and Surface Water

Monitoring Program	Sampling Locations	Sampling Parameters
Groundwater	MW22-01 MW22-02 MW22-03 MW22-04 MW22-05	<u>Field Measurements:</u> pH, conductivity, temperature, water elevation <u>Laboratory Analysis:</u> pH, conductivity, specific conductance, total suspended solids (TSS), total dissolved solids (TDS), total alkalinity (as CaCO ₃), bromide, chloride, fluoride, sulphate, hardness, biochemical oxygen demand (BOD), chemical oxygen demand (COD), ammonia, nitrate + nitrite, nitrate, nitrite, orthophosphate, and dissolved metals.
Surface Water	Noohalk Creek upstream of Landfill (E245136 or Noohalk Creek Upstream) Noohalk Creek upstream of Highway 20 (E239642 or Noohalk Creek Downstream)	<u>Field Measurements:</u> pH, conductivity, temperature, water elevation <u>Laboratory Analysis:</u> pH, conductivity, specific conductance, total suspended solids (TSS), total dissolved solids (TDS), total alkalinity (as CaCO ₃), bromide, chloride, fluoride, sulphate, hardness, biochemical oxygen demand (BOD), chemical oxygen demand (COD), ammonia, nitrate + nitrite, nitrate, nitrite, orthophosphate, and total metals.

3.1 Applicable Standards & Guidelines

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

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

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

3.1.1 Groundwater

The BC CSR water use categories include the following:

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

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

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

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

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

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

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

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

3.1.2 Surface Water

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

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

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

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

4. METHODOLOGY

4.1 Overview of Drilling, Monitoring Well Installation & Well Development

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

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

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

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

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

4.1.1 Geodetic Survey

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

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

- Topographic survey of the landfill area.

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

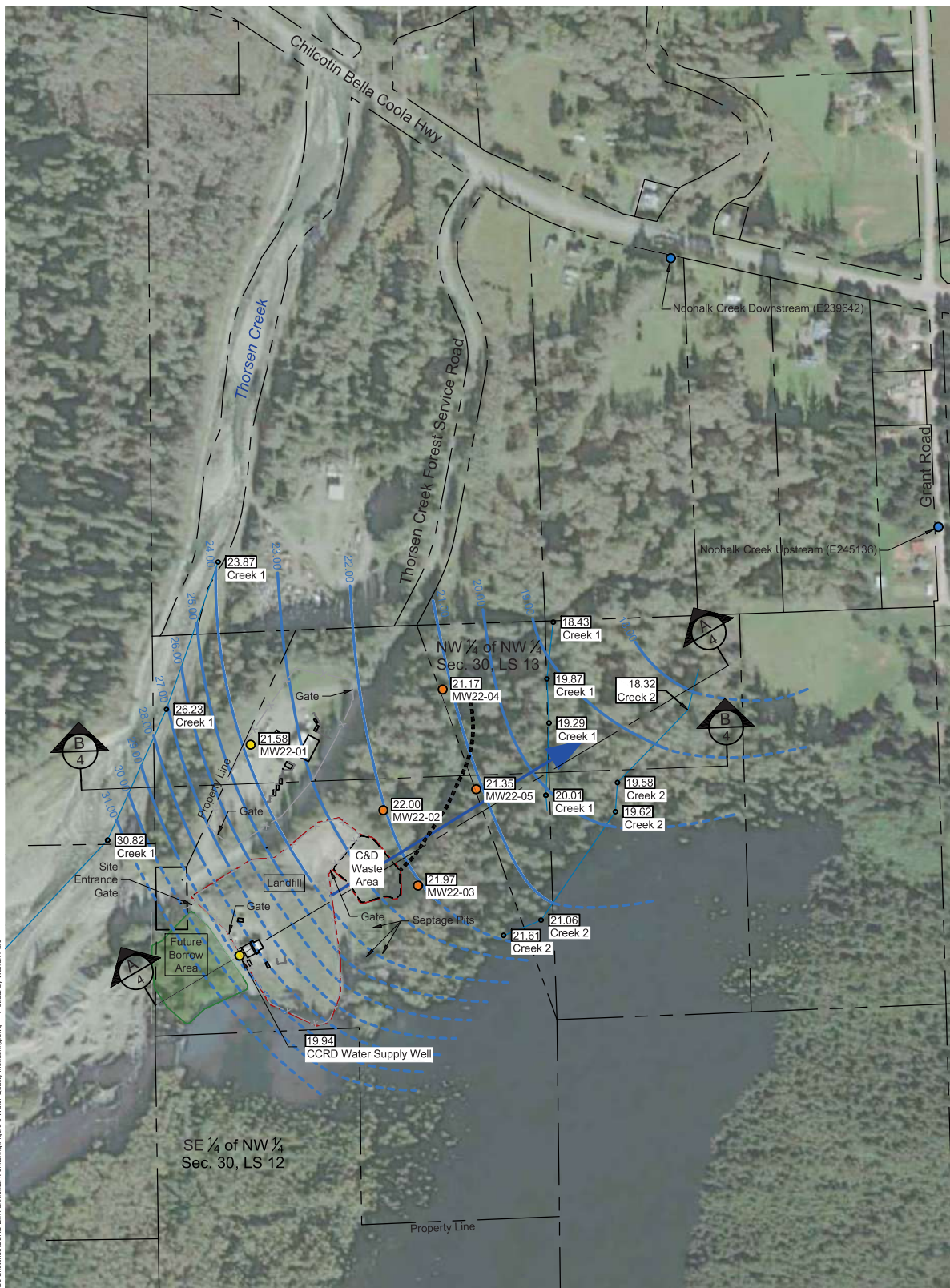
4.2 Overview of Water Sampling Locations & Schedule

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

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

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

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



X:\Proj\2021\12\0629400-CCRD Environmental Monitoring\Figure 3 Water Quality Monitoring.dwg Plotted by Warren Pare

4.2.1 Groundwater Monitoring

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

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

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

Table 4: Groundwater Well Installation Locations

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

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

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

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

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

4.2.2 Surface Water Monitoring

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

Table 5: Surface Water Sampling Locations

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

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

4.3 Quality Assurance and Quality Control (QA/QC)

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

5. RESULTS AND DISCUSSION

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

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

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

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

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

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

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

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

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

5.1 Monitoring Well Installation

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

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

Table 6: Well completion details

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

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

¹ Units of mbgs refer to “meters below ground surface”.

² Units of masl refer to “meters above sea level”

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

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

5.2 Groundwater

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

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

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

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

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

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

5.2.1 Discussion

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

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

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

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

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

No detectable hydrocarbons were identified in any groundwater samples.

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

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

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

5.3 Surface Water

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

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

Table 7: Surface water quality historical comparison

Parameter	Units	Noohalk Creek Upstream of Landfill (E245136)		Noohalk Creek Downstream of Landfill (E239642)	
		Dec. 18, 2013	Oct. 31, 2022	Dec. 18, 2013	Oct. 31, 2022
Field Parameters					
Temperature	°C	6.1	6.1	6.1	5.8
pH	N/A	7.1	5.8	6.7	6.3
Conductivity	uS/cm	36.4	36.2	47.4	18.4
Laboratory Parameters					
Hardness	mg/L	11.6	10.9	15.1	12.6
Total Alkalinity (CaCO ₃)	mg/L	7.51	5.6	10.9	7.0
Sulphate	mg/L	3.89	2.29	4.01	2.91
Chloride	mg/L	0.91	<0.50	2.4	1.22
Nitrate	mg/L	0.530	0.740	0.474	0.763
Nitrite	mg/L	<0.0050	<0.0010	<0.0050	0.0010
Nitrate + Nitrite	mg/L	0.530	0.740	0.474	0.764
Orthophosphate	mg/L	<0.0050	<0.0010	<0.0050	0.0012

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

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

BC Ambient Water Quality Guidelines

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

5.3.1 Discussion

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

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

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

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

5.4 Quality Assurance and Quality Control (QA/QC)

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

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

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

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

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

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

6. CONCLUSIONS AND RECOMMENDATIONS

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

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

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

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

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

7. DISCLAIMER

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

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

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8. CLOSURE

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

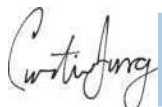
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**TABLE 8: 2022 GROUNDWATER QUALITY - GENERAL CHEMISTRY AND
DISSOLVED METALS**

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

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

DISOLVED METALS					MW22-01	MW22-02	MW22-03	MW22-04	MW22-05
Analyte	Units	LOR	Sch. 3.2 Water FAW*	Sch. 3.2 Water DW**	2-Nov-22	2-Nov-22	2-Nov-22	2-Nov-22	2-Nov-22
Nickel (Ni)-Dissolved	mg/L	0.00050	H based 0.25 @ H < 60 0.65 @ H 60 - <120 1.1 @ H 120 - < 180 1.5 @ H >= 180	0.08	<0.00050	0.00059	0.00107	<0.00050	0.00189
Phosphorus (P)-Dissolved	mg/L	0.050	-	-	<0.050	<0.050	<0.050	<0.050	<0.050
Potassium (K)-Dissolved	mg/L	0.050	-	-	0.817	5.41	3.59	1.21	4.19
Rubidium (Rb)-Dissolved	mg/L	0.00020	-	-	0.00088	0.00559	0.00443	0.00107	0.00630
Selenium (Se)-Dissolved	mg/L	0.000050	0.02	0.01	0.000060	0.000070	0.000151	0.000138	0.000096
Silicon (Si)-Dissolved	mg/L	0.050	-	-	2.92	3.43	4.44	3.38	3.40
Silver (Ag)-Dissolved	mg/L	0.000010	H based 0.0005 @ H <= 100 0.015 @ H > 100	0.02	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)-Dissolved	mg/L	0.050	-	200	0.801	5.82	7.47	7.35	13.9
Strontium (Sr)-Dissolved	mg/L	0.00020	-	2.5	0.0221	0.0905	0.0682	0.0600	0.0942
Sulfur (S)-Dissolved	mg/L	0.50	-	-	1.45	3.84	2.40	2.52	13.7
Tellurium (Te)-Dissolved	mg/L	0.00020	-	-	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Thallium (Tl)-Dissolved	mg/L	0.000010	0.003	-	<0.000010	0.000042	0.000041	<0.000010	0.000605
Thorium (Th)-Dissolved	mg/L	0.00010	-	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Tin (Sn)-Dissolved	mg/L	0.00010	-	2.5	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)-Dissolved	mg/L	0.00030	1	-	<0.00030	0.00043	<0.00030	<0.00090	0.00837
Tungsten (W)-Dissolved	mg/L	0.00010	-	0.003	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Uranium (U)-Dissolved	mg/L	0.000010	0.085	0.02	<0.000010	0.000277	0.000096	0.000175	0.000134
Vanadium (V)-Dissolved	mg/L	0.00050	-	0.02	<0.00050	0.00368	<0.00050	<0.00050	0.00240
Zinc (Zn)-Dissolved	mg/L	0.0010	H based 0.075 @ H <90 0.15 @ H 90 - <100 0.9 @ H 100 - <200 1.65 @ H 200 - <300 2.4 @ H 300 - <400	3	0.0011	0.0012	<0.0010	<0.0010	0.0033
Zirconium (Zr)-Dissolved	mg/L	0.000020	-	-	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020

*Standard: British Columbia Contaminated Sites Regulation (July, 2021) - Schedule 3.2 Water Standards Freshwater Aquatic Life
 **Standard: British Columbia Contaminated Sites Regulation (July, 2021) - Schedule 3.2 Water Standards Drinking Water
 ***Guideline: British Columbia Approved and Working Water Quality Guidelines (August, 2019) - BCAPPWWG - Freshwater Aquatic Life
 Color Key: Exceeds CSR Standard - FAW Exceeds CSR Standard - DW

TABLE 9: 2022 GROUNDWATER QUALITY - PETROLEUM HYDROCARBONS

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

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

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

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

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

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

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

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

**TABLE 11: 2022 SURFACE WATER QUALITY - PETROLEUM
HYDROCARBONS**

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

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

APPENDIX A: Geotechnical Drilling and Monitoring Well Installation Field Logs

GEO-ENVIRONMENTAL FIELD BOREHOLE LOG

Project Number:		Project Site: CCRD Bella Coola LF		Borehole No.: MW22-01				
Start Date & Time: Nov 2/22 1400		Completion Date & Time:		Weather: Clear / Sunny				
Drilling Contractor: Crestech Drilling		Drill Rig Type: ODEX Track "Fraser"		Total Depth:				
Borehole Location: N 3E				Gas Meter:				
Depth (m or ft)	Graphic Log	Soil Description (Refer to Guide)	Sample Type	Sample Number	Recovery	Soil Vapour Reading		Monitoring Well
						CGI (ppm or LEL)	PID (ppm)	
		- 0.5' organics / topsoil layer						
4'		Coarse ^{medium} sand + gravel with some organics (roots), moist, gray						No meq this alt
9'		Rock/boulder @ ~6'						
		Boulder @ ~8'						
		Coarse-medium sand + gravel, moist, gray						
		Water @ 11'						
14'		Well graded sand w/ some gravel + trace silt. gray, moist						
19'		- Boulder/rock @ ~16'						
		- 18'						
		- 21'						
24'		End of Borehole @ 24'						
		- Casing getting stuck due to rocks.						

GEO-ENVIRONMENTAL FIELD BOREHOLE LOG

Project Number:	Project Site:	Borehole No.: MW22-01
Start Date & Time: Nov. 2/22-11:15	Completion Date & Time:	Weather: Clear
Drilling Contractor: Geotech	Drill Rig Type: 202X Trach	Total Depth:
Borehole Location: N, E		Gas Meter:

[illegible]

GEO-ENVIRONMENTAL FIELD BOREHOLE LOG

Project Number:	Project Site: <u>ICRD Bella Costa LT</u>	Borehole No.: <u>4W22-02</u>
Start Date & Time: <u>Nov. 1 / 2022 - 15:30</u>	Completion Date & Time: <u>Nov. 1/22 - 17:15</u>	Weather: <u>Clear / Sunny</u>
Drilling Contractor: <u>Geotech</u>	Drill Rig Type: <u>ODEX Track-Mounted</u>	Total Depth:
Borehole Location: N _____, E _____		Gas Meter:

Depth (m or ft)	Graphic Log	Soil Description (Refer to Guide)	Sample Type	Sample Number	Recovery	Soil Vapour Reading		Monitoring Well Stick up (~1m) w/ well protectors
						CGI (ppm or LEL)	PID (ppm)	
0'		Coarse-medium grained sand w/ some gravel Moist, grey						
4'		Boulder @ 3-4'						
8'		Well graded sand/medium/coarse grain w/ cobbles, moist, grey - Boulder @ 6-7'						
12'		- Water @ 9' (driller observation)						
16'		Medium-coarse sand w/ cobbles, moist, grey						
20'		Coarse sand and gravel, moist, grey.						
24'		Medium/coarse sand w/ some gravel wet, grey - Water @ 20-21' (very wet water discharge).						
28'		End of borehole @ 25'						

GEO-ENVIRONMENTAL FIELD BOREHOLE LOG

Project Number:	Project Site:	Borehole No.:
Start Date & Time:	Completion Date & Time:	Weather:
Drilling Contractor:	Drill Rig Type:	Total Depth:
Borehole Location: N	E	Gas Meter:

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

Technician: CS

Borehole Log: Sheet 1 of 1



GEO-ENVIRONMENTAL FIELD BOREHOLE LOG

Project Number: _____	Project Site: <u>CCRD Balla Coola LF</u>	Borehole No.: <u>MW22-04</u>
Start Date & Time: <u>Nov. 1 / 2022 - 13:00</u>	Completion Date & Time: <u>14:30</u>	Weather: <u>Partly cloudy / overcast</u>
Drilling Contractor: <u>Crestech Drilling</u>	Drill Rig Type: <u>OD EX Track</u>	Total Depth: _____
Borehole Location: <u>N</u> , <u>E</u>		Gas Meter: _____

Depth (m or ft)	Graphic Log	Soil Description (Refer to Guide)	Sample Type	Sample Number	Recovery	Soil Vapour Reading		Monitoring Well
						CGI (ppm or LEL)	PID (ppm)	
		Coarse - Sand and cobbles, moist, grey				Pentair chips to surface		stick up (1m w/ well protect)

Technician: CS/ER

Borehole Log: Sheet 1 of 1

mh

GEO-ENVIRONMENTAL FIELD BOREHOLE LOG

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

Depth (m or ft)	Graphic Log	Soil Description (Refer to Guide)	Sample Type	Sample Number	Recovery	Soil Vapour Reading		Monitoring Well
						CGI (ppm or LEL)	PID (ppm)	
		Organic topsoil / soil at surface.						n/a sticking from steel protector
+1.5						Rentrite		
-6ft wet		Coarse sand, moist / semi dry, grey. - More wet near bottom. (wet around 6ft)				CH ₁₀₅ (3/8") to surface		
-3'								
		Coarse sand, moist, grey.				sand to 12"		
-4'±								
		Coarse sand, wet, gray.						5ft screen
-4.9m								
		Fine sand, trace silt, wet, most gray						End of borehole
-7.5								19
-9.0								

APPENDIX B: Laboratory Analytical Results for Groundwater and Surface Water

CERTIFICATE OF ANALYSIS

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

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

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Surrogate Control Limits

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

Signatories

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

<i>Signatories</i>	<i>Position</i>
Alex Thornton	Analyst
Angelo Salandanan	Lab Assistant
Caitlin Macey	Team Leader - Inorganics
Cindy Tang	Team Leader - Inorganics
Cynthia Bauer	Organic Supervisor
Hamideh Moradi	Analyst
Jeanie Mark	Laboratory Analyst
Kim Jensen	Department Manager - Metals
Lindsay Gung	Supervisor - Water Chemistry
Maqsood Ul-Hassan	Laboratory Analyst
Miles Gropen	Department Manager - Inorganics
Owen Cheng	
Sorina Motea	Laboratory Analyst

Laboratory Department

Metals, Burnaby, British Columbia
 Metals, Burnaby, British Columbia
 Inorganics, Burnaby, British Columbia
 Inorganics, Burnaby, British Columbia
 Organics, Calgary, Alberta
 Metals, Burnaby, British Columbia
 Organics, Calgary, Alberta
 Metals, Burnaby, British Columbia
 Inorganics, Burnaby, British Columbia
 Organics, Calgary, Alberta
 Inorganics, Burnaby, British Columbia
 Metals, Burnaby, British Columbia
 Organics, Calgary, Alberta



Page : 3 of 15
Work Order : VA22C6784 Amendment 1
Client : Morrison Hershfield Limited
Project : 210629400

General Comments

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

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

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

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

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

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

<: less than.

>: greater than.

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

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

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

Workorder Comments

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

Qualifiers

Qualifier	Description
DLCI	Detection Limit Raised: Chromatographic interference due to co-elution.
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
HTD	Hold time exceeded for re-analysis or dilution, but initial testing was conducted within hold time.
RRV	Reported result verified by repeat analysis.



Analytical Results

Sub-Matrix: Water		Client sample ID					MW22-01	MW22-02	MW22-03	MW22-04	MW22-05
(Matrix: Water)		Client sampling date / time					02-Nov-2022 18:00	02-Nov-2022 17:00	02-Nov-2022 17:30	02-Nov-2022 15:30	02-Nov-2022 15:15
Analyte	CAS Number	Method	LOR	Unit	VA22C6784-001	VA22C6784-002	VA22C6784-003	VA22C6784-004	VA22C6784-005		
Physical Tests											
conductivity	----	E100	2.0	µS/cm	31.5	207	173	169	257		
hardness (as CaCO3), dissolved	----	EC100	0.60	mg/L	11.2	74.1	61.8	41.7	72.3		
pH	----	E108	0.10	pH units	6.93	7.34	7.29	7.54	7.37		
solids, total dissolved [TDS]	----	E162	10	mg/L	29	114	111	120	148		
solids, total suspended [TSS]	----	E160	3.0	mg/L	<3.0	181	104	1120	179		
alkalinity, total (as CaCO3)	----	E290	2.0	mg/L	7.6	90.4	60.4	82.8	77.1		
Anions and Nutrients											
ammonia, total (as N)	7664-41-7	E298	0.0050	mg/L	<0.0050	3.69	1.80	0.0216	3.65		
bromide	24959-67-9	E235.Br-L	0.050	mg/L	<0.050	<0.050	<0.050	<0.050	<0.050		
chloride	16887-00-6	E235.Cl	0.50	mg/L	<0.50	0.99	8.44	1.23	4.09		
fluoride	16984-48-8	E235.F	0.020	mg/L	<0.040 ^{DLCL}	0.096	0.063	0.067	<0.060 ^{DLCL}		
nitrate (as N)	14797-55-8	E235.NO3-L	0.0050	mg/L	0.268	0.0050	0.822	0.210	<0.0050		
nitrate + nitrite (as N)	----	EC235.N+N	0.0050	mg/L	0.268	0.0076	0.826	0.210	<0.0051		
nitrite (as N)	14797-65-0	E235.NO2-L	0.0010	mg/L	<0.0010	0.0026	0.0044	<0.0010	<0.0010		
phosphate, ortho-, dissolved (as P)	14265-44-2	E378-U	0.0010	mg/L	<0.0010	0.0014	0.0022	0.0020	<0.0010		
sulfate (as SO4)	14808-79-8	E235.SO4	0.30	mg/L	4.73	9.93	6.50	8.60	39.1		
Organic / Inorganic Carbon											
carbon, total organic [TOC]	----	E355-L	0.50	mg/L	<0.50	13.8	8.95	44.8	27.6		
Dissolved Metals											
aluminum, dissolved	7429-90-5	E421	0.0010	mg/L	0.0022	0.0389	0.0204	0.0314	0.257		
antimony, dissolved	7440-36-0	E421	0.00010	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010		
arsenic, dissolved	7440-38-2	E421	0.00010	mg/L	<0.00010	0.00137	0.00012	<0.00010	0.00050		
barium, dissolved	7440-39-3	E421	0.00010	mg/L	0.00568	0.0638	0.0564	0.0298	0.0878		
beryllium, dissolved	7440-41-7	E421	0.000100	mg/L	<0.000100	<0.000100	<0.000100	<0.000100	<0.000100		
bismuth, dissolved	7440-69-9	E421	0.000050	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050		
boron, dissolved	7440-42-8	E421	0.010	mg/L	<0.010	0.163	0.055	<0.010	0.272		
cadmium, dissolved	7440-43-9	E421	0.0000050	mg/L	<0.0000050	0.0000154	0.0000194	0.0000138	0.0000206		
calcium, dissolved	7440-70-2	E421	0.050	mg/L	3.98	25.7	20.8	15.1	24.1		
cesium, dissolved	7440-46-2	E421	0.000010	mg/L	<0.000010	0.000035	0.000032	<0.000010	0.000080		



Analytical Results

Sub-Matrix: Water

(Matrix: Water)

Sub-Matrix: Water (Matrix: Water)		Client sample ID							
		Client sampling date / time							
Analyte	CAS Number	Method	LOR	Unit	MW22-01	MW22-02	MW22-03	MW22-04	MW22-05
					Result	Result	Result	Result	Result
Dissolved Metals									
chromium, dissolved	7440-47-3	E421	0.00050	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	0.00085
cobalt, dissolved	7440-48-4	E421	0.00010	mg/L	<0.00010	0.00052	0.00067	0.00020	0.00455
copper, dissolved	7440-50-8	E421	0.00020	mg/L	0.00257	0.00144	0.00221	0.00045	0.00192
iron, dissolved	7439-89-6	E421	0.010	mg/L	<0.010	0.037	0.012	0.053	4.01
lead, dissolved	7439-92-1	E421	0.000050	mg/L	0.000064	<0.000050	<0.000050	<0.000050	<0.000050
lithium, dissolved	7439-93-2	E421	0.0010	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
magnesium, dissolved	7439-95-4	E421	0.0050	mg/L	0.303	2.41	2.40	0.980	2.94
manganese, dissolved	7439-96-5	E421	0.00010	mg/L	0.00102	0.221	0.147	0.0438	0.547
mercury, dissolved	7439-97-6	E509	0.00000050	mg/L	<0.00000050	<0.00000050	<0.00000050	<0.00000050	<0.00000050
molybdenum, dissolved	7439-98-7	E421	0.000050	mg/L	0.00110	0.00402	0.00120	0.000807	0.00142
nickel, dissolved	7440-02-0	E421	0.00050	mg/L	<0.00050	0.00059	0.00107	<0.00050	0.00189
phosphorus, dissolved	7723-14-0	E421	0.050	mg/L	<0.050	<0.050	<0.050	<0.050	<0.050
potassium, dissolved	7440-09-7	E421	0.050	mg/L	0.817	5.41	3.59	1.21	4.19
rubidium, dissolved	7440-17-7	E421	0.00020	mg/L	0.00088	0.00559	0.00443	0.00107	0.00830
selenium, dissolved	7782-49-2	E421	0.000050	mg/L	0.000060	0.000070	0.000151	0.000138	0.000096
silicon, dissolved	7440-21-3	E421	0.050	mg/L	2.92	3.43	4.44	3.38	3.40
silver, dissolved	7440-22-4	E421	0.000010	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
sodium, dissolved	7440-23-5	E421	0.050	mg/L	0.801	5.82	7.47	7.35	13.9
strontium, dissolved	7440-24-6	E421	0.00020	mg/L	0.0221	0.0905	0.0682	0.0600	0.0942
sulfur, dissolved	7704-34-9	E421	0.50	mg/L	1.45	3.84	2.40	2.52	13.7
tellurium, dissolved	13494-80-9	E421	0.00020	mg/L	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
thallium, dissolved	7440-28-0	E421	0.000010	mg/L	<0.000010	0.000042	0.000041	<0.000010	0.000065
thorium, dissolved	7440-29-1	E421	0.00010	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
tin, dissolved	7440-31-5	E421	0.00010	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
titanium, dissolved	7440-32-6	E421	0.00030	mg/L	<0.00030	0.00043	<0.00030	<0.00090 ^{DLM}	0.00837
tungsten, dissolved	7440-33-7	E421	0.00010	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
uranium, dissolved	7440-61-1	E421	0.000010	mg/L	<0.000010	0.000277	0.000096	0.000175	0.000134
vanadium, dissolved	7440-62-2	E421	0.00050	mg/L	<0.00050	0.00368	<0.00050	<0.00050	0.00240
zinc, dissolved	7440-66-6	E421	0.0010	mg/L	0.0011	0.0012	<0.0010	<0.0010	0.0033
zirconium, dissolved	7440-67-7	E421	0.00020	mg/L	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020



Analytical Results

Sub-Matrix: Water
(Matrix: Water)

Client sample ID				MW22-01	MW22-02	MW22-03	MW22-04	MW22-05
Client sampling date / time				02-Nov-2022 18:00	02-Nov-2022 17:00	02-Nov-2022 17:30	02-Nov-2022 15:30	02-Nov-2022 15:15
Analyte	CAS Number	Method	LOR	Unit	VA22C6784-001	VA22C6784-002	VA22C6784-003	VA22C6784-005
Dissolved Metals				Result	Result	Result	Result	Result
dissolved mercury filtration location		EP509	-	-	Field	Field	Field	Field
dissolved metals filtration location		EP421	-	-	Field	Field	Field	Field
Aggregate Organics					Result	Result	Result	Result
biochemical oxygen demand [BOD]		E550	2.0					
chemical oxygen demand [COD]		E559-L	10	mg/L	<2.0	12.2	7.1	45.6
				mg/L	<10	51	48	91
Volatile Organic Compounds					Result	Result	Result	Result
chlorobenzene	108-90-7	E611C	0.50					
chloromethane	74-87-3	E611C	5.0	µg/L	<0.50	<0.50	<0.50	<0.50
dichlorobenzene, 1,2-	95-50-1	E611C	0.50	µg/L	<5.0	<5.0	<5.0	<5.0
dichlorobenzene, 1,3-	541-73-1	E611C	0.50	µg/L	<0.50	<0.50	<0.50	<0.50
dichlorobenzene, 1,4-	106-46-7	E611C	0.50	µg/L	<0.50	<0.50	<0.50	<0.50
dichloropropane, 1,2-	78-87-5	E611C	0.50	µg/L	<0.50	<0.50	<0.50	<0.50
dichloropropylene, cis+trans-1,3-	542-75-6	E611C	0.75	µg/L	<0.75	<0.75	<0.75	<0.75
dichloropropylene, cis-1,3-	10061-01-5	E611C	0.50	µg/L	<0.50	<0.50	<0.50	<0.50
tetrachloroethane, 1,1,1,2-	630-20-6	E611C	0.50	µg/L	<0.50	<0.50	<0.50	<0.50
tetrachloroethane, 1,1,2,2-	79-34-5	E611C	0.20	µg/L	<0.20	<0.20	<0.20	<0.20
trichloroethane, 1,1,2-	79-00-5	E611C	0.50	µg/L	<0.50	<0.50	<0.50	<0.50
trichlorofluoromethane	75-69-4	E611C	0.50	µg/L	<0.50	<0.50	<0.50	<0.50
Volatile Organic Compounds [Drycleaning]					Result	Result	Result	Result
carbon tetrachloride	56-23-5	E611C	0.50					
chloroethane	75-00-3	E611C	0.50	µg/L	<0.50	<0.50	<0.50	<0.50
dichloroethane, 1,1-	75-34-3	E611C	0.50	µg/L	<0.50	<0.50	<0.50	<0.50
dichloroethane, 1,2-	107-06-2	E611C	0.50	µg/L	<0.50	<0.50	<0.50	<0.50
dichloroethylene, 1,1-	75-35-4	E611C	0.50	µg/L	<0.50	<0.50	<0.50	<0.50
dichloroethylene, cis-1,2-	156-59-2	E611C	0.50	µg/L	<0.50	<0.50	<0.50	<0.50
dichloroethylene, trans-1,2-	156-60-5	E611C	0.50	µg/L	<0.50	<0.50	<0.50	<0.50
dichloromethane	75-09-2	E611C	1.0	µg/L	<1.0	<1.0	<1.0	<1.0
dichloropropylene, trans-1,3-	10061-02-6	E611C	0.50	µg/L	<0.50	<0.50	<0.50	<0.50
tetrachloroethylene	127-18-4	E611C	0.50	µg/L	<0.50	<0.50	<0.50	<0.50
trichloroethane, 1,1,1-	71-55-6	E611C	0.50	µg/L	<0.50	<0.50	<0.50	<0.50



Analytical Results

Sub-Matrix: Water

(Matrix: Water)

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



Analytical Results

Sub-Matrix: Water
(Matrix: Water)

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

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



Analytical Results

Sub-Matrix: Water

(Matrix: Water)

Client sample ID					Field Blank	DUP	Noohalk Creek Upstream	Noohalk Creek Downstream	
Client sampling date / time					02-Nov-2022 12:00	02-Nov-2022 12:00	31-Oct-2022 17:30	31-Oct-2022 17:00	
Analyte	CAS Number	Method	LOR	Unit	VA22C6784-006 Result	VA22C6784-007 Result	VA22C6784-008 Result	VA22C6784-009 Result	
Physical Tests									
conductivity		E100	2.0	µS/cm	<2.0	207	27.1	33.1	
hardness (as CaCO ₃), dissolved		EC100	0.60	mg/L	<0.60	74.4	----	----	
hardness (as CaCO ₃), from total Ca/Mg		EC100A	0.60	mg/L	----	----	10.9	12.6	
pH		E108	0.10	pH units	5.36	7.49	6.86	6.93	
solids, total dissolved [TDS]		E162	10	mg/L	<10	118	33	36	
solids, total suspended [TSS]		E160	3.0	mg/L	<3.0	229	11.1	10.9	
alkalinity, total (as CaCO ₃)		E290	2.0	mg/L	<2.0	90.2	5.6	7.0	
Anions and Nutrients									
ammonia, total (as N)	7664-41-7	E298	0.0050	mg/L	<0.0050	3.80	0.0066	0.0149	
bromide	24959-67-9	E235.Br-L	0.050	mg/L	<0.050	<0.050	<0.050	<0.050	
chloride	16887-00-6	E235.Cl	0.50	mg/L	<0.50	1.00	<0.50	1.22	
fluoride	16984-48-8	E235.F	0.020	mg/L	<0.020	0.039	<0.020	<0.020	
nitrate (as N)	14797-55-8	E235.NO3-L	0.0050	mg/L	0.0478 ^{HTD, RRV}	0.0075	0.740	0.763	
nitrate + nitrite (as N)		EC235.N+N	0.0050	mg/L	0.0478	0.0105	0.740	0.764	
nitrite (as N)	14797-65-0	E235.NO2-L	0.0010	mg/L	<0.0010	0.0030	<0.0010	0.0010	
phosphate, ortho-, dissolved (as P)	14265-44-2	E378-U	0.0010	mg/L	<0.0010	0.0011	<0.0010	0.0012	
sulfate (as SO ₄)	14808-79-8	E235.SO4	0.30	mg/L	<0.30	10.4	2.29	2.91	
Organic / Inorganic Carbon									
carbon, total organic [TOC]		E355-L	0.50	mg/L	<0.50	14.1	4.20	5.73	
Total Metals									
aluminum, total	7429-90-5	E420	0.0030	mg/L	----	----	0.282	0.325	
antimony, total	7440-36-0	E420	0.00010	mg/L	----	----	<0.00010	<0.00010	
arsenic, total	7440-38-2	E420	0.00010	mg/L	----	----	<0.00010	<0.00010	
barium, total	7440-39-3	E420	0.00010	mg/L	----	----	0.0228	0.0202	
beryllium, total	7440-41-7	E420	0.000100	mg/L	----	----	<0.000100	<0.000100	
bismuth, total	7440-69-9	E420	0.000050	mg/L	----	----	<0.000050	<0.000050	
boron, total	7440-42-8	E420	0.010	mg/L	----	----	<0.010	<0.010	
cadmium, total	7440-43-9	E420	0.0000050	mg/L	----	----	<0.0000050	<0.0000050	
calcium, total	7440-70-2	E420	0.050	mg/L	----	----	3.74	4.21	
cesium, total	7440-46-2	E420	0.000010	mg/L	----	----	0.000010	0.000011	



Analytical Results

Sub-Matrix: Water

(Matrix: Water)

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



Analytical Results

Sub-Matrix: Water
(Matrix: Water)

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



Analytical Results

Sub-Matrix: Water

(Matrix: Water)

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



Analytical Results

Sub-Matrix: Water
(Matrix: Water)

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



Analytical Results

Sub-Matrix: Water
(Matrix: Water)

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



Analytical Results

Sub-Matrix: Water
 (Matrix: Water)

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

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

QUALITY CONTROL INTERPRETIVE REPORT

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

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

Key

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

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

DQO: Data Quality Objective.

LOR: Limit of Reporting (detection limit).

RPD: Relative Percent Difference.

Workorder Comments

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

Summary of Outliers

Outliers : Quality Control Samples

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

Outliers: Reference Material (RM) Samples

- No Reference Material (RM) Sample outliers occur.

Outliers : Analysis Holding Time Compliance (Breaches)

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

Outliers : Frequency of Quality Control Samples

- No Quality Control Sample Frequency Outliers occur.



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Work Order : VA22C6784 Amendment 1
Client : Morrison Hershfield Limited
Project : 210629400

Outliers : Quality Control Samples

Duplicates, Method Blanks, Laboratory Control Samples and Matrix Spikes

Matrix: **Water**

Analyte Group	Laboratory sample ID	Client/Ref Sample ID	Analyte	CAS Number	Method	Result	Limits	Comment
Matrix Spike (MS) Recoveries								
Dissolved Metals	Anonymous	Anonymous	silver, dissolved	7440-22-4	E421	65.8 % MES	70.0-130%	Recovery less than lower data quality objective

Result Qualifiers

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



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Work Order : VA22C6784 Amendment 1
Client : Morrison Hershfield Limited
Project : 210629400

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		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	
Aggregate Organics : Biochemical Oxygen Demand - 5 day										
HDPE [BOD HT 3d] DUP		E550	02-Nov-2022				04-Nov-2022	3 days	2 days	✓
Aggregate Organics : Biochemical Oxygen Demand - 5 day										
HDPE [BOD HT 3d] Field Blank		E550	02-Nov-2022				04-Nov-2022	3 days	2 days	✓
Aggregate Organics : Biochemical Oxygen Demand - 5 day										
HDPE [BOD HT 3d] MW22-01		E550	02-Nov-2022				04-Nov-2022	3 days	2 days	✓
Aggregate Organics : Biochemical Oxygen Demand - 5 day										
HDPE [BOD HT 3d] MW22-02		E550	02-Nov-2022				04-Nov-2022	3 days	2 days	✓
Aggregate Organics : Biochemical Oxygen Demand - 5 day										
HDPE [BOD HT 3d] MW22-03		E550	02-Nov-2022				04-Nov-2022	3 days	2 days	✓
Aggregate Organics : Biochemical Oxygen Demand - 5 day										
HDPE [BOD HT 3d] MW22-04		E550	02-Nov-2022				04-Nov-2022	3 days	2 days	✓
Aggregate Organics : Biochemical Oxygen Demand - 5 day										
HDPE [BOD HT 3d] MW22-05		E550	02-Nov-2022				04-Nov-2022	3 days	2 days	✓



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

Analyte Group	Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis				
				Preparation Date	Holding Times		Eval	Analysis Date	Holding Times		Eval	
					Rec	Actual			Rec	Actual		
Aggregate Organics : Biochemical Oxygen Demand - 5 day												
HDPE [BOD HT 3d]	Noochalk Creek Downstream	E550	31-Oct-2022						04-Nov-2022	3 days	4 days	✖
Aggregate Organics : Biochemical Oxygen Demand - 5 day												
HDPE [BOD HT 3d]	Noochalk Creek Upstream	E550	31-Oct-2022						04-Nov-2022	3 days	4 days	✖
Aggregate Organics : Chemical Oxygen Demand by Colourimetry (Low Level)												
Amber glass total (sulfuric acid)	DUP	E559-L	02-Nov-2022						12-Nov-2022	28 days	10 days	✔
Aggregate Organics : Chemical Oxygen Demand by Colourimetry (Low Level)												
Amber glass total (sulfuric acid)	Field Blank	E559-L	02-Nov-2022						12-Nov-2022	28 days	10 days	✔
Aggregate Organics : Chemical Oxygen Demand by Colourimetry (Low Level)												
Amber glass total (sulfuric acid)	MW22-01	E559-L	02-Nov-2022						12-Nov-2022	28 days	10 days	✔
Aggregate Organics : Chemical Oxygen Demand by Colourimetry (Low Level)												
Amber glass total (sulfuric acid)	MW22-02	E559-L	02-Nov-2022						12-Nov-2022	28 days	10 days	✔
Aggregate Organics : Chemical Oxygen Demand by Colourimetry (Low Level)												
Amber glass total (sulfuric acid)	MW22-03	E559-L	02-Nov-2022						12-Nov-2022	28 days	10 days	✔
Aggregate Organics : Chemical Oxygen Demand by Colourimetry (Low Level)												
Amber glass total (sulfuric acid)	MW22-04	E559-L	02-Nov-2022						12-Nov-2022	28 days	10 days	✔
Aggregate Organics : Chemical Oxygen Demand by Colourimetry (Low Level)												
Amber glass total (sulfuric acid)	MW22-05	E559-L	02-Nov-2022						12-Nov-2022	28 days	10 days	✔



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Work Order : VA22C6784 Amendment 1
Client : Morrison Hershfield Limited
Project : 210629400

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

Analyte Group		Method	Sampling Date	Extraction / Preparation				Analysis			
Container / Client Sample ID(s)	Eval			Analysis Date	Holding Times		Eval	Holding Times			
					Preparation Date	Rec		Actual	Rec	Actual	
Aggregate Organics : Chemical Oxygen Demand by Colourimetry (Low Level)											
Amber glass total (sulfuric acid) Noohalk Creek Downstream		E559-L	31-Oct-2022	-----	-----	-----	28 days	12 days	✓		
Aggregate Organics : Chemical Oxygen Demand by Colourimetry (Low Level)											
Amber glass total (sulfuric acid) Noohalk Creek Upstream		E559-L	31-Oct-2022	-----	-----	-----	28 days	12 days	✓		
Anions and Nutrients : Ammonia by Fluorescence											
Amber glass total (sulfuric acid) DUP		E298	02-Nov-2022	16-Nov-2022	-----	-----	28 days	15 days	✓		
Anions and Nutrients : Ammonia by Fluorescence											
Amber glass total (sulfuric acid) Field Blank		E298	02-Nov-2022	16-Nov-2022	-----	-----	28 days	15 days	✓		
Anions and Nutrients : Ammonia by Fluorescence											
Amber glass total (sulfuric acid) MW22-01		E298	02-Nov-2022	16-Nov-2022	-----	-----	28 days	15 days	✓		
Anions and Nutrients : Ammonia by Fluorescence											
Amber glass total (sulfuric acid) MW22-02		E298	02-Nov-2022	16-Nov-2022	-----	-----	28 days	15 days	✓		
Anions and Nutrients : Ammonia by Fluorescence											
Amber glass total (sulfuric acid) MW22-03		E298	02-Nov-2022	16-Nov-2022	-----	-----	28 days	15 days	✓		
Anions and Nutrients : Ammonia by Fluorescence											
Amber glass total (sulfuric acid) MW22-04		E298	02-Nov-2022	16-Nov-2022	-----	-----	28 days	15 days	✓		
Anions and Nutrients : Ammonia by Fluorescence											
Amber glass total (sulfuric acid) MW22-05		E298	02-Nov-2022	16-Nov-2022	-----	-----	28 days	15 days	✓		



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

Analyte Group		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 : Ammonia by Fluorescence										
Amber glass total (sulfuric acid) Noohalk Creek Downstream		E298	31-Oct-2022	16-Nov-2022	-----		17-Nov-2022	28 days	17 days	✓
Anions and Nutrients : Ammonia by Fluorescence										
Amber glass total (sulfuric acid) Noohalk Creek Upstream		E298	31-Oct-2022	16-Nov-2022	-----		17-Nov-2022	28 days	17 days	✓
Anions and Nutrients : Bromide in Water by IC (Low Level)										
HDPE [BOD HT 3d] MW22-01		E235.Br-L	02-Nov-2022	05-Nov-2022	28 days	2 days	05-Nov-2022	26 days	0 days	✓
Anions and Nutrients : Bromide in Water by IC (Low Level)										
HDPE [BOD HT 3d] MW22-02		E235.Br-L	02-Nov-2022	05-Nov-2022	28 days	2 days	05-Nov-2022	26 days	0 days	✓
Anions and Nutrients : Bromide in Water by IC (Low Level)										
HDPE [BOD HT 3d] MW22-03		E235.Br-L	02-Nov-2022	05-Nov-2022	28 days	2 days	05-Nov-2022	26 days	0 days	✓
Anions and Nutrients : Bromide in Water by IC (Low Level)										
HDPE [BOD HT 3d] DUP		E235.Br-L	02-Nov-2022	05-Nov-2022	28 days	3 days	05-Nov-2022	25 days	0 days	✓
Anions and Nutrients : Bromide in Water by IC (Low Level)										
HDPE [BOD HT 3d] Field Blank		E235.Br-L	02-Nov-2022	05-Nov-2022	28 days	3 days	05-Nov-2022	25 days	0 days	✓
Anions and Nutrients : Bromide in Water by IC (Low Level)										
HDPE [BOD HT 3d] MW22-04		E235.Br-L	02-Nov-2022	05-Nov-2022	28 days	3 days	05-Nov-2022	25 days	0 days	✓
Anions and Nutrients : Bromide in Water by IC (Low Level)										
HDPE [BOD HT 3d] MW22-05		E235.Br-L	02-Nov-2022	05-Nov-2022	28 days	3 days	05-Nov-2022	25 days	0 days	✓



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

Analyte Group		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 [BOD HT 3d] Noohalk Creek Downstream		E235.Br-L	31-Oct-2022	05-Nov-2022	28 days	5 days	05-Nov-2022	23 days	0 days	✓
Anions and Nutrients : Bromide in Water by IC (Low Level)										
HDPE [BOD HT 3d] Noohalk Creek Upstream		E235.Br-L	31-Oct-2022	05-Nov-2022	28 days	5 days	05-Nov-2022	23 days	0 days	✓
Anions and Nutrients : Chloride in Water by IC										
HDPE [BOD HT 3d] MW22-01		E235.Cl	02-Nov-2022	05-Nov-2022	28 days	2 days	05-Nov-2022	26 days	0 days	✓
Anions and Nutrients : Chloride in Water by IC										
HDPE [BOD HT 3d] MW22-02		E235.Cl	02-Nov-2022	05-Nov-2022	28 days	2 days	05-Nov-2022	26 days	0 days	✓
Anions and Nutrients : Chloride in Water by IC										
HDPE [BOD HT 3d] MW22-03		E235.Cl	02-Nov-2022	05-Nov-2022	28 days	2 days	05-Nov-2022	26 days	0 days	✓
Anions and Nutrients : Chloride in Water by IC										
HDPE [BOD HT 3d] DUP		E235.Cl	02-Nov-2022	05-Nov-2022	28 days	3 days	05-Nov-2022	25 days	0 days	✓
Anions and Nutrients : Chloride in Water by IC										
HDPE [BOD HT 3d] Field Blank		E235.Cl	02-Nov-2022	05-Nov-2022	28 days	3 days	05-Nov-2022	25 days	0 days	✓
Anions and Nutrients : Chloride in Water by IC										
HDPE [BOD HT 3d] MW22-04		E235.Cl	02-Nov-2022	05-Nov-2022	28 days	3 days	05-Nov-2022	25 days	0 days	✓
Anions and Nutrients : Chloride in Water by IC										
HDPE [BOD HT 3d] MW22-05		E235.Cl	02-Nov-2022	05-Nov-2022	28 days	3 days	05-Nov-2022	25 days	0 days	✓



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Matrix: Water										
Evaluation: ✖ = Holding time exceedance ; ✔ = Within Holding Time										
Analyte Group		Method	Sampling Date	Extraction / Preparation			Analysis			
Container / Client Sample ID(s)				Preparation Date	Holding Times		Analysis Date	Eval	Holding Times	
					Rec	Actual			Rec	Actual
Anions and Nutrients : Chloride in Water by IC										
HDPE [BOD HT 3d]	Noohalk Creek Downstream	E235.Cl	31-Oct-2022	05-Nov-2022	28 days	5 days	✔	05-Nov-2022	23 days	0 days
										✔
Anions and Nutrients : Chloride in Water by IC										
HDPE [BOD HT 3d]	Noohalk Creek Upstream	E235.Cl	31-Oct-2022	05-Nov-2022	28 days	5 days	✔	05-Nov-2022	23 days	0 days
										✔
Anions and Nutrients : Dissolved Orthophosphate by Colourimetry (Ultra Trace Level 0.001										
HDPE [BOD HT 3d]	MW22-01	E378-U	02-Nov-2022	05-Nov-2022	3 days	2 days	✔	05-Nov-2022	1 days	0 days
										✔
Anions and Nutrients : Dissolved Orthophosphate by Colourimetry (Ultra Trace Level 0.001										
HDPE [BOD HT 3d]	MW22-02	E378-U	02-Nov-2022	05-Nov-2022	3 days	2 days	✔	05-Nov-2022	1 days	0 days
										✔
Anions and Nutrients : Dissolved Orthophosphate by Colourimetry (Ultra Trace Level 0.001										
HDPE [BOD HT 3d]	MW22-03	E378-U	02-Nov-2022	05-Nov-2022	3 days	2 days	✔	05-Nov-2022	1 days	0 days
										✔
Anions and Nutrients : Dissolved Orthophosphate by Colourimetry (Ultra Trace Level 0.001										
HDPE [BOD HT 3d]	DUP	E378-U	02-Nov-2022	05-Nov-2022	3 days	3 days	✔	05-Nov-2022	0 days	0 days
										✔
Anions and Nutrients : Dissolved Orthophosphate by Colourimetry (Ultra Trace Level 0.001										
HDPE [BOD HT 3d]	Field Blank	E378-U	02-Nov-2022	05-Nov-2022	3 days	3 days	✔	05-Nov-2022	0 days	0 days
										✔
Anions and Nutrients : Dissolved Orthophosphate by Colourimetry (Ultra Trace Level 0.001										
HDPE [BOD HT 3d]	MW22-04	E378-U	02-Nov-2022	05-Nov-2022	3 days	3 days	✔	05-Nov-2022	0 days	0 days
										✔



Matrix: Water											
Analyte Group		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 : Dissolved Orthophosphate by Colourimetry (Ultra Trace Level 0.001											
HDPE [BOD HT 3d] MW22-05		E378-U	02-Nov-2022	05-Nov-2022	3 days	3 days	✓	05-Nov-2022	0 days	0 days	✓
Anions and Nutrients : Dissolved Orthophosphate by Colourimetry (Ultra Trace Level 0.001											
HDPE [BOD HT 3d] Noohalk Creek Upstream		E378-U	31-Oct-2022	05-Nov-2022	3 days	4 days	✖ EHT	05-Nov-2022	-1 days	0 days	✖ EHT
Anions and Nutrients : Dissolved Orthophosphate by Colourimetry (Ultra Trace Level 0.001											
HDPE [BOD HT 3d] Noohalk Creek Downstream		E378-U	31-Oct-2022	05-Nov-2022	3 days	5 days	✖ EHT	05-Nov-2022	-2 days	0 days	✖ EHT
Anions and Nutrients : Fluoride in Water by IC											
HDPE [BOD HT 3d] MW22-01		E235.F	02-Nov-2022	05-Nov-2022	28 days	2 days	✓	05-Nov-2022	26 days	0 days	✓
Anions and Nutrients : Fluoride in Water by IC											
HDPE [BOD HT 3d] MW22-02		E235.F	02-Nov-2022	05-Nov-2022	28 days	2 days	✓	05-Nov-2022	26 days	0 days	✓
Anions and Nutrients : Fluoride in Water by IC											
HDPE [BOD HT 3d] MW22-03		E235.F	02-Nov-2022	05-Nov-2022	28 days	2 days	✓	05-Nov-2022	26 days	0 days	✓
Anions and Nutrients : Fluoride in Water by IC											
HDPE [BOD HT 3d] DUP		E235.F	02-Nov-2022	05-Nov-2022	28 days	3 days	✓	05-Nov-2022	25 days	0 days	✓
Anions and Nutrients : Fluoride in Water by IC											
HDPE [BOD HT 3d] Field Blank		E235.F	02-Nov-2022	05-Nov-2022	28 days	3 days	✓	05-Nov-2022	25 days	0 days	✓



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

Analyte Group		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 [BOD HT 3d] MW22-04		E235.F	02-Nov-2022	05-Nov-2022	28 days	3 days	05-Nov-2022	25 days	0 days	✓
Anions and Nutrients : Fluoride in Water by IC										
HDPE [BOD HT 3d] MW22-05		E235.F	02-Nov-2022	05-Nov-2022	28 days	3 days	05-Nov-2022	25 days	0 days	✓
Anions and Nutrients : Fluoride in Water by IC										
HDPE [BOD HT 3d] Noohalk Creek Downstream		E235.F	31-Oct-2022	05-Nov-2022	28 days	5 days	05-Nov-2022	23 days	0 days	✓
Anions and Nutrients : Fluoride in Water by IC										
HDPE [BOD HT 3d] Noohalk Creek Upstream		E235.F	31-Oct-2022	05-Nov-2022	28 days	5 days	05-Nov-2022	23 days	0 days	✓
Anions and Nutrients : Nitrate in Water by IC (Low Level)										
HDPE [BOD HT 3d] MW22-01		E235.NO3-L	02-Nov-2022	05-Nov-2022	3 days	2 days	05-Nov-2022	3 days	0 days	✓
Anions and Nutrients : Nitrate in Water by IC (Low Level)										
HDPE [BOD HT 3d] MW22-02		E235.NO3-L	02-Nov-2022	05-Nov-2022	3 days	2 days	05-Nov-2022	3 days	0 days	✓
Anions and Nutrients : Nitrate in Water by IC (Low Level)										
HDPE [BOD HT 3d] MW22-03		E235.NO3-L	02-Nov-2022	05-Nov-2022	3 days	2 days	05-Nov-2022	3 days	0 days	✓
Anions and Nutrients : Nitrate in Water by IC (Low Level)										
HDPE [BOD HT 3d] DUP		E235.NO3-L	02-Nov-2022	05-Nov-2022	3 days	3 days	05-Nov-2022	3 days	0 days	✓
Anions and Nutrients : Nitrate in Water by IC (Low Level)										
HDPE [BOD HT 3d] Field Blank		E235.NO3-L	02-Nov-2022	05-Nov-2022	3 days	3 days	05-Nov-2022	3 days	0 days	✓



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

Analyte Group Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times		Eval	Analysis Date	Holding Times		
				Rec	Actual			Rec	Actual	
Anions and Nutrients : Nitrate in Water by IC (Low Level)										
HDPE [BOD HT 3d] MW22-04	E235.NO3-L	02-Nov-2022	05-Nov-2022	3 days	3 days	✓	05-Nov-2022	3 days	0 days	✓
Anions and Nutrients : Nitrate in Water by IC (Low Level)										
HDPE [BOD HT 3d] MW22-05	E235.NO3-L	02-Nov-2022	05-Nov-2022	3 days	3 days	✓	05-Nov-2022	3 days	0 days	✓
Anions and Nutrients : Nitrate in Water by IC (Low Level)										
HDPE [BOD HT 3d] Noohalk Creek Downstream	E235.NO3-L	31-Oct-2022	05-Nov-2022	3 days	5 days	✗ EHT	05-Nov-2022	3 days	0 days	✓
Anions and Nutrients : Nitrate in Water by IC (Low Level)										
HDPE [BOD HT 3d] Noohalk Creek Upstream	E235.NO3-L	31-Oct-2022	05-Nov-2022	3 days	5 days	✗ EHT	05-Nov-2022	3 days	0 days	✓
Anions and Nutrients : Nitrite in Water by IC (Low Level)										
HDPE [BOD HT 3d] MW22-01	E235.NO2-L	02-Nov-2022	05-Nov-2022	3 days	2 days	✓	05-Nov-2022	1 days	0 days	✓
Anions and Nutrients : Nitrite in Water by IC (Low Level)										
HDPE [BOD HT 3d] MW22-02	E235.NO2-L	02-Nov-2022	05-Nov-2022	3 days	2 days	✓	05-Nov-2022	1 days	0 days	✓
Anions and Nutrients : Nitrite in Water by IC (Low Level)										
HDPE [BOD HT 3d] MW22-03	E235.NO2-L	02-Nov-2022	05-Nov-2022	3 days	2 days	✓	05-Nov-2022	1 days	0 days	✓
Anions and Nutrients : Nitrite in Water by IC (Low Level)										
HDPE [BOD HT 3d] DUP	E235.NO2-L	02-Nov-2022	05-Nov-2022	3 days	3 days	✓	05-Nov-2022	0 days	0 days	✓
Anions and Nutrients : Nitrite in Water by IC (Low Level)										
HDPE [BOD HT 3d] Field Blank	E235.NO2-L	02-Nov-2022	05-Nov-2022	3 days	3 days	✓	05-Nov-2022	0 days	0 days	✓



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

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



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

Analyte Group		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 : Sulfate in Water by IC											
HDPE [BOD HT 3d] MW22-04		E235.S04	02-Nov-2022	05-Nov-2022	28 days	3 days		05-Nov-2022	25 days	0 days	✓
Anions and Nutrients : Sulfate in Water by IC											
HDPE [BOD HT 3d] MW22-05		E235.S04	02-Nov-2022	05-Nov-2022	28 days	3 days		05-Nov-2022	25 days	0 days	✓
Anions and Nutrients : Sulfate in Water by IC											
HDPE [BOD HT 3d] Noohalk Creek Downstream		E235.S04	31-Oct-2022	05-Nov-2022	28 days	5 days		05-Nov-2022	23 days	0 days	✓
Anions and Nutrients : Sulfate in Water by IC											
HDPE [BOD HT 3d] Noohalk Creek Upstream		E235.S04	31-Oct-2022	05-Nov-2022	28 days	5 days		05-Nov-2022	23 days	0 days	✓
Dissolved Metals : Dissolved Mercury in Water by CVAAS											
Glass vial dissolved (hydrochloric acid) MW22-01		E509	02-Nov-2022	05-Nov-2022	-----	-----		05-Nov-2022	28 days	2 days	✓
Dissolved Metals : Dissolved Mercury in Water by CVAAS											
Glass vial dissolved (hydrochloric acid) DUP		E509	02-Nov-2022	05-Nov-2022	-----	-----		05-Nov-2022	28 days	3 days	✓
Dissolved Metals : Dissolved Mercury in Water by CVAAS											
Glass vial dissolved (hydrochloric acid) Field Blank		E509	02-Nov-2022	05-Nov-2022	-----	-----		05-Nov-2022	28 days	3 days	✓
Dissolved Metals : Dissolved Mercury in Water by CVAAS											
Glass vial dissolved (hydrochloric acid) MW22-02		E509	02-Nov-2022	05-Nov-2022	-----	-----		05-Nov-2022	28 days	3 days	✓
Dissolved Metals : Dissolved Mercury in Water by CVAAS											
Glass vial dissolved (hydrochloric acid) MW22-03		E509	02-Nov-2022	05-Nov-2022	-----	-----		05-Nov-2022	28 days	3 days	✓



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

Analyte Group		Method	Sampling Date	Extraction / Preparation				Analysis			
Container / Client Sample ID(s)	Eval			Preparation Date	Holding Times		Analysis Date	Holding Times		Eval	
					Rec	Actual		Rec	Actual		
Dissolved Metals : Dissolved Mercury in Water by CVAAS											
Glass vial dissolved (hydrochloric acid)	MW22-04	E509	02-Nov-2022	05-Nov-2022	-----	-----		05-Nov-2022	28 days	3 days	✓
Dissolved Metals : Dissolved Mercury in Water by CVAAS											
Glass vial dissolved (hydrochloric acid)	MW22-05	E509	02-Nov-2022	05-Nov-2022	-----	-----		05-Nov-2022	28 days	3 days	✓
Dissolved Metals : Dissolved Metals in Water by CRC ICPMS											
HDPE dissolved (nitric acid)	DUP	E421	02-Nov-2022	09-Nov-2022	-----	-----		12-Nov-2022	180 days	10 days	✓
Dissolved Metals : Dissolved Metals in Water by CRC ICPMS											
HDPE dissolved (nitric acid)	Field Blank	E421	02-Nov-2022	09-Nov-2022	-----	-----		12-Nov-2022	180 days	10 days	✓
Dissolved Metals : Dissolved Metals in Water by CRC ICPMS											
HDPE dissolved (nitric acid)	MW22-01	E421	02-Nov-2022	09-Nov-2022	-----	-----		12-Nov-2022	180 days	10 days	✓
Dissolved Metals : Dissolved Metals in Water by CRC ICPMS											
HDPE dissolved (nitric acid)	MW22-02	E421	02-Nov-2022	09-Nov-2022	-----	-----		12-Nov-2022	180 days	10 days	✓
Dissolved Metals : Dissolved Metals in Water by CRC ICPMS											
HDPE dissolved (nitric acid)	MW22-03	E421	02-Nov-2022	09-Nov-2022	-----	-----		12-Nov-2022	180 days	10 days	✓
Dissolved Metals : Dissolved Metals in Water by CRC ICPMS											
HDPE dissolved (nitric acid)	MW22-04	E421	02-Nov-2022	09-Nov-2022	-----	-----		12-Nov-2022	180 days	10 days	✓
Dissolved Metals : Dissolved Metals in Water by CRC ICPMS											
HDPE dissolved (nitric acid)	MW22-05	E421	02-Nov-2022	09-Nov-2022	-----	-----		12-Nov-2022	180 days	10 days	✓



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

Analyte Group		Method	Sampling Date	Extraction / Preparation				Analysis		
				Preparation Date	Holding Times		Eval	Analysis Date	Holding Times	
Rec	Actual	Rec	Actual		Rec	Actual				
Hydrocarbons : BC PHCs - EPH by GC-FID										
Amber glass/Teflon lined cap (sodium bisulfate) DUP	E601A	02-Nov-2022	14-Nov-2022	14 days	12 days	✓	15-Nov-2022	40 days	1 days	✓
Hydrocarbons : BC PHCs - EPH by GC-FID										
Amber glass/Teflon lined cap (sodium bisulfate) Field Blank	E601A	02-Nov-2022	14-Nov-2022	14 days	12 days	✓	15-Nov-2022	40 days	1 days	✓
Hydrocarbons : BC PHCs - EPH by GC-FID										
Amber glass/Teflon lined cap (sodium bisulfate) MW22-01	E601A	02-Nov-2022	14-Nov-2022	14 days	12 days	✓	15-Nov-2022	40 days	1 days	✓
Hydrocarbons : BC PHCs - EPH by GC-FID										
Amber glass/Teflon lined cap (sodium bisulfate) MW22-02	E601A	02-Nov-2022	14-Nov-2022	14 days	12 days	✓	15-Nov-2022	40 days	1 days	✓
Hydrocarbons : BC PHCs - EPH by GC-FID										
Amber glass/Teflon lined cap (sodium bisulfate) MW22-03	E601A	02-Nov-2022	14-Nov-2022	14 days	12 days	✓	15-Nov-2022	40 days	1 days	✓
Hydrocarbons : BC PHCs - EPH by GC-FID										
Amber glass/Teflon lined cap (sodium bisulfate) MW22-04	E601A	02-Nov-2022	14-Nov-2022	14 days	12 days	✓	15-Nov-2022	40 days	1 days	✓
Hydrocarbons : BC PHCs - EPH by GC-FID										
Amber glass/Teflon lined cap (sodium bisulfate) MW22-05	E601A	02-Nov-2022	14-Nov-2022	14 days	12 days	✓	15-Nov-2022	40 days	1 days	✓
Hydrocarbons : BC PHCs - EPH by GC-FID										
Amber glass/Teflon lined cap (sodium bisulfate) Noohalk Creek Downstream	E601A	31-Oct-2022	13-Nov-2022	14 days	13 days	✓	13-Nov-2022	40 days	0 days	✓
Hydrocarbons : BC PHCs - EPH by GC-FID										
Amber glass/Teflon lined cap (sodium bisulfate) Noohalk Creek Upstream	E601A	31-Oct-2022	13-Nov-2022	14 days	13 days	✓	13-Nov-2022	40 days	0 days	✓



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

Analyte Group	Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis				
				Preparation Date	Holding Times		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) DUP		E355-L	02-Nov-2022	06-Nov-2022	-----	-----	06-Nov-2022	28 days	4 days		✓	
Organic / Inorganic Carbon : Total Organic Carbon (Non-Purgeable) by Combustion (Low Level)												
Amber glass total (sulfuric acid) Field Blank		E355-L	02-Nov-2022	06-Nov-2022	-----	-----	06-Nov-2022	28 days	4 days		✓	
Organic / Inorganic Carbon : Total Organic Carbon (Non-Purgeable) by Combustion (Low Level)												
Amber glass total (sulfuric acid) MW22-01		E355-L	02-Nov-2022	06-Nov-2022	-----	-----	06-Nov-2022	28 days	4 days		✓	
Organic / Inorganic Carbon : Total Organic Carbon (Non-Purgeable) by Combustion (Low Level)												
Amber glass total (sulfuric acid) MW22-02		E355-L	02-Nov-2022	06-Nov-2022	-----	-----	06-Nov-2022	28 days	4 days		✓	
Organic / Inorganic Carbon : Total Organic Carbon (Non-Purgeable) by Combustion (Low Level)												
Amber glass total (sulfuric acid) MW22-03		E355-L	02-Nov-2022	06-Nov-2022	-----	-----	06-Nov-2022	28 days	4 days		✓	
Organic / Inorganic Carbon : Total Organic Carbon (Non-Purgeable) by Combustion (Low Level)												
Amber glass total (sulfuric acid) MW22-04		E355-L	02-Nov-2022	06-Nov-2022	-----	-----	06-Nov-2022	28 days	4 days		✓	
Organic / Inorganic Carbon : Total Organic Carbon (Non-Purgeable) by Combustion (Low Level)												
Amber glass total (sulfuric acid) MW22-05		E355-L	02-Nov-2022	06-Nov-2022	-----	-----	06-Nov-2022	28 days	4 days		✓	
Organic / Inorganic Carbon : Total Organic Carbon (Non-Purgeable) by Combustion (Low Level)												
Amber glass total (sulfuric acid) Noohalk Creek Downstream		E355-L	31-Oct-2022	06-Nov-2022	-----	-----	06-Nov-2022	28 days	6 days		✓	
Organic / Inorganic Carbon : Total Organic Carbon (Non-Purgeable) by Combustion (Low Level)												
Amber glass total (sulfuric acid) Noohalk Creek Upstream		E355-L	31-Oct-2022	06-Nov-2022	-----	-----	06-Nov-2022	28 days	6 days		✓	



Matrix: Water											
Analyte Group		Method	Sampling Date	Extraction / Preparation			Analysis			Eval	
Container / Client Sample ID(s)				Preparation Date	Holding Times		Analysis Date	Holding Times			
					Rec	Actual		Rec	Actual		
Physical Tests : Alkalinity Species by Titration											
HDPE [BOD HT 3d] DUP		E290	02-Nov-2022	16-Nov-2022	14 days	14 days	✓	16-Nov-2022	0 days	0 days	✓
Physical Tests : Alkalinity Species by Titration											
HDPE [BOD HT 3d] Field Blank		E290	02-Nov-2022	16-Nov-2022	14 days	14 days	✓	16-Nov-2022	0 days	0 days	✓
Physical Tests : Alkalinity Species by Titration											
HDPE [BOD HT 3d] MW22-01		E290	02-Nov-2022	16-Nov-2022	14 days	14 days	✓	16-Nov-2022	0 days	0 days	✓
Physical Tests : Alkalinity Species by Titration											
HDPE [BOD HT 3d] MW22-02		E290	02-Nov-2022	16-Nov-2022	14 days	14 days	✓	16-Nov-2022	0 days	0 days	✓
Physical Tests : Alkalinity Species by Titration											
HDPE [BOD HT 3d] MW22-03		E290	02-Nov-2022	16-Nov-2022	14 days	14 days	✓	16-Nov-2022	0 days	0 days	✓
Physical Tests : Alkalinity Species by Titration											
HDPE [BOD HT 3d] MW22-04		E290	02-Nov-2022	16-Nov-2022	14 days	14 days	✓	16-Nov-2022	0 days	0 days	✓
Physical Tests : Alkalinity Species by Titration											
HDPE [BOD HT 3d] MW22-05		E290	02-Nov-2022	16-Nov-2022	14 days	14 days	✓	16-Nov-2022	0 days	0 days	✓
Physical Tests : Alkalinity Species by Titration											
HDPE [BOD HT 3d] Noohalk Creek Downstream		E290	31-Oct-2022	16-Nov-2022	14 days	16 days	✗ EHT	16-Nov-2022	-2 days	0 days	✗ EHT
Physical Tests : Alkalinity Species by Titration											
HDPE [BOD HT 3d] Noohalk Creek Upstream		E290	31-Oct-2022	16-Nov-2022	14 days	16 days	✗ EHT	16-Nov-2022	-2 days	0 days	✗ EHT



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

Analyte Group	Sampling Date	Method	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times		Eval	Analysis Date	Holding Times		Eval
				Rec	Actual			Rec	Actual	
Physical Tests : Conductivity in Water										
HDPE [BOD HT 3d] MW22-01	02-Nov-2022	E100	05-Nov-2022	28 days	2 days	✓	05-Nov-2022	26 days	0 days	✓
Physical Tests : Conductivity in Water										
HDPE [BOD HT 3d] MW22-02	02-Nov-2022	E100	05-Nov-2022	28 days	2 days	✓	05-Nov-2022	26 days	0 days	✓
Physical Tests : Conductivity in Water										
HDPE [BOD HT 3d] MW22-03	02-Nov-2022	E100	05-Nov-2022	28 days	2 days	✓	05-Nov-2022	26 days	0 days	✓
Physical Tests : Conductivity in Water										
HDPE [BOD HT 3d] DUP	02-Nov-2022	E100	05-Nov-2022	28 days	3 days	✓	05-Nov-2022	25 days	0 days	✓
Physical Tests : Conductivity in Water										
HDPE [BOD HT 3d] Field Blank	02-Nov-2022	E100	05-Nov-2022	28 days	3 days	✓	05-Nov-2022	25 days	0 days	✓
Physical Tests : Conductivity in Water										
HDPE [BOD HT 3d] MW22-04	02-Nov-2022	E100	05-Nov-2022	28 days	3 days	✓	05-Nov-2022	25 days	0 days	✓
Physical Tests : Conductivity in Water										
HDPE [BOD HT 3d] MW22-05	02-Nov-2022	E100	05-Nov-2022	28 days	3 days	✓	05-Nov-2022	25 days	0 days	✓
Physical Tests : Conductivity in Water										
HDPE [BOD HT 3d] Noohalk Creek Downstream	31-Oct-2022	E100	05-Nov-2022	28 days	5 days	✓	05-Nov-2022	23 days	0 days	✓
Physical Tests : Conductivity in Water										
HDPE [BOD HT 3d] Noohalk Creek Upstream	31-Oct-2022	E100	05-Nov-2022	28 days	5 days	✓	05-Nov-2022	23 days	0 days	✓



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

Analyte Group	Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
				Preparation Date	Holding Times		Eval	Analysis Date	Holding Times		
					Rec	Actual			Rec	Actual	
Physical Tests : pH by Meter											
HDPE [BOD HT 3d] DUP		E108	02-Nov-2022	05-Nov-2022	4 hrs	4 hrs	✖ EHTR-FM	05-Nov-2022	-59.75 hrs	4 hrs	✖ EHTR-FM
Physical Tests : pH by Meter											
HDPE [BOD HT 3d] Field Blank		E108	02-Nov-2022	05-Nov-2022	4 hrs	4 hrs	✖ EHTR-FM	05-Nov-2022	-59.75 hrs	4 hrs	✖ EHTR-FM
Physical Tests : pH by Meter											
HDPE [BOD HT 3d] MW22-04		E108	02-Nov-2022	05-Nov-2022	5 hrs	1.50 hrs	✖ EHTR-FM	05-Nov-2022	-58.55 hrs	5 hrs	✖ EHTR-FM
Physical Tests : pH by Meter											
HDPE [BOD HT 3d] MW22-05		E108	02-Nov-2022	05-Nov-2022	5 hrs	1.75 hrs	✖ EHTR-FM	05-Nov-2022	-58.55 hrs	5 hrs	✖ EHTR-FM
Physical Tests : pH by Meter											
HDPE [BOD HT 3d] MW22-01		E108	02-Nov-2022	05-Nov-2022	5 hrs	22 hrs	✖ EHTL	05-Nov-2022	-34.55 hrs	5 hrs	✖ EHTL
Physical Tests : pH by Meter											
HDPE [BOD HT 3d] MW22-02		E108	02-Nov-2022	05-Nov-2022	5 hrs	23 hrs	✖ EHTL	05-Nov-2022	-34.55 hrs	5 hrs	✖ EHTL
Physical Tests : pH by Meter											
HDPE [BOD HT 3d] MW22-03		E108	02-Nov-2022	05-Nov-2022	5 hrs	23 hrs	✖ EHTL	05-Nov-2022	-34.55 hrs	5 hrs	✖ EHTL
Physical Tests : pH by Meter											
HDPE [BOD HT 3d] Noohalk Creek Downstream		E108	31-Oct-2022	05-Nov-2022	9 hrs	23 hrs	✖ EHTR-FM	05-Nov-2022	-84.79 hrs	9 hrs	✖ EHTR-FM
Physical Tests : pH by Meter											
HDPE [BOD HT 3d] Noohalk Creek Upstream		E108	31-Oct-2022	05-Nov-2022	9 hrs	23 hrs	✖ EHTR-FM	05-Nov-2022	-84.79 hrs	9 hrs	✖ EHTR-FM



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

Analyte Group	Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation			Analysis				
				Preparation Date	Holding Times		Eval	Analysis Date	Holding Times		Eval
					Rec	Actual			Rec	Actual	
Physical Tests : TDS by Gravimetry											
HDPE [BOD HT 3d] DUP		E162	02-Nov-2022	-----	-----	-----		05-Nov-2022	7 days	3 days	✓
Physical Tests : TDS by Gravimetry											
HDPE [BOD HT 3d] Field Blank		E162	02-Nov-2022	-----	-----	-----		05-Nov-2022	7 days	3 days	✓
Physical Tests : TDS by Gravimetry											
HDPE [BOD HT 3d] MW22-01		E162	02-Nov-2022	-----	-----	-----		05-Nov-2022	7 days	3 days	✓
Physical Tests : TDS by Gravimetry											
HDPE [BOD HT 3d] MW22-02		E162	02-Nov-2022	-----	-----	-----		05-Nov-2022	7 days	3 days	✓
Physical Tests : TDS by Gravimetry											
HDPE [BOD HT 3d] MW22-03		E162	02-Nov-2022	-----	-----	-----		05-Nov-2022	7 days	3 days	✓
Physical Tests : TDS by Gravimetry											
HDPE [BOD HT 3d] MW22-04		E162	02-Nov-2022	-----	-----	-----		05-Nov-2022	7 days	3 days	✓
Physical Tests : TDS by Gravimetry											
HDPE [BOD HT 3d] MW22-05		E162	02-Nov-2022	-----	-----	-----		05-Nov-2022	7 days	3 days	✓
Physical Tests : TDS by Gravimetry											
HDPE [BOD HT 3d] Noohalk Creek Downstream		E162	31-Oct-2022	-----	-----	-----		05-Nov-2022	7 days	5 days	✓
Physical Tests : TDS by Gravimetry											
HDPE [BOD HT 3d] Noohalk Creek Upstream		E162	31-Oct-2022	-----	-----	-----		05-Nov-2022	7 days	5 days	✓



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

Analyte Group		Method	Sampling Date	Extraction / Preparation			Analysis			
Container / Client Sample ID(s)	Eval			Analysis Date	Holding Times	Rec	Actual			
								Preparation Date	Rec	Actual
Physical Tests : TSS by Gravimetry										
HDPE [BOD HT 3d] DUP		E160	02-Nov-2022				05-Nov-2022	7 days	3 days	✓
Physical Tests : TSS by Gravimetry										
HDPE [BOD HT 3d] Field Blank		E160	02-Nov-2022				05-Nov-2022	7 days	3 days	✓
Physical Tests : TSS by Gravimetry										
HDPE [BOD HT 3d] MW22-01		E160	02-Nov-2022				05-Nov-2022	7 days	3 days	✓
Physical Tests : TSS by Gravimetry										
HDPE [BOD HT 3d] MW22-02		E160	02-Nov-2022				05-Nov-2022	7 days	3 days	✓
Physical Tests : TSS by Gravimetry										
HDPE [BOD HT 3d] MW22-03		E160	02-Nov-2022				05-Nov-2022	7 days	3 days	✓
Physical Tests : TSS by Gravimetry										
HDPE [BOD HT 3d] MW22-04		E160	02-Nov-2022				05-Nov-2022	7 days	3 days	✓
Physical Tests : TSS by Gravimetry										
HDPE [BOD HT 3d] MW22-05		E160	02-Nov-2022				05-Nov-2022	7 days	3 days	✓
Physical Tests : TSS by Gravimetry										
HDPE [BOD HT 3d] Noohalk Creek Downstream		E160	31-Oct-2022				05-Nov-2022	7 days	5 days	✓
Physical Tests : TSS by Gravimetry										
HDPE [BOD HT 3d] Noohalk Creek Upstream		E160	31-Oct-2022				05-Nov-2022	7 days	5 days	✓



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

Analyte Group		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		
Polycyclic Aromatic Hydrocarbons : PAHs by Hexane LVI GC-MS											
Amber glass/Teflon lined cap (sodium bisulfate) DUP		E641A	02-Nov-2022	14-Nov-2022	14 days	12 days		15-Nov-2022	40 days	1 days	✓
Polycyclic Aromatic Hydrocarbons : PAHs by Hexane LVI GC-MS											
Amber glass/Teflon lined cap (sodium bisulfate) Field Blank		E641A	02-Nov-2022	14-Nov-2022	14 days	12 days		15-Nov-2022	40 days	1 days	✓
Polycyclic Aromatic Hydrocarbons : PAHs by Hexane LVI GC-MS											
Amber glass/Teflon lined cap (sodium bisulfate) MW22-01		E641A	02-Nov-2022	14-Nov-2022	14 days	12 days		15-Nov-2022	40 days	1 days	✓
Polycyclic Aromatic Hydrocarbons : PAHs by Hexane LVI GC-MS											
Amber glass/Teflon lined cap (sodium bisulfate) MW22-02		E641A	02-Nov-2022	14-Nov-2022	14 days	12 days		15-Nov-2022	40 days	1 days	✓
Polycyclic Aromatic Hydrocarbons : PAHs by Hexane LVI GC-MS											
Amber glass/Teflon lined cap (sodium bisulfate) MW22-03		E641A	02-Nov-2022	14-Nov-2022	14 days	12 days		15-Nov-2022	40 days	1 days	✓
Polycyclic Aromatic Hydrocarbons : PAHs by Hexane LVI GC-MS											
Amber glass/Teflon lined cap (sodium bisulfate) MW22-04		E641A	02-Nov-2022	14-Nov-2022	14 days	12 days		15-Nov-2022	40 days	1 days	✓
Polycyclic Aromatic Hydrocarbons : PAHs by Hexane LVI GC-MS											
Amber glass/Teflon lined cap (sodium bisulfate) MW22-05		E641A	02-Nov-2022	14-Nov-2022	14 days	12 days		15-Nov-2022	40 days	1 days	✓
Polycyclic Aromatic Hydrocarbons : PAHs by Hexane LVI GC-MS											
Amber glass/Teflon lined cap (sodium bisulfate) Noohalk Creek Downstream		E641A	31-Oct-2022	13-Nov-2022	14 days	13 days		13-Nov-2022	40 days	0 days	✓
Polycyclic Aromatic Hydrocarbons : PAHs by Hexane LVI GC-MS											
Amber glass/Teflon lined cap (sodium bisulfate) Noohalk Creek Upstream		E641A	31-Oct-2022	13-Nov-2022	14 days	13 days		13-Nov-2022	40 days	0 days	✓



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

Analyte Group	Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis				
				Preparation Date	Holding Times		Eval	Analysis Date	Holding Times			
					Rec	Actual			Rec	Actual		
Total Metals : Total Mercury in Water by CVAAS												
Glass vial total (hydrochloric acid)	Noohalk Creek Downstream	E508	31-Oct-2022	07-Nov-2022				07-Nov-2022	28 days	7 days	✓	
Total Metals : Total Mercury in Water by CVAAS												
Glass vial total (hydrochloric acid)	Noohalk Creek Upstream	E508	31-Oct-2022	07-Nov-2022				07-Nov-2022	28 days	7 days	✓	
Total Metals : Total metals in Water by CRC ICPMS												
HDPE total (nitric acid)	Noohalk Creek Downstream	E420	31-Oct-2022	10-Nov-2022				15-Nov-2022	180 days	15 days	✓	
Total Metals : Total metals in Water by CRC ICPMS												
HDPE total (nitric acid)	Noohalk Creek Upstream	E420	31-Oct-2022	10-Nov-2022				15-Nov-2022	180 days	15 days	✓	
Volatile Organic Compounds : VOCs (BC List) by Headspace GC-MS												
Glass vial (sodium bisulfate)	DUP	E611C	02-Nov-2022	08-Nov-2022				12-Nov-2022				
Volatile Organic Compounds : VOCs (BC List) by Headspace GC-MS												
Glass vial (sodium bisulfate)	Field Blank	E611C	02-Nov-2022	08-Nov-2022				12-Nov-2022				
Volatile Organic Compounds : VOCs (BC List) by Headspace GC-MS												
Glass vial (sodium bisulfate)	MW22-01	E611C	02-Nov-2022	08-Nov-2022				12-Nov-2022				
Volatile Organic Compounds : VOCs (BC List) by Headspace GC-MS												
Glass vial (sodium bisulfate)	MW22-02	E611C	02-Nov-2022	08-Nov-2022				12-Nov-2022				
Volatile Organic Compounds : VOCs (BC List) by Headspace GC-MS												
Glass vial (sodium bisulfate)	MW22-03	E611C	02-Nov-2022	08-Nov-2022				12-Nov-2022				



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

Analyte Group		Method	Sampling Date	Extraction / Preparation				Analysis		
Container / Client Sample ID(s)	Analysis Date			Preparation Date	Holding Times		Eval	Holding Times		Eval
					Rec	Actual		Rec	Actual	
Volatile Organic Compounds : VOCs (BC List) by Headspace GC-MS										
Glass vial (sodium bisulfate)	MW22-04	E611C	02-Nov-2022	08-Nov-2022	08-Nov-2022	08-Nov-2022	12-Nov-2022	08-Nov-2022	12-Nov-2022	
Volatile Organic Compounds : VOCs (BC List) by Headspace GC-MS										
Glass vial (sodium bisulfate)	MW22-05	E611C	02-Nov-2022	08-Nov-2022	08-Nov-2022	08-Nov-2022	12-Nov-2022	08-Nov-2022	12-Nov-2022	
Volatile Organic Compounds : VOCs (BC List) by Headspace GC-MS										
Glass vial (sodium bisulfate)	Noohalk Creek Downstream	E611C	31-Oct-2022	08-Nov-2022	08-Nov-2022	08-Nov-2022	12-Nov-2022	08-Nov-2022	12-Nov-2022	
Volatile Organic Compounds : VOCs (BC List) by Headspace GC-MS										
Glass vial (sodium bisulfate)	Noohalk Creek Upstream	E611C	31-Oct-2022	08-Nov-2022	08-Nov-2022	08-Nov-2022	12-Nov-2022	08-Nov-2022	12-Nov-2022	
Volatile Organic Compounds [Drycleaning] : VOCs (BC List) by Headspace GC-MS										
Glass vial (sodium bisulfate)	DUP	E611C	02-Nov-2022	08-Nov-2022	08-Nov-2022	08-Nov-2022	12-Nov-2022	08-Nov-2022	12-Nov-2022	
Volatile Organic Compounds [Drycleaning] : VOCs (BC List) by Headspace GC-MS										
Glass vial (sodium bisulfate)	Field Blank	E611C	02-Nov-2022	08-Nov-2022	08-Nov-2022	08-Nov-2022	12-Nov-2022	08-Nov-2022	12-Nov-2022	
Volatile Organic Compounds [Drycleaning] : VOCs (BC List) by Headspace GC-MS										
Glass vial (sodium bisulfate)	MW22-01	E611C	02-Nov-2022	08-Nov-2022	08-Nov-2022	08-Nov-2022	12-Nov-2022	08-Nov-2022	12-Nov-2022	
Volatile Organic Compounds [Drycleaning] : VOCs (BC List) by Headspace GC-MS										
Glass vial (sodium bisulfate)	MW22-02	E611C	02-Nov-2022	08-Nov-2022	08-Nov-2022	08-Nov-2022	12-Nov-2022	08-Nov-2022	12-Nov-2022	
Volatile Organic Compounds [Drycleaning] : VOCs (BC List) by Headspace GC-MS										
Glass vial (sodium bisulfate)	MW22-03	E611C	02-Nov-2022	08-Nov-2022	08-Nov-2022	08-Nov-2022	12-Nov-2022	08-Nov-2022	12-Nov-2022	



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Analyte Group		Method	Sampling Date	Extraction / Preparation				Analysis		
Container / Client Sample ID(s)	Eval			Preparation Date	Holding Times		Analysis Date	Holding Times		Eval
					Rec	Actual		Rec	Actual	
Volatile Organic Compounds [Drycleaning] : VOCs (BC List) by Headspace GC-MS										
Glass vial (sodium bisulfate) MW22-04		E611C	02-Nov-2022	08-Nov-2022	-----	-----	-----	-----	-----	
Volatile Organic Compounds [Drycleaning] : VOCs (BC List) by Headspace GC-MS										
Glass vial (sodium bisulfate) MW22-05		E611C	02-Nov-2022	08-Nov-2022	-----	-----	-----	-----	-----	
Volatile Organic Compounds [Drycleaning] : VOCs (BC List) by Headspace GC-MS										
Glass vial (sodium bisulfate) Noohalk Creek Downstream		E611C	31-Oct-2022	08-Nov-2022	-----	-----	-----	-----	-----	
Volatile Organic Compounds [Drycleaning] : VOCs (BC List) by Headspace GC-MS										
Glass vial (sodium bisulfate) Noohalk Creek Upstream		E611C	31-Oct-2022	08-Nov-2022	-----	-----	-----	-----	-----	
Volatile Organic Compounds [Fuels] : VOCs (BC List) by Headspace GC-MS										
Glass vial (sodium bisulfate) DUP		E611C	02-Nov-2022	08-Nov-2022	-----	-----	-----	14 days	10 days	
Volatile Organic Compounds [Fuels] : VOCs (BC List) by Headspace GC-MS										
Glass vial (sodium bisulfate) Field Blank		E611C	02-Nov-2022	08-Nov-2022	-----	-----	-----	14 days	10 days	
Volatile Organic Compounds [Fuels] : VOCs (BC List) by Headspace GC-MS										
Glass vial (sodium bisulfate) MW22-01		E611C	02-Nov-2022	08-Nov-2022	-----	-----	-----	14 days	10 days	
Volatile Organic Compounds [Fuels] : VOCs (BC List) by Headspace GC-MS										
Glass vial (sodium bisulfate) MW22-02		E611C	02-Nov-2022	08-Nov-2022	-----	-----	-----	14 days	10 days	
Volatile Organic Compounds [Fuels] : VOCs (BC List) by Headspace GC-MS										
Glass vial (sodium bisulfate) MW22-03		E611C	02-Nov-2022	08-Nov-2022	-----	-----	-----	14 days	10 days	



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Analyte Group		Method	Sampling Date	Extraction / Preparation				Analysis		
Container / Client Sample ID(s)	Eval			Preparation Date	Holding Times		Analysis Date	Holding Times		Eval
					Rec	Actual		Rec	Actual	
Volatile Organic Compounds [Fuels] : VOCs (BC List) by Headspace GC-MS										
Glass vial (sodium bisulfate) MW22-04		E611C	02-Nov-2022	08-Nov-2022	16:00:00	16:00:00	12-Nov-2022	14 days	10 days	✓
Volatile Organic Compounds [Fuels] : VOCs (BC List) by Headspace GC-MS										
Glass vial (sodium bisulfate) MW22-05		E611C	02-Nov-2022	08-Nov-2022	16:00:00	16:00:00	12-Nov-2022	14 days	10 days	✓
Volatile Organic Compounds [Fuels] : VOCs (BC List) by Headspace GC-MS										
Glass vial (sodium bisulfate) Noohalk Creek Downstream		E611C	31-Oct-2022	08-Nov-2022	16:00:00	16:00:00	12-Nov-2022	14 days	12 days	✓
Volatile Organic Compounds [Fuels] : VOCs (BC List) by Headspace GC-MS										
Glass vial (sodium bisulfate) Noohalk Creek Upstream		E611C	31-Oct-2022	08-Nov-2022	16:00:00	16:00:00	12-Nov-2022	14 days	12 days	✓
Volatile Organic Compounds [THMs] : VOCs (BC List) by Headspace GC-MS										
Glass vial (sodium bisulfate) DUP		E611C	02-Nov-2022	08-Nov-2022	16:00:00	16:00:00	12-Nov-2022	16:00:00	16:00:00	
Volatile Organic Compounds [THMs] : VOCs (BC List) by Headspace GC-MS										
Glass vial (sodium bisulfate) Field Blank		E611C	02-Nov-2022	08-Nov-2022	16:00:00	16:00:00	12-Nov-2022	16:00:00	16:00:00	
Volatile Organic Compounds [THMs] : VOCs (BC List) by Headspace GC-MS										
Glass vial (sodium bisulfate) MW22-01		E611C	02-Nov-2022	08-Nov-2022	16:00:00	16:00:00	12-Nov-2022	16:00:00	16:00:00	
Volatile Organic Compounds [THMs] : VOCs (BC List) by Headspace GC-MS										
Glass vial (sodium bisulfate) MW22-02		E611C	02-Nov-2022	08-Nov-2022	16:00:00	16:00:00	12-Nov-2022	16:00:00	16:00:00	
Volatile Organic Compounds [THMs] : VOCs (BC List) by Headspace GC-MS										
Glass vial (sodium bisulfate) MW22-03		E611C	02-Nov-2022	08-Nov-2022	16:00:00	16:00:00	12-Nov-2022	16:00:00	16:00:00	



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Matrix: Water										
Evaluation: ✖ = Holding time exceedance ; ✓ = Within Holding Time										
Analyte Group		Method	Sampling Date	Extraction / Preparation			Analysis			
Container / Client Sample ID(s)	Preparation Date			Holding Times		Eval	Analysis Date	Holding Times		
				Rec	Actual			Rec	Actual	
Volatile Organic Compounds [THMs] : VOCs (BC List) by Headspace GC-MS										
Glass vial (sodium bisulfate)	MW22-04	E611C	02-Nov-2022	08-Nov-2022	☐	☐		12-Nov-2022	☐	☐
Volatile Organic Compounds [THMs] : VOCs (BC List) by Headspace GC-MS										
Glass vial (sodium bisulfate)	MW22-05	E611C	02-Nov-2022	08-Nov-2022	☐	☐		12-Nov-2022	☐	☐
Volatile Organic Compounds [THMs] : VOCs (BC List) by Headspace GC-MS										
Glass vial (sodium bisulfate)	Noohalk Creek Downstream	E611C	31-Oct-2022	08-Nov-2022	☐	☐		12-Nov-2022	☐	☐
Volatile Organic Compounds [THMs] : VOCs (BC List) by Headspace GC-MS										
Glass vial (sodium bisulfate)	Noohalk Creek Upstream	E611C	31-Oct-2022	08-Nov-2022	☐	☐		12-Nov-2022	☐	☐

Legend & Qualifier Definitions

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

EHTL: Exceeded ALS recommended hold time prior to analysis. Sample was received less than 24 hours prior to expiry.

EHT: Exceeded ALS recommended hold time prior to analysis.

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



Quality Control Parameter Frequency Compliance

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

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

Quality Control Sample Type		QC Lot #	Count		Frequency (%)		Evaluation	
Analytical Methods	Method		QC	Regular	Actual	Expected		
Laboratory Duplicates (DUP)	Alkalinity Species by Titration	E290	745789	1	9	11.1	5.0	✓
	Ammonia by Fluorescence	E298	745895	1	9	11.1	5.0	✓
	Biochemical Oxygen Demand - 5 day	E550	731090	1	15	6.6	5.0	✓
	Bromide in Water by IC (Low Level)	E235.Br-L	731535	3	30	10.0	5.0	✓
	Chemical Oxygen Demand by Colourimetry (Low Level)	E559-L	740658	1	19	5.2	5.0	✓
	Chloride in Water by IC	E235.Cl	731534	3	50	6.0	5.0	✓
	Conductivity in Water	E100	731532	3	40	7.5	5.0	✓
	Dissolved Mercury in Water by CVAAS	E509	731623	1	20	5.0	5.0	✓
	Dissolved Metals in Water by CRC ICPMS	E421	736358	1	20	5.0	5.0	✓
	Dissolved Orthophosphate by Colourimetry (Ultra Trace Level 0.001 mg/L)	E378-U	731539	3	26	11.5	5.0	✓
	Fluoride in Water by IC	E235.F	731533	3	43	6.9	5.0	✓
	Nitrate in Water by IC (Low Level)	E235.NO3-L	731536	3	46	6.5	5.0	✓
	Nitrite in Water by IC (Low Level)	E235.NO2-L	731537	3	54	5.5	5.0	✓
	pH by Meter	E108	731530	3	49	6.1	5.0	✓
	Sulfate in Water by IC	E235.SO4	731538	3	53	5.6	5.0	✓
	TDS by Gravimetry	E162	731864	1	20	5.0	5.0	✓
	Total Mercury in Water by CVAAS	E508	733391	1	20	5.0	5.0	✓
	Total metals in Water by CRC ICPMS	E420	735839	1	20	5.0	5.0	✓
	Total Organic Carbon (Non-Purgeable) by Combustion (Low Level)	E355-L	732901	1	20	5.0	5.0	✓
	TSS by Gravimetry	E160	731860	1	20	5.0	5.0	✓
	VOCs (BC List) by Headspace GC-MS	E611C	734790	1	9	11.1	5.0	✓
	Laboratory Control Samples (LCS)							
	Alkalinity Species by Titration	E290	745789	1	9	11.1	5.0	✓
	Ammonia by Fluorescence	E298	745895	1	9	11.1	5.0	✓
	BC PHCs - EPH by GC-FID	E601A	741177	2	12	16.6	5.0	✓
	Biochemical Oxygen Demand - 5 day	E550	731090	1	15	6.6	5.0	✓
Bromide in Water by IC (Low Level)	E235.Br-L	731535	3	30	10.0	5.0	✓	
Chemical Oxygen Demand by Colourimetry (Low Level)	E559-L	740658	1	19	5.2	5.0	✓	
Chloride in Water by IC	E235.Cl	731534	3	50	6.0	5.0	✓	
Conductivity in Water	E100	731532	3	40	7.5	5.0	✓	
Dissolved Mercury in Water by CVAAS	E509	731623	1	20	5.0	5.0	✓	
Dissolved Metals in Water by CRC ICPMS	E421	736358	1	20	5.0	5.0	✓	
Dissolved Orthophosphate by Colourimetry (Ultra Trace Level 0.001 mg/L)	E378-U	731539	3	26	11.5	5.0	✓	
Fluoride in Water by IC	E235.F	731533	3	43	6.9	5.0	✓	
Nitrate in Water by IC (Low Level)	E235.NO3-L	731536	3	46	6.5	5.0	✓	
Nitrite in Water by IC (Low Level)	E235.NO2-L	731537	3	54	5.5	5.0	✓	



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

Quality Control Sample Type							
Analytical Methods	Method	QC Lot #	Count		Frequency (%)		Evaluation
			QC	Regular	Actual	Expected	
Laboratory Control Samples (LCS) - Continued							
PAHs by Hexane LVI GC-MS	E641A	741176	2	16	12.5	5.0	✓
pH by Meter	E108	731530	3	49	6.1	5.0	✓
Sulfate in Water by IC	E235.SO4	731538	3	53	5.6	5.0	✓
TDS by Gravimetry	E162	731864	1	20	5.0	5.0	✓
Total Mercury in Water by CVAAS	E508	733391	1	20	5.0	5.0	✓
Total metals in Water by CRC ICPMS	E420	735839	1	20	5.0	5.0	✓
Total Organic Carbon (Non-Purgeable) by Combustion (Low Level)	E355-L	732901	1	20	5.0	5.0	✓
TSS by Gravimetry	E160	731860	1	20	5.0	5.0	✓
VOCs (BC List) by Headspace GC-MS	E611C	734790	1	9	11.1	5.0	✓
Method Blanks (MB)							
Alkalinity Species by Titration	E290	745789	1	9	11.1	5.0	✓
Ammonia by Fluorescence	E298	745895	1	9	11.1	5.0	✓
BC PHCs - EPH by GC-FID	E601A	741177	2	12	16.6	5.0	✓
Biochemical Oxygen Demand - 5 day	E550	731090	1	15	6.6	5.0	✓
Bromide in Water by IC (Low Level)	E235.Br-L	731535	3	30	10.0	5.0	✓
Chemical Oxygen Demand by Colourimetry (Low Level)	E559-L	740658	1	19	5.2	5.0	✓
Chloride in Water by IC	E235.Cl	731534	3	50	6.0	5.0	✓
Conductivity in Water	E100	731532	3	40	7.5	5.0	✓
Dissolved Mercury in Water by CVAAS	E509	731623	1	20	5.0	5.0	✓
Dissolved Metals in Water by CRC ICPMS	E421	736358	1	20	5.0	5.0	✓
Dissolved Orthophosphate by Colourimetry (Ultra Trace Level 0.001 mg/L)	E378-U	731539	3	26	11.5	5.0	✓
Fluoride in Water by IC	E235.F	731533	3	43	6.9	5.0	✓
Nitrate in Water by IC (Low Level)	E235.NO3-L	731536	3	46	6.5	5.0	✓
Nitrite in Water by IC (Low Level)	E235.NO2-L	731537	3	54	5.5	5.0	✓
PAHs by Hexane LVI GC-MS	E641A	741176	2	16	12.5	5.0	✓
Sulfate in Water by IC	E235.SO4	731538	3	53	5.6	5.0	✓
TDS by Gravimetry	E162	731864	1	20	5.0	5.0	✓
Total Mercury in Water by CVAAS	E508	733391	1	20	5.0	5.0	✓
Total metals in Water by CRC ICPMS	E420	735839	1	20	5.0	5.0	✓
Total Organic Carbon (Non-Purgeable) by Combustion (Low Level)	E355-L	732901	1	20	5.0	5.0	✓
TSS by Gravimetry	E160	731860	1	20	5.0	5.0	✓
VOCs (BC List) by Headspace GC-MS	E611C	734790	1	9	11.1	5.0	✓
Matrix Spikes (MS)							
Ammonia by Fluorescence	E298	745895	1	9	11.1	5.0	✓
Bromide in Water by IC (Low Level)	E235.Br-L	731535	3	30	10.0	5.0	✓
Chemical Oxygen Demand by Colourimetry (Low Level)	E559-L	740658	1	19	5.2	5.0	✓
Chloride in Water by IC	E235.Cl	731534	3	50	6.0	5.0	✓
Dissolved Mercury in Water by CVAAS	E509	731623	1	20	5.0	5.0	✓
Dissolved Metals in Water by CRC ICPMS	E421	736358	1	20	5.0	5.0	✓



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Matrix: Water									
Evaluation: * = QC frequency outside specification; ✓ = QC frequency within specification.									
Quality Control Sample Type		Method	QC Lot #	Count		Frequency (%)		Evaluation	
Analytical Methods				QC	Regular	Actual	Expected		
Matrix Spikes (MS) - Continued									
Dissolved Orthophosphate by Colourimetry (Ultra Trace Level 0.001 mg/L)		E378-U	731539	3	26	11.5	5.0		✓
Fluoride in Water by IC		E235.F	731533	3	43	6.9	5.0		✓
Nitrate in Water by IC (Low Level)		E235.NO3-L	731536	3	46	6.5	5.0		✓
Nitrite in Water by IC (Low Level)		E235.NO2-L	731537	3	54	5.5	5.0		✓
Sulfate in Water by IC		E235.SO4	731538	3	53	5.6	5.0		✓
Total Mercury in Water by CVAAS		E508	733391	1	20	5.0	5.0		✓
Total metals in Water by CRC ICPMS		E420	735839	1	20	5.0	5.0		✓
Total Organic Carbon (Non-Purgeable) by Combustion (Low Level)		E355-L	732901	1	20	5.0	5.0		✓
VOCs (BC List) by Headspace GC-MS		E611C	734790	1	9	11.1	5.0		✓



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Methodology References and Summaries

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

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



Analytical Methods		Method / Lab	Matrix	Method Reference	Method Descriptions
Sulfate in Water by IC		E235.S04 Vancouver - Environmental	Water	EPA 300.1 (mod)	Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.
Alkalinity Species by Titration		E290 Vancouver - Environmental	Water	APHA 2320 B (mod)	Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.
Ammonia by Fluorescence		E298 Vancouver - Environmental	Water	Method Fialab 100, 2018	Ammonia in water is determined by automated continuous flow analysis with membrane diffusion and fluorescence detection, after reaction with OPA (ortho-phthalaldehyde). This method is approved under US EPA 40 CFR Part 136 (May 2021)
Total Organic Carbon (Non-Purgeable) by Combustion (Low Level)		E355-L Vancouver - Environmental	Water	APHA 5310 B (mod)	Total Organic Carbon (Non-Purgeable), also known as NPOC (total), is a direct measurement of TOC after an acidified sample has been purged to remove inorganic carbon (IC). Analysis is by high temperature combustion with infrared detection of CO ₂ . NPOC does not include volatile organic species that are purged off with IC. For samples where the majority of total carbon (TC) is comprised of IC (which is common), this method is more accurate and more reliable than the TOC by subtraction method (i.e. TC minus TIC).
Dissolved Orthophosphate by Colourimetry (Ultra Trace Level 0.001 mg/L)		E378-U Vancouver - Environmental	Water	APHA 4500-P F (mod)	Dissolved Orthophosphate is determined colourimetrically on a sample that has been lab or field filtered through a 0.45 micron membrane filter.
Total metals in Water by CRC ICPMS		E420 Vancouver - Environmental	Water	EPA 200.2/6020B (mod)	Field filtration is recommended to ensure test results represent conditions at time of sampling. Water samples are digested with nitric and hydrochloric acids, and analyzed by Collision/Reaction Cell ICPMS.
Dissolved Metals in Water by CRC ICPMS		E421 Vancouver - Environmental	Water	APHA 3030B/EPA 6020B (mod)	Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by Collision/Reaction Cell ICPMS.
Total Mercury in Water by CVAAS		E508 Vancouver - Environmental	Water	EPA 1631E (mod)	Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method. Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS
Dissolved Mercury in Water by CVAAS		E509 Vancouver - Environmental	Water	APHA 3030B/EPA 1631E (mod)	Water samples are filtered (0.45 um), preserved with HCl, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS.



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Analytical Methods		Method / Lab	Matrix	Method Reference	Method Descriptions
Biochemical Oxygen Demand - 5 day		E550 Vancouver - Environmental	Water	APHA 5210 B (mod)	Samples are diluted and incubated for a specified time period, after which the oxygen depletion is measured using a dissolved oxygen meter.
Chemical Oxygen Demand by Colourimetry (Low Level)		E559-L Vancouver - Environmental	Water	APHA 5220 D (mod)	Free chlorine is a negative interference in the BOD method; please advise ALS when free chlorine is present in samples. Samples are analyzed using the closed reflux colourimetric method.
BC PHCs - EPH by GC-FID		E601A Calgary - Environmental	Water	BC MOE Lab Manual	Sample extracts are analyzed by GC-FID for BC hydrocarbon fractions.
VOCs (BC List) by Headspace GC-MS		E611C Calgary - Environmental	Water	EPA 8260D (mod)	Volatile Organic Compounds (VOCs) are analyzed by static headspace GC-MS. Samples are prepared in headspace vials and are heated and agitated on the headspace autosampler, causing VOCs to partition between the aqueous phase and the headspace in accordance with Henry's law.
PAHs by Hexane LVI GC-MS		E641A Calgary - Environmental	Water	EPA 8270E (mod)	Polycyclic Aromatic Hydrocarbons (PAHs) are analyzed by large volume injection (LVI) GC-MS.
Dissolved Hardness (Calculated)		EC100 Vancouver - Environmental	Water	APHA 2340B	"Hardness (as 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.
Hardness (Calculated) from Total Ca/Mg		EC100A Vancouver - Environmental	Water	APHA 2340B	"Hardness (as CaCO ₃), from total Ca/Mg" is calculated from the sum of total 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. Hardness from total Ca/Mg is normally comparable to Dissolved Hardness in non-turbid waters.
Nitrate and Nitrite (as N) (Calculation)		EC235.N+N Vancouver - Environmental	Water	EPA 300.0	Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).
LEPH and HEPH: EPH-PAH		EC600A Calgary - Environmental	Water	BC MOE Lab Manual (LEPH and HEPH) (mod)	Light Extractable Petroleum Hydrocarbons (LEPH) and Heavy Extractable Petroleum Hydrocarbons (HEPH) are calculated as follows: LEPH = Extractable Petroleum Hydrocarbons (EPH10-19) minus Acenaphthene, Acridine, Anthracene, Fluorene, Naphthalene and Phenanthrene; HEPH = Extractable Petroleum Hydrocarbons (EPH19-32) minus Benz(a)anthracene, Benzo(a)pyrene, Fluoranthene, and Pyrene.
Preparation Methods		Method / Lab	Matrix	Method Reference	Method Descriptions
Preparation for Ammonia		EP298 Vancouver - Environmental	Water		Sample preparation for Preserved Nutrients Water Quality Analysis.



Preparation Methods		Method / Lab	Matrix	Method Reference	Method Descriptions
Preparation for Total Organic Carbon by Combustion		EP355 Vancouver - Environmental	Water		Preparation for Total Organic Carbon by Combustion
Dissolved Metals Water Filtration		EP421 Vancouver - Environmental	Water	APHA 3030B	Water samples are filtered (0.45 um), and preserved with HNO ₃ .
Dissolved Mercury Water Filtration		EP509 Vancouver - Environmental	Water	APHA 3030B	Water samples are filtered (0.45 um), and preserved with HCl.
VOCs Preparation for Headspace Analysis		EP581 Calgary - Environmental	Water	EPA 5021A (mod)	Samples are prepared in headspace vials and are heated and agitated on the headspace autosampler. An aliquot of the headspace is then injected into the GC/MS-FID system.
PHCs and PAHs Hexane Extraction		EP601 Calgary - Environmental	Water	EPA 3511 (mod)	Petroleum Hydrocarbons (PHCs) and Polycyclic Aromatic Hydrocarbons (PAHs) are extracted using a hexane liquid-liquid extraction.

QUALITY CONTROL REPORT

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

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

This Quality Control Report contains the following information:

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

Signatories

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

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



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Project : 210629400

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.



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Work Order : VA22C6784 Amendment 1
Client : Morrison Hershfield Limited
Project : 210629400

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



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Work Order : VA22C6784 Amendment 1
Client : Morrison Hershfield Limited
Project : 210629400

Sub-Matrix: Water						Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Client sample ID	Analyte	CAS Number	Method	LOR	Unit	Original Result	Duplicate Result	RPD(%) or Difference	Duplicate Limits	Qualifier
Anions and Nutrients (QC Lot: 731539) - continued											
KS2204232-001	Anonymous	phosphate, ortho-, dissolved (as P)	14265-44-2	E378-U	0.0100	mg/L	0.0563	0.0562	0.0001	Diff <2x LOR	----
Anions and Nutrients (QC Lot: 731552)											
KS2204232-002	Anonymous	phosphate, ortho-, dissolved (as P)	14265-44-2	E378-U	0.0010	mg/L	0.0302	0.0302	0.241%	20%	----
Anions and Nutrients (QC Lot: 731556)											
FJ2203127-001	Anonymous	chloride	16887-00-6	E235.Cl	0.50	mg/L	<0.50	<0.50	0	Diff <2x LOR	----
Anions and Nutrients (QC Lot: 731557)											
FJ2203127-001	Anonymous	nitrite (as N)	14797-65-0	E235.NO2-L	0.0010	mg/L	<0.0010	<0.0010	0	Diff <2x LOR	----
Anions and Nutrients (QC Lot: 731559)											
FJ2203127-001	Anonymous	sulfate (as SO4)	14808-79-8	E235.SO4	0.30	mg/L	14.0	14.1	0.412%	20%	----
Anions and Nutrients (QC Lot: 731560)											
KS2204232-002	Anonymous	fluoride	16984-48-8	E235.F	0.400	mg/L	<0.400	<0.400	0	Diff <2x LOR	----
Anions and Nutrients (QC Lot: 731561)											
KS2204232-002	Anonymous	bromide	24959-67-9	E235.Br-L	1.00	mg/L	1.20	1.30	0.095	Diff <2x LOR	----
Anions and Nutrients (QC Lot: 731562)											
KS2204232-002	Anonymous	nitrate (as N)	14797-55-8	E235.NO3-L	0.100	mg/L	44.3	43.8	1.10%	20%	----
Anions and Nutrients (QC Lot: 731609)											
VA22C6784-008	Noohalk Creek Upstream	sulfate (as SO4)	14808-79-8	E235.SO4	0.30	mg/L	2.29	2.25	0.04	Diff <2x LOR	----
Anions and Nutrients (QC Lot: 731610)											
VA22C6784-008	Noohalk Creek Upstream	nitrate (as N)	14797-55-8	E235.NO3-L	0.0050	mg/L	0.740	0.742	0.254%	20%	----
Anions and Nutrients (QC Lot: 731611)											
VA22C6784-008	Noohalk Creek Upstream	nitrite (as N)	14797-65-0	E235.NO2-L	0.0010	mg/L	<0.0010	<0.0010	0	Diff <2x LOR	----
Anions and Nutrients (QC Lot: 731612)											
VA22C6784-008	Noohalk Creek Upstream	fluoride	16984-48-8	E235.F	0.020	mg/L	<0.020	<0.020	0	Diff <2x LOR	----
Anions and Nutrients (QC Lot: 731613)											
VA22C6784-008	Noohalk Creek Upstream	chloride	16887-00-6	E235.Cl	0.50	mg/L	<0.50	<0.50	0	Diff <2x LOR	----
Anions and Nutrients (QC Lot: 731614)											
VA22C6784-008	Noohalk Creek Upstream	bromide	24959-67-9	E235.Br-L	0.050	mg/L	<0.050	<0.050	0	Diff <2x LOR	----
Anions and Nutrients (QC Lot: 731620)											
VA22C6784-008	Noohalk Creek Upstream	phosphate, ortho-, dissolved (as P)	14265-44-2	E378-U	0.0010	mg/L	<0.0010	<0.0010	0	Diff <2x LOR	----
Anions and Nutrients (QC Lot: 745895)											
VA22C6784-001	MW22-01	ammonia, total (as N)	7664-41-7	E298	0.0050	mg/L	<0.0050	<0.0050	0	Diff <2x LOR	----
Organic / Inorganic Carbon (QC Lot: 732901)											
VA22C6784-001	MW22-01	carbon, total organic [TOC]	-----	E355-L	0.50	mg/L	<0.50	<0.50	0	Diff <2x LOR	----



Sub-Matrix: Water						Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Client sample ID	Analyte	CAS Number	Method	LOR	Unit	Original Result	Duplicate Result	RPD(%) or Difference	Duplicate Limits	Qualifier
Total Metals (QC Lot: 733391)											
KS2204233-001	Anonymous	mercury, total	7439-97-6	E508	0.0000050	mg/L	<0.0000050	<0.0000050	0	Diff <2x LOR	----
Total Metals (QC Lot: 735839)											
VA22C6711-001	Anonymous	aluminum, total	7429-90-5	E420	0.0060	mg/L	1.17	1.20	3.01%	20%	----
		antimony, total	7440-36-0	E420	0.00020	mg/L	<0.00020	<0.00020	0	Diff <2x LOR	----
		arsenic, total	7440-38-2	E420	0.00020	mg/L	<0.00020	0.00020	0.000004	Diff <2x LOR	----
		barium, total	7440-39-3	E420	0.00020	mg/L	0.00668	0.00671	0.398%	20%	----
		beryllium, total	7440-41-7	E420	0.00040	mg/L	0.000075	0.000067	0.000008	Diff <2x LOR	----
		bismuth, total	7440-69-9	E420	0.000100	mg/L	<0.000100	<0.000100	0	Diff <2x LOR	----
		boron, total	7440-42-8	E420	0.020	mg/L	0.170	0.162	0.008	Diff <2x LOR	----
		cadmium, total	7440-43-9	E420	0.0000100	mg/L	0.00372	0.00378	1.72%	20%	----
		calcium, total	7440-70-2	E420	0.100	mg/L	508	488	4.14%	20%	----
		cesium, total	7440-46-2	E420	0.000020	mg/L	0.000201	0.000200	0.236%	20%	----
		chromium, total	7440-47-3	E420	0.00050	mg/L	<0.00050	0.00080	0.00030	Diff <2x LOR	----
		cobalt, total	7440-48-4	E420	0.00020	mg/L	0.00296	0.00297	0.152%	20%	----
		copper, total	7440-50-8	E420	0.00100	mg/L	0.895	0.903	0.912%	20%	----
		iron, total	7439-89-6	E420	0.020	mg/L	0.068	0.071	0.003	Diff <2x LOR	----
		lead, total	7439-92-1	E420	0.000100	mg/L	0.00417	0.00423	1.26%	20%	----
		lithium, total	7439-93-2	E420	0.0020	mg/L	0.0554	0.0515	7.36%	20%	----
		magnesium, total	7439-95-4	E420	0.0100	mg/L	40.9	40.5	1.04%	20%	----
		manganese, total	7439-96-5	E420	0.00020	mg/L	0.342	0.349	1.90%	20%	----
		molybdenum, total	7439-98-7	E420	0.000100	mg/L	0.000158	0.000142	0.000015	Diff <2x LOR	----
		nickel, total	7440-02-0	E420	0.00100	mg/L	0.00238	0.00234	0.00005	Diff <2x LOR	----
		phosphorus, total	7723-14-0	E420	0.100	mg/L	<0.100	<0.100	0	Diff <2x LOR	----
		potassium, total	7440-09-7	E420	0.100	mg/L	0.973	0.989	0.016	Diff <2x LOR	----
		rubidium, total	7440-17-7	E420	0.00040	mg/L	0.00106	0.00096	0.00010	Diff <2x LOR	----
		selenium, total	7782-49-2	E420	0.000100	mg/L	0.000219	0.000185	0.000034	Diff <2x LOR	----
		silicon, total	7440-21-3	E420	0.20	mg/L	2.20	2.22	0.878%	20%	----
		silver, total	7440-22-4	E420	0.000020	mg/L	<0.000020	<0.000020	0	Diff <2x LOR	----
		sodium, total	7440-23-5	E420	0.100	mg/L	10.6	10.8	2.08%	20%	----
		strontium, total	7440-24-6	E420	0.00040	mg/L	2.20	2.31	4.65%	20%	----
		sulfur, total	7704-34-9	E420	1.00	mg/L	534	529	1.03%	20%	----
		tellurium, total	13494-80-9	E420	0.00040	mg/L	<0.00040	<0.00040	0	Diff <2x LOR	----
		thallium, total	7440-28-0	E420	0.000020	mg/L	0.000050	0.000052	0.000002	Diff <2x LOR	----
		thorium, total	7440-29-1	E420	0.00020	mg/L	<0.00020	<0.00020	0	Diff <2x LOR	----



Sub-Matrix: Water			Laboratory Duplicate (DUP) Report								
Laboratory sample ID	Client sample ID	Analyte	CAS Number	Method	LOR	Unit	Original Result	Duplicate Result	RPD(%) or Difference	Duplicate Limits	Qualifier
Total Metals (QC Lot: 735839) - continued											
VA22C6711-001	Anonymous	tin, total	7440-31-5	E420	0.00020	mg/L	<0.00020	<0.00020	0	Diff <2x LOR	-----
		titanium, total	7440-32-6	E420	0.00060	mg/L	<0.00060	<0.00060	0	Diff <2x LOR	-----
		tungsten, total	7440-33-7	E420	0.00020	mg/L	<0.00020	<0.00020	0	Diff <2x LOR	-----
		uranium, total	7440-61-1	E420	0.000020	mg/L	0.000098	0.000093	0.000005	Diff <2x LOR	-----
		vanadium, total	7440-62-2	E420	0.00100	mg/L	<0.00100	<0.00100	0	Diff <2x LOR	-----
		zinc, total	7440-66-6	E420	0.0060	mg/L	0.886	0.892	0.624%	20%	-----
		zirconium, total	7440-67-7	E420	0.00040	mg/L	<0.00040	<0.00040	0	Diff <2x LOR	-----
Dissolved Metals (QC Lot: 731623)											
VA22C6110-014	Anonymous	mercury, dissolved	7439-97-6	E509	0.00250	mg/L	0.0144	0.0160	0.00154	Diff <2x LOR	-----
Dissolved Metals (QC Lot: 736358)											
TY2203715-001	Anonymous	aluminum, dissolved	7429-90-5	E421	0.0020	mg/L	0.322	0.324	0.703%	20%	-----
		antimony, dissolved	7440-36-0	E421	0.00020	mg/L	<0.00020	<0.00020	0	Diff <2x LOR	-----
		arsenic, dissolved	7440-38-2	E421	0.00020	mg/L	0.00147	0.00144	0.00004	Diff <2x LOR	-----
		barium, dissolved	7440-39-3	E421	0.00020	mg/L	0.291	0.300	2.96%	20%	-----
		beryllium, dissolved	7440-41-7	E421	0.000040	mg/L	<0.000040	<0.000040	0	Diff <2x LOR	-----
		bismuth, dissolved	7440-69-9	E421	0.000100	mg/L	<0.000100	<0.000100	0	Diff <2x LOR	-----
		boron, dissolved	7440-42-8	E421	0.020	mg/L	0.024	0.024	0.0003	Diff <2x LOR	-----
		cadmium, dissolved	7440-43-9	E421	0.0000100	mg/L	<0.0000100	<0.0000100	0	Diff <2x LOR	-----
		calcium, dissolved	7440-70-2	E421	0.100	mg/L	273	266	2.54%	20%	-----
		cesium, dissolved	7440-46-2	E421	0.000020	mg/L	0.00204	0.00201	1.57%	20%	-----
		chromium, dissolved	7440-47-3	E421	0.00100	mg/L	<0.00100	<0.00100	0	Diff <2x LOR	-----
		cobalt, dissolved	7440-48-4	E421	0.00020	mg/L	<0.00020	<0.00020	0	Diff <2x LOR	-----
		copper, dissolved	7440-50-8	E421	0.00040	mg/L	<0.00040	<0.00040	0	Diff <2x LOR	-----
		iron, dissolved	7439-89-6	E421	0.020	mg/L	0.158	0.154	0.004	Diff <2x LOR	-----
		lead, dissolved	7439-92-1	E421	0.000100	mg/L	<0.000100	<0.000100	0	Diff <2x LOR	-----
		lithium, dissolved	7439-93-2	E421	0.0020	mg/L	0.136	0.134	0.828%	20%	-----
		magnesium, dissolved	7439-95-4	E421	0.0100	mg/L	0.0250	0.0235	0.0015	Diff <2x LOR	-----
		manganese, dissolved	7439-96-5	E421	0.00020	mg/L	0.00194	0.00181	0.00013	Diff <2x LOR	-----
		molybdenum, dissolved	7439-98-7	E421	0.000100	mg/L	0.0276	0.0275	0.354%	20%	-----
		nickel, dissolved	7440-02-0	E421	0.00100	mg/L	0.00144	0.00147	0.00003	Diff <2x LOR	-----
		phosphorus, dissolved	7723-14-0	E421	0.100	mg/L	<0.100	<0.100	0	Diff <2x LOR	-----
		potassium, dissolved	7440-09-7	E421	0.100	mg/L	65.4	63.9	2.27%	20%	-----
		rubidium, dissolved	7440-17-7	E421	0.00040	mg/L	0.169	0.168	0.612%	20%	-----
		selenium, dissolved	7782-49-2	E421	0.000100	mg/L	0.00109	0.00119	8.82%	20%	-----



Sub-Matrix: **Water**

Sub-Matrix: Water											
Laboratory Duplicate (DUP) Report											
Laboratory sample ID	Client sample ID	Analyte	CAS Number	Method	LOR	Unit	Original Result	Duplicate Result	RPD(%) or Difference	Duplicate Limits	Qualifier
Dissolved Metals (QC Lot: 736358) - continued											
TY2203715-001	Anonymous	silicon, dissolved	7440-21-3	E421	0.100	mg/L	1.51	1.49	1.38%	20%	----
		silver, dissolved	7440-22-4	E421	0.000020	mg/L	<0.000020	<0.000020	0	Diff <2x LOR	----
		sodium, dissolved	7440-23-5	E421	0.100	mg/L	120	121	1.03%	20%	----
		strontium, dissolved	7440-24-6	E421	0.00040	mg/L	1.44	1.42	1.16%	20%	----
		sulfur, dissolved	7704-34-9	E421	1.00	mg/L	26.1	26.6	1.93%	20%	----
		tellurium, dissolved	13494-80-9	E421	0.00040	mg/L	<0.00040	<0.00040	0	Diff <2x LOR	----
		thallium, dissolved	7440-28-0	E421	0.000020	mg/L	<0.000020	<0.000020	0	Diff <2x LOR	----
		thorium, dissolved	7440-29-1	E421	0.00020	mg/L	<0.00020	<0.00020	0	Diff <2x LOR	----
		tin, dissolved	7440-31-5	E421	0.00020	mg/L	<0.00020	<0.00020	0	Diff <2x LOR	----
		titanium, dissolved	7440-32-6	E421	0.00060	mg/L	<0.00060	<0.00060	0	Diff <2x LOR	----
		tungsten, dissolved	7440-33-7	E421	0.00020	mg/L	0.00251	0.00254	1.14%	20%	----
		uranium, dissolved	7440-61-1	E421	0.000020	mg/L	<0.000020	<0.000020	0	Diff <2x LOR	----
		vanadium, dissolved	7440-62-2	E421	0.00100	mg/L	0.00924	0.00931	0.00007	Diff <2x LOR	----
		zinc, dissolved	7440-66-6	E421	0.0020	mg/L	<0.0020	<0.0020	0	Diff <2x LOR	----
		zirconium, dissolved	7440-67-7	E421	0.00060	mg/L	<0.00060	<0.00060	0	Diff <2x LOR	----
Aggregate Organics (QC Lot: 731090)											
KS2204223-001	Anonymous	biochemical oxygen demand [BOD]	----	E550	2.0	mg/L	<2.0	<2.0	0.0%	30%	----
Aggregate Organics (QC Lot: 740658)											
VA22C6704-001	Anonymous	chemical oxygen demand [COD]	----	E559-L	10	mg/L	18	18	0.3	Diff <2x LOR	----
Volatile Organic Compounds (QC Lot: 734790)											
VA22C6784-001	MW22-01	benzene	71-43-2	E611C	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		bromodichloromethane	75-27-4	E611C	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		bromoform	75-25-2	E611C	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		carbon tetrachloride	56-23-5	E611C	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		chlorobenzene	108-90-7	E611C	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		chloroethane	75-00-3	E611C	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		chloroform	67-66-3	E611C	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		chloromethane	74-87-3	E611C	5.0	µg/L	<5.0	<5.0	0	Diff <2x LOR	----
		dibromochloromethane	124-48-1	E611C	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		dichlorobenzene, 1,2-	95-50-1	E611C	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		dichlorobenzene, 1,3-	541-73-1	E611C	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		dichlorobenzene, 1,4-	106-46-7	E611C	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		dichloroethane, 1,1-	75-34-3	E611C	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		dichloroethane, 1,2-	107-06-2	E611C	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----



Sub-Matrix: Water			Laboratory Duplicate (DUP) Report								
Laboratory sample ID	Client sample ID	Analyte	CAS Number	Method	LOR	Unit	Original Result	Duplicate Result	RPD(%) or Difference	Duplicate Limits	Qualifier
Volatile Organic Compounds (QC Lot: 734790) - continued											
VA22C6784-001	MW22-01	dichloroethylene, 1,1-	75-35-4	E611C	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	Pass
		dichloroethylene, cis-1,2-	156-59-2	E611C	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	Pass
		dichloroethylene, trans-1,2-	156-60-5	E611C	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	Pass
		dichloromethane	75-09-2	E611C	1.0	µg/L	<1.0	<1.0	0	Diff <2x LOR	Pass
		dichloropropane, 1,2-	78-87-5	E611C	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	Pass
		dichloropropylene, cis-1,3-	10061-01-5	E611C	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	Pass
		dichloropropylene, trans-1,3-	10061-02-6	E611C	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	Pass
		ethylbenzene	100-41-4	E611C	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	Pass
		methyl-tert-butyl ether [MTBE]	1634-04-4	E611C	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	Pass
		styrene	100-42-5	E611C	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	Pass
		tetrachloroethane, 1,1,1,2-	630-20-6	E611C	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	Pass
		tetrachloroethane, 1,1,2,2-	79-34-5	E611C	0.20	µg/L	<0.20	<0.20	0	Diff <2x LOR	Pass
		tetrachloroethylene	127-18-4	E611C	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	Pass
		toluene	108-88-3	E611C	0.40	µg/L	<0.40	<0.40	0	Diff <2x LOR	Pass
		trichloroethane, 1,1,1-	71-55-6	E611C	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	Pass
		trichloroethane, 1,1,2-	79-00-5	E611C	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	Pass
		trichloroethylene	79-01-6	E611C	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	Pass
		trichlorofluoromethane	75-69-4	E611C	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	Pass
		vinyl chloride	75-01-4	E611C	0.40	µg/L	<0.40	<0.40	0	Diff <2x LOR	Pass
		xylene, m+p-	179601-23-1	E611C	0.40	µg/L	<0.40	<0.40	0	Diff <2x LOR	Pass
		xylene, o-	95-47-6	E611C	0.30	µg/L	<0.30	<0.30	0	Diff <2x LOR	Pass



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 DOO for Method Blanks is for the result to be < LOR.

Sub-Matrix: Water

Analyte	CAS Number	Method	LOR	Unit	Result	Qualifier
Physical Tests (QCLot: 731532)						
conductivity	----	E100	1	µS/cm	1.1	-----
Physical Tests (QCLot: 731554)						
conductivity	----	E100	1	µS/cm	1.1	-----
Physical Tests (QCLot: 731617)						
conductivity	----	E100	1	µS/cm	1.2	-----
Physical Tests (QCLot: 731860)						
solids, total suspended [TSS]	----	E160	3	mg/L	<3.0	-----
Physical Tests (QCLot: 731864)						
solids, total dissolved [TDS]	----	E162	10	mg/L	<10	-----
Physical Tests (QCLot: 745789)						
alkalinity, total (as CaCO ₃)	----	E290	1	mg/L	<1.0	-----
Anions and Nutrients (QCLot: 731533)						
fluoride	16984-48-8	E235.F	0.02	mg/L	<0.020	-----
Anions and Nutrients (QCLot: 731534)						
chloride	16887-00-6	E235.Cl	0.5	mg/L	<0.50	-----
Anions and Nutrients (QCLot: 731535)						
bromide	24959-67-9	E235.Br-L	0.05	mg/L	<0.050	-----
Anions and Nutrients (QCLot: 731536)						
nitrate (as N)	14797-55-8	E235.NO3-L	0.005	mg/L	<0.0050	-----
Anions and Nutrients (QCLot: 731537)						
nitrite (as N)	14797-65-0	E235.NO2-L	0.001	mg/L	<0.0010	-----
Anions and Nutrients (QCLot: 731538)						
sulfate (as SO ₄)	14808-79-8	E235.SO4	0.3	mg/L	<0.30	-----
Anions and Nutrients (QCLot: 731539)						
phosphate, ortho-, dissolved (as P)	14265-44-2	E378-U	0.001	mg/L	<0.0010	-----
Anions and Nutrients (QCLot: 731552)						
phosphate, ortho-, dissolved (as P)	14265-44-2	E378-U	0.001	mg/L	<0.0010	-----
Anions and Nutrients (QCLot: 731556)						
chloride	16887-00-6	E235.Cl	0.5	mg/L	<0.50	-----
Anions and Nutrients (QCLot: 731557)						
nitrite (as N)	14797-65-0	E235.NO2-L	0.001	mg/L	<0.0010	-----
Anions and Nutrients (QCLot: 731559)						



Sub-Matrix: Water

Analyte	CAS Number	Method	LOR	Unit	Result	Qualifier
Anions and Nutrients (QCLot: 731559) - continued						
sulfate (as SO ₄)	14808-79-8	E235.SO4	0.3	mg/L	<0.30	-----
Anions and Nutrients (QCLot: 731560)						
fluoride	16984-48-8	E235.F	0.02	mg/L	<0.020	-----
Anions and Nutrients (QCLot: 731561)						
bromide	24959-67-9	E235.Br-L	0.05	mg/L	<0.050	-----
Anions and Nutrients (QCLot: 731562)						
nitrate (as N)	14797-55-8	E235.NO3-L	0.005	mg/L	<0.0050	-----
Anions and Nutrients (QCLot: 731609)						
sulfate (as SO ₄)	14808-79-8	E235.SO4	0.3	mg/L	<0.30	-----
Anions and Nutrients (QCLot: 731610)						
nitrate (as N)	14797-55-8	E235.NO3-L	0.005	mg/L	<0.0050	-----
Anions and Nutrients (QCLot: 731611)						
nitrite (as N)	14797-55-0	E235.NO2-L	0.001	mg/L	<0.0010	-----
Anions and Nutrients (QCLot: 731612)						
fluoride	16984-48-8	E235.F	0.02	mg/L	<0.020	-----
Anions and Nutrients (QCLot: 731613)						
chloride	16887-00-6	E235.Cl	0.5	mg/L	<0.50	-----
Anions and Nutrients (QCLot: 731614)						
bromide	24959-67-9	E235.Br-L	0.05	mg/L	<0.050	-----
Anions and Nutrients (QCLot: 731620)						
phosphate, ortho-, dissolved (as P)	14265-44-2	E378-U	0.001	mg/L	<0.0010	-----
Anions and Nutrients (QCLot: 745895)						
ammonia, total (as N)	7664-41-7	E298	0.005	mg/L	<0.0050	-----
Organic / Inorganic Carbon (QCLot: 732901)						
carbon, total organic [TOC]	----	E355-L	0.5	mg/L	<0.50	-----
Total Metals (QCLot: 733391)						
mercury, total	7439-97-6	E508	0.000005	mg/L	<0.0000050	-----
Total Metals (QCLot: 735839)						
aluminum, total	7429-90-5	E420	0.003	mg/L	<0.0030	-----
antimony, total	7440-36-0	E420	0.0001	mg/L	<0.00010	-----
arsenic, total	7440-38-2	E420	0.0001	mg/L	<0.00010	-----
barium, total	7440-39-3	E420	0.0001	mg/L	<0.00010	-----
beryllium, total	7440-41-7	E420	0.00002	mg/L	<0.000020	-----
bismuth, total	7440-69-9	E420	0.00005	mg/L	<0.000050	-----
boron, total	7440-42-8	E420	0.01	mg/L	<0.010	-----



Sub-Matrix: Water

Analyte	CAS Number	Method	LOR	Unit	Result	Qualifier
Total Metals (QCLot: 735839) - continued						
cadmium, total	7440-43-9	E420	0.000005	mg/L	<0.0000050	-----
calcium, total	7440-70-2	E420	0.05	mg/L	<0.050	-----
cesium, total	7440-46-2	E420	0.00001	mg/L	<0.000010	-----
chromium, total	7440-47-3	E420	0.0005	mg/L	<0.00050	-----
cobalt, total	7440-48-4	E420	0.0001	mg/L	<0.00010	-----
copper, total	7440-50-8	E420	0.0005	mg/L	<0.00050	-----
iron, total	7439-89-6	E420	0.01	mg/L	<0.010	-----
lead, total	7439-92-1	E420	0.00005	mg/L	<0.000050	-----
lithium, total	7439-93-2	E420	0.001	mg/L	<0.0010	-----
magnesium, total	7439-95-4	E420	0.005	mg/L	<0.0050	-----
manganese, total	7439-96-5	E420	0.0001	mg/L	<0.00010	-----
molybdenum, total	7439-98-7	E420	0.00005	mg/L	<0.000050	-----
nickel, total	7440-02-0	E420	0.0005	mg/L	<0.00050	-----
phosphorus, total	7723-14-0	E420	0.05	mg/L	<0.050	-----
potassium, total	7440-09-7	E420	0.05	mg/L	<0.050	-----
rubidium, total	7440-17-7	E420	0.0002	mg/L	<0.00020	-----
selenium, total	7782-49-2	E420	0.00005	mg/L	<0.000050	-----
silicon, total	7440-21-3	E420	0.1	mg/L	<0.10	-----
silver, total	7440-22-4	E420	0.00001	mg/L	<0.000010	-----
sodium, total	7440-23-5	E420	0.05	mg/L	<0.050	-----
strontium, total	7440-24-6	E420	0.0002	mg/L	<0.00020	-----
sulfur, total	7704-34-9	E420	0.5	mg/L	<0.50	-----
tellurium, total	13494-80-9	E420	0.0002	mg/L	<0.00020	-----
thallium, total	7440-28-0	E420	0.00001	mg/L	<0.000010	-----
thorium, total	7440-29-1	E420	0.0001	mg/L	<0.00010	-----
tin, total	7440-31-5	E420	0.0001	mg/L	<0.00010	-----
titanium, total	7440-32-6	E420	0.0003	mg/L	<0.00030	-----
tungsten, total	7440-33-7	E420	0.0001	mg/L	<0.00010	-----
uranium, total	7440-61-1	E420	0.00001	mg/L	<0.000010	-----
vanadium, total	7440-62-2	E420	0.0005	mg/L	<0.00050	-----
zinc, total	7440-66-6	E420	0.003	mg/L	<0.0030	-----
zirconium, total	7440-67-7	E420	0.0002	mg/L	<0.00020	-----
Dissolved Metals (QCLot: 731623)						
mercury, dissolved	7439-97-6	E509	0.000005	mg/L	<0.0000050	-----
Dissolved Metals (QCLot: 736358)						



Sub-Matrix: Water

Analyte	CAS Number	Method	LOR	Unit	Result	Qualifier
Dissolved Metals (QCLot: 736358) - continued						
aluminum, dissolved	7429-90-5	E421	0.001	mg/L	<0.0010	----
antimony, dissolved	7440-36-0	E421	0.0001	mg/L	<0.00010	----
arsenic, dissolved	7440-38-2	E421	0.0001	mg/L	<0.00010	----
barium, dissolved	7440-39-3	E421	0.0001	mg/L	<0.00010	----
beryllium, dissolved	7440-41-7	E421	0.00002	mg/L	<0.000020	----
bismuth, dissolved	7440-69-9	E421	0.00005	mg/L	<0.000050	----
boron, dissolved	7440-42-8	E421	0.01	mg/L	<0.010	----
cadmium, dissolved	7440-43-9	E421	0.000005	mg/L	<0.0000050	----
calcium, dissolved	7440-70-2	E421	0.05	mg/L	<0.050	----
cesium, dissolved	7440-46-2	E421	0.00001	mg/L	<0.000010	----
chromium, dissolved	7440-47-3	E421	0.0005	mg/L	<0.00050	----
cobalt, dissolved	7440-48-4	E421	0.0001	mg/L	<0.00010	----
copper, dissolved	7440-50-8	E421	0.0002	mg/L	<0.00020	----
iron, dissolved	7439-89-6	E421	0.01	mg/L	<0.010	----
lead, dissolved	7439-92-1	E421	0.00005	mg/L	<0.000050	----
lithium, dissolved	7439-93-2	E421	0.001	mg/L	<0.0010	----
magnesium, dissolved	7439-95-4	E421	0.005	mg/L	<0.0050	----
manganese, dissolved	7439-96-5	E421	0.0001	mg/L	<0.00010	----
molybdenum, dissolved	7439-98-7	E421	0.00005	mg/L	<0.000050	----
nickel, dissolved	7440-02-0	E421	0.0005	mg/L	<0.00050	----
phosphorus, dissolved	7723-14-0	E421	0.05	mg/L	<0.050	----
potassium, dissolved	7440-09-7	E421	0.05	mg/L	<0.050	----
rubidium, dissolved	7440-17-7	E421	0.0002	mg/L	<0.00020	----
selenium, dissolved	7782-49-2	E421	0.00005	mg/L	<0.000050	----
silicon, dissolved	7440-21-3	E421	0.05	mg/L	<0.050	----
silver, dissolved	7440-22-4	E421	0.00001	mg/L	<0.000010	----
sodium, dissolved	7440-23-5	E421	0.05	mg/L	<0.050	----
strontium, dissolved	7440-24-6	E421	0.0002	mg/L	<0.00020	----
sulfur, dissolved	7704-34-9	E421	0.5	mg/L	<0.50	----
tellurium, dissolved	13494-80-9	E421	0.0002	mg/L	<0.00020	----
thallium, dissolved	7440-28-0	E421	0.00001	mg/L	<0.000010	----
thorium, dissolved	7440-29-1	E421	0.0001	mg/L	<0.00010	----
tin, dissolved	7440-31-5	E421	0.0001	mg/L	<0.00010	----
titanium, dissolved	7440-32-6	E421	0.0003	mg/L	<0.00030	----
tungsten, dissolved	7440-33-7	E421	0.0001	mg/L	<0.00010	----



Sub-Matrix: Water

Analyte	CAS Number	Method	LOR	Unit	Result	Qualifier
Dissolved Metals (QCLot: 736358) - continued						
uranium, dissolved	7440-61-1	E421	0.00001	mg/L	<0.000010	-----
vanadium, dissolved	7440-62-2	E421	0.00005	mg/L	<0.000050	-----
zinc, dissolved	7440-66-6	E421	0.001	mg/L	<0.0010	-----
zirconium, dissolved	7440-67-7	E421	0.0002	mg/L	<0.000020	-----
Aggregate Organics (QCLot: 731090)						
biochemical oxygen demand [BOD]	----	E550	2	mg/L	<2.0	-----
Aggregate Organics (QCLot: 740658)						
chemical oxygen demand [COD]	----	E559-L	10	mg/L	<10	-----
Volatile Organic Compounds (QCLot: 734790)						
benzene	71-43-2	E611C	0.5	µg/L	<0.50	-----
bromodichloromethane	75-27-4	E611C	0.5	µg/L	<0.50	-----
bromoform	75-25-2	E611C	0.5	µg/L	<0.50	-----
carbon tetrachloride	56-23-5	E611C	0.5	µg/L	<0.50	-----
chlorobenzene	108-90-7	E611C	0.5	µg/L	<0.50	-----
chloroethane	75-00-3	E611C	0.5	µg/L	<0.50	-----
chloroform	67-66-3	E611C	0.5	µg/L	<0.50	-----
chloromethane	74-87-3	E611C	5	µg/L	<5.0	-----
dibromochloromethane	124-48-1	E611C	0.5	µg/L	<0.50	-----
dichlorobenzene, 1,2-	95-50-1	E611C	0.5	µg/L	<0.50	-----
dichlorobenzene, 1,3-	541-73-1	E611C	0.5	µg/L	<0.50	-----
dichlorobenzene, 1,4-	106-46-7	E611C	0.5	µg/L	<0.50	-----
dichloroethane, 1,1-	75-34-3	E611C	0.5	µg/L	<0.50	-----
dichloroethane, 1,2-	107-06-2	E611C	0.5	µg/L	<0.50	-----
dichloroethylene, 1,1-	75-35-4	E611C	0.5	µg/L	<0.50	-----
dichloroethylene, cis-1,2-	156-59-2	E611C	0.5	µg/L	<0.50	-----
dichloroethylene, trans-1,2-	156-60-5	E611C	0.5	µg/L	<0.50	-----
dichloromethane	75-09-2	E611C	1	µg/L	<1.0	-----
dichloropropane, 1,2-	78-87-5	E611C	0.5	µg/L	<0.50	-----
dichloropropylene, cis-1,3-	10061-01-5	E611C	0.5	µg/L	<0.50	-----
dichloropropylene, trans-1,3-	10061-02-6	E611C	0.5	µg/L	<0.50	-----
ethylbenzene	100-41-4	E611C	0.5	µg/L	<0.50	-----
methyl-tert-butyl ether [MTBE]	1634-04-4	E611C	0.5	µg/L	<0.50	-----
styrene	100-42-5	E611C	0.5	µg/L	<0.50	-----
tetrachloroethane, 1,1,1,2-	630-20-6	E611C	0.5	µg/L	<0.50	-----
tetrachloroethane, 1,1,2,2-	79-34-5	E611C	0.2	µg/L	<0.20	-----



Sub-Matrix: Water

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



Sub-Matrix: Water

Analyte	CAS Number	Method	LOR	Unit	Result	Qualifier
Polycyclic Aromatic Hydrocarbons (QCLot: 741176) - continued						
quinoline	91-22-5	E641A	0.05	µg/L	<0.050	-----
Polycyclic Aromatic Hydrocarbons (QCLot: 741650)						
acenaphthene	83-32-9	E641A	0.01	µg/L	<0.010	-----
acenaphthylene	208-96-8	E641A	0.01	µg/L	<0.010	-----
acridine	260-94-6	E641A	0.01	µg/L	<0.010	-----
anthracene	120-12-7	E641A	0.01	µg/L	<0.010	-----
benz(a)anthracene	56-55-3	E641A	0.01	µg/L	<0.010	-----
benzo(a)pyrene	50-32-8	E641A	0.005	µg/L	<0.0050	-----
benzo(b+)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	-----



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Project : 210629400

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**

Analyte	CAS Number	Method	LOR	Unit	Laboratory Control Sample (LCS) Report				Qualifier
					Spike Concentration	Recovery (%) LCS	Low	High	
Physical Tests (QCLot: 731530)									
pH	-----	E108	-----	pH units	7 pH units	99.8	98.0	102	-----
Physical Tests (QCLot: 731532)									
conductivity	-----	E100	1	µS/cm	146.9 µS/cm	98.3	90.0	110	-----
Physical Tests (QCLot: 731553)									
pH	-----	E108	-----	pH units	7 pH units	99.8	98.0	102	-----
Physical Tests (QCLot: 731554)									
conductivity	-----	E100	1	µS/cm	146.9 µS/cm	98.9	90.0	110	-----
Physical Tests (QCLot: 731617)									
conductivity	-----	E100	1	µS/cm	146.9 µS/cm	97.3	90.0	110	-----
Physical Tests (QCLot: 731618)									
pH	-----	E108	-----	pH units	7 pH units	100	98.0	102	-----
Physical Tests (QCLot: 731860)									
solids, total suspended [TSS]	-----	E160	3	mg/L	150 mg/L	87.5	85.0	115	-----
Physical Tests (QCLot: 731864)									
solids, total dissolved [TDS]	-----	E162	10	mg/L	1000 mg/L	101	85.0	115	-----
Physical Tests (QCLot: 745789)									
alkalinity, total (as CaCO3)	-----	E290	1	mg/L	500 mg/L	103	85.0	115	-----
Anions and Nutrients (QCLot: 731533)									
fluoride	16984-48-8	E235.F	0.02	mg/L	1 mg/L	99.7	90.0	110	-----
Anions and Nutrients (QCLot: 731534)									
chloride	16887-00-6	E235.Cl	0.5	mg/L	100 mg/L	101	90.0	110	-----
Anions and Nutrients (QCLot: 731535)									
bromide	24959-67-9	E235.Br-L	0.05	mg/L	0.5 mg/L	100	85.0	115	-----
Anions and Nutrients (QCLot: 731536)									
nitrate (as N)	14797-55-8	E235.NO3-L	0.005	mg/L	2.5 mg/L	102	90.0	110	-----
Anions and Nutrients (QCLot: 731537)									
nitrite (as N)	14797-65-0	E235.NO2-L	0.001	mg/L	0.5 mg/L	102	90.0	110	-----
Anions and Nutrients (QCLot: 731538)									
sulfate (as SO4)	14808-79-8	E235.SO4	0.3	mg/L	100 mg/L	103	90.0	110	-----
Anions and Nutrients (QCLot: 731539)									
phosphate, ortho-, dissolved (as P)	14265-44-2	E378-U	0.001	mg/L	0.03 mg/L	93.6	80.0	120	-----



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Sub-Matrix: **Water**

Sub-Matrix: Water		Laboratory Control Sample (LCS) Report						
		Spike		Recovery (%)		Recovery Limits (%)		Qualifier
Analyte	CAS Number	Method	LOR	Unit	Concentration	LCS	Low	
Anions and Nutrients (QCLot: 731552)								
phosphate, ortho-, dissolved (as P)	14265-44-2	E378-U	0.001	mg/L	0.03 mg/L	94.7	80.0	120
Anions and Nutrients (QCLot: 731556)								
chloride	16887-00-6	E235.Cl	0.5	mg/L	100 mg/L	100	90.0	110
Anions and Nutrients (QCLot: 731557)								
nitrite (as N)	14797-65-0	E235.NO2-L	0.001	mg/L	0.5 mg/L	100	90.0	110
Anions and Nutrients (QCLot: 731559)								
sulfate (as SO4)	14808-79-8	E235.SO4	0.3	mg/L	100 mg/L	102	90.0	110
Anions and Nutrients (QCLot: 731560)								
fluoride	16984-48-8	E235.F	0.02	mg/L	1 mg/L	100	90.0	110
Anions and Nutrients (QCLot: 731561)								
bromide	24959-67-9	E235.Br-L	0.05	mg/L	0.5 mg/L	99.1	85.0	115
Anions and Nutrients (QCLot: 731562)								
nitrate (as N)	14797-55-8	E235.NO3-L	0.005	mg/L	2.5 mg/L	102	90.0	110
Anions and Nutrients (QCLot: 731609)								
sulfate (as SO4)	14808-79-8	E235.SO4	0.3	mg/L	100 mg/L	103	90.0	110
Anions and Nutrients (QCLot: 731610)								
nitrate (as N)	14797-55-8	E235.NO3-L	0.005	mg/L	2.5 mg/L	102	90.0	110
Anions and Nutrients (QCLot: 731611)								
nitrite (as N)	14797-65-0	E235.NO2-L	0.001	mg/L	0.5 mg/L	101	90.0	110
Anions and Nutrients (QCLot: 731612)								
fluoride	16984-48-8	E235.F	0.02	mg/L	1 mg/L	97.9	90.0	110
Anions and Nutrients (QCLot: 731613)								
chloride	16887-00-6	E235.Cl	0.5	mg/L	100 mg/L	100	90.0	110
Anions and Nutrients (QCLot: 731614)								
bromide	24959-67-9	E235.Br-L	0.05	mg/L	0.5 mg/L	99.3	85.0	115
Anions and Nutrients (QCLot: 731620)								
phosphate, ortho-, dissolved (as P)	14265-44-2	E378-U	0.001	mg/L	0.03 mg/L	94.3	80.0	120
Anions and Nutrients (QCLot: 745895)								
ammonia, total (as N)	7664-41-7	E298	0.005	mg/L	0.2 mg/L	102	85.0	115
Organic / Inorganic Carbon (QCLot: 732901)								
carbon, total organic [TOC]	----	E355-L	0.5	mg/L	8.57 mg/L	98.6	80.0	120
Total Metals (QCLot: 733391)								
mercury, total	7439-97-6	E508	0.000005	mg/L	0.0001 mg/L	102	80.0	120



Sub-Matrix: **Water**

Sub-Matrix: Water							Laboratory Control Sample (LCS) Report			
Analyte	CAS Number		Method	LOR	Unit	Spike Concentration	Recovery Limits (%)		Qualifier	
							Recovery (%)	Low		High
Total Metals (QCLot: 735839)										
aluminum, total	7429-90-5	E420		0.003	mg/L	2 mg/L	97.7	80.0	120	Pass
antimony, total	7440-36-0	E420		0.0001	mg/L	1 mg/L	106	80.0	120	Pass
arsenic, total	7440-38-2	E420		0.0001	mg/L	1 mg/L	109	80.0	120	Pass
barium, total	7440-39-3	E420		0.0001	mg/L	0.25 mg/L	107	80.0	120	Pass
beryllium, total	7440-41-7	E420		0.00002	mg/L	0.1 mg/L	103	80.0	120	Pass
bismuth, total	7440-69-9	E420		0.00005	mg/L	1 mg/L	108	80.0	120	Pass
boron, total	7440-42-8	E420		0.01	mg/L	1 mg/L	96.5	80.0	120	Pass
cadmium, total	7440-43-9	E420		0.000005	mg/L	0.1 mg/L	105	80.0	120	Pass
calcium, total	7440-70-2	E420		0.05	mg/L	50 mg/L	104	80.0	120	Pass
cesium, total	7440-46-2	E420		0.00001	mg/L	0.05 mg/L	98.4	80.0	120	Pass
chromium, total	7440-47-3	E420		0.0005	mg/L	0.25 mg/L	99.8	80.0	120	Pass
cobalt, total	7440-48-4	E420		0.0001	mg/L	0.25 mg/L	103	80.0	120	Pass
copper, total	7440-50-8	E420		0.0005	mg/L	0.25 mg/L	101	80.0	120	Pass
iron, total	7439-89-6	E420		0.01	mg/L	1 mg/L	113	80.0	120	Pass
lead, total	7439-92-1	E420		0.00005	mg/L	0.5 mg/L	111	80.0	120	Pass
lithium, total	7439-93-2	E420		0.001	mg/L	0.25 mg/L	103	80.0	120	Pass
magnesium, total	7439-95-4	E420		0.005	mg/L	50 mg/L	109	80.0	120	Pass
manganese, total	7439-96-5	E420		0.0001	mg/L	0.25 mg/L	104	80.0	120	Pass
molybdenum, total	7439-98-7	E420		0.00005	mg/L	0.25 mg/L	104	80.0	120	Pass
nickel, total	7440-02-0	E420		0.0005	mg/L	0.5 mg/L	103	80.0	120	Pass
phosphorus, total	7723-14-0	E420		0.05	mg/L	10 mg/L	106	80.0	120	Pass
potassium, total	7440-09-7	E420		0.05	mg/L	50 mg/L	107	80.0	120	Pass
rubidium, total	7440-17-7	E420		0.0002	mg/L	0.1 mg/L	105	80.0	120	Pass
selenium, total	7782-49-2	E420		0.00005	mg/L	1 mg/L	103	80.0	120	Pass
silicon, total	7440-21-3	E420		0.1	mg/L	10 mg/L	106	80.0	120	Pass
silver, total	7440-22-4	E420		0.00001	mg/L	0.1 mg/L	95.1	80.0	120	Pass
sodium, total	7440-23-5	E420		0.05	mg/L	50 mg/L	99.7	80.0	120	Pass
strontium, total	7440-24-6	E420		0.0002	mg/L	0.25 mg/L	104	80.0	120	Pass
sulfur, total	7704-34-9	E420		0.5	mg/L	50 mg/L	90.6	80.0	120	Pass
tellurium, total	13494-80-9	E420		0.0002	mg/L	0.1 mg/L	100	80.0	120	Pass
thallium, total	7440-28-0	E420		0.00001	mg/L	1 mg/L	114	80.0	120	Pass
thorium, total	7440-29-1	E420		0.0001	mg/L	0.1 mg/L	105	80.0	120	Pass
tin, total	7440-31-5	E420		0.0001	mg/L	0.5 mg/L	104	80.0	120	Pass
titanium, total	7440-32-6	E420		0.0003	mg/L	0.25 mg/L	99.1	80.0	120	Pass
tungsten, total	7440-33-7	E420		0.0001	mg/L	0.1 mg/L	110	80.0	120	Pass
uranium, total	7440-61-1	E420		0.00001	mg/L	0.005 mg/L	109	80.0	120	Pass



Sub-Matrix: Water								
Laboratory Control Sample (LCS) Report								
Analyte	CAS Number	Method	LOR	Unit	Spike	Recovery Limits (%)	Qualifier	
					Concentration	LCS		Low
Total Metals (QCLot: 735839) - continued								
vanadium, total	7440-62-2	E420	0.0005	mg/L	0.5 mg/L	104	80.0	120
zinc, total	7440-66-6	E420	0.003	mg/L	0.5 mg/L	109	80.0	120
zirconium, total	7440-67-7	E420	0.0002	mg/L	0.1 mg/L	102	80.0	120
mercury, dissolved	7439-97-6	E509	0.000005	mg/L	0.0001 mg/L	95.4	80.0	120
Dissolved Metals (QCLot: 736358)								
aluminum, dissolved	7429-90-5	E421	0.001	mg/L	2 mg/L	107	80.0	120
antimony, dissolved	7440-36-0	E421	0.0001	mg/L	1 mg/L	105	80.0	120
arsenic, dissolved	7440-38-2	E421	0.0001	mg/L	1 mg/L	110	80.0	120
barium, dissolved	7440-39-3	E421	0.0001	mg/L	0.25 mg/L	105	80.0	120
beryllium, dissolved	7440-41-7	E421	0.00002	mg/L	0.1 mg/L	103	80.0	120
bismuth, dissolved	7440-69-9	E421	0.00005	mg/L	1 mg/L	104	80.0	120
boron, dissolved	7440-42-8	E421	0.01	mg/L	1 mg/L	95.0	80.0	120
cadmium, dissolved	7440-43-9	E421	0.000005	mg/L	0.1 mg/L	106	80.0	120
calcium, dissolved	7440-70-2	E421	0.05	mg/L	50 mg/L	105	80.0	120
cesium, dissolved	7440-46-2	E421	0.00001	mg/L	0.05 mg/L	104	80.0	120
chromium, dissolved	7440-47-3	E421	0.0005	mg/L	0.25 mg/L	107	80.0	120
cobalt, dissolved	7440-48-4	E421	0.0001	mg/L	0.25 mg/L	105	80.0	120
copper, dissolved	7440-50-8	E421	0.0002	mg/L	0.25 mg/L	104	80.0	120
iron, dissolved	7439-89-6	E421	0.01	mg/L	1 mg/L	102	80.0	120
lead, dissolved	7439-92-1	E421	0.00005	mg/L	0.5 mg/L	104	80.0	120
lithium, dissolved	7439-93-2	E421	0.001	mg/L	0.25 mg/L	107	80.0	120
magnesium, dissolved	7439-95-4	E421	0.005	mg/L	50 mg/L	110	80.0	120
manganese, dissolved	7439-96-5	E421	0.0001	mg/L	0.25 mg/L	107	80.0	120
molybdenum, dissolved	7439-98-7	E421	0.00005	mg/L	0.25 mg/L	107	80.0	120
nickel, dissolved	7440-02-0	E421	0.0005	mg/L	0.5 mg/L	108	80.0	120
phosphorus, dissolved	7723-14-0	E421	0.05	mg/L	10 mg/L	113	80.0	120
potassium, dissolved	7440-09-7	E421	0.05	mg/L	50 mg/L	108	80.0	120
rubidium, dissolved	7440-17-7	E421	0.0002	mg/L	0.1 mg/L	105	80.0	120
selenium, dissolved	7782-49-2	E421	0.00005	mg/L	1 mg/L	103	80.0	120
silicon, dissolved	7440-21-3	E421	0.05	mg/L	10 mg/L	110	80.0	120
silver, dissolved	7440-22-4	E421	0.00001	mg/L	0.1 mg/L	89.2	80.0	120
sodium, dissolved	7440-23-5	E421	0.05	mg/L	50 mg/L	108	80.0	120
strontium, dissolved	7440-24-6	E421	0.0002	mg/L	0.25 mg/L	107	80.0	120
sulfur, dissolved	7704-34-9	E421	0.5	mg/L	50 mg/L	104	80.0	120
tellurium, dissolved	13494-80-9	E421	0.0002	mg/L	0.1 mg/L	101	80.0	120



Sub-Matrix: Water					Laboratory Control Sample (LCS) Report				
Analyte	CAS Number	Method	LOR	Unit	Spike Concentration	Recovery (%)	Recovery Limits (%)		Qualifier
						LCS	Low	High	
Dissolved Metals (QCLot: 736358) - continued									
thallium, dissolved	7440-28-0	E421	0.00001	mg/L	1 mg/L	106	80.0	120	----
thorium, dissolved	7440-29-1	E421	0.0001	mg/L	0.1 mg/L	99.5	80.0	120	----
tin, dissolved	7440-31-5	E421	0.0001	mg/L	0.5 mg/L	104	80.0	120	----
titanium, dissolved	7440-32-6	E421	0.0003	mg/L	0.25 mg/L	102	80.0	120	----
tungsten, dissolved	7440-33-7	E421	0.0001	mg/L	0.1 mg/L	103	80.0	120	----
uranium, dissolved	7440-61-1	E421	0.00001	mg/L	0.005 mg/L	109	80.0	120	----
vanadium, dissolved	7440-62-2	E421	0.0005	mg/L	0.5 mg/L	109	80.0	120	----
zinc, dissolved	7440-66-6	E421	0.001	mg/L	0.5 mg/L	104	80.0	120	----
zirconium, dissolved	7440-67-7	E421	0.0002	mg/L	0.1 mg/L	106	80.0	120	----
Aggregate Organics (QCLot: 731090)									
biochemical oxygen demand [BOD]	----	E550	2	mg/L	198 mg/L	104	85.0	115	----
Aggregate Organics (QCLot: 740658)									
chemical oxygen demand [COD]	----	E559-L	10	mg/L	100 mg/L	105	85.0	115	----
Volatile Organic Compounds (QCLot: 734790)									
benzene	71-43-2	E611C	0.5	µg/L	100 µg/L	97.7	70.0	130	----
bromodichloromethane	75-27-4	E611C	0.5	µg/L	100 µg/L	104	70.0	130	----
bromoform	75-25-2	E611C	0.5	µg/L	100 µg/L	89.2	70.0	130	----
carbon tetrachloride	56-23-5	E611C	0.5	µg/L	100 µg/L	110	70.0	130	----
chlorobenzene	108-90-7	E611C	0.5	µg/L	100 µg/L	103	70.0	130	----
chloroethane	75-00-3	E611C	0.5	µg/L	100 µg/L	108	70.0	130	----
chloroform	67-66-3	E611C	0.5	µg/L	100 µg/L	109	70.0	130	----
chloromethane	74-87-3	E611C	5	µg/L	100 µg/L	95.5	70.0	130	----
dibromochloromethane	124-48-1	E611C	0.5	µg/L	100 µg/L	102	70.0	130	----
dichlorobenzene, 1,2-	95-50-1	E611C	0.5	µg/L	100 µg/L	101	70.0	130	----
dichlorobenzene, 1,3-	541-73-1	E611C	0.5	µg/L	100 µg/L	95.8	70.0	130	----
dichlorobenzene, 1,4-	106-46-7	E611C	0.5	µg/L	100 µg/L	99.9	70.0	130	----
dichloroethane, 1,1-	75-34-3	E611C	0.5	µg/L	100 µg/L	106	70.0	130	----
dichloroethane, 1,2-	107-06-2	E611C	0.5	µg/L	100 µg/L	96.4	70.0	130	----
dichloroethylene, 1,1-	75-35-4	E611C	0.5	µg/L	100 µg/L	101	70.0	130	----
dichloroethylene, cis-1,2-	156-59-2	E611C	0.5	µg/L	100 µg/L	103	70.0	130	----
dichloroethylene, trans-1,2-	156-60-5	E611C	0.5	µg/L	100 µg/L	93.5	70.0	130	----
dichloromethane	75-09-2	E611C	1	µg/L	100 µg/L	94.6	70.0	130	----
dichloropropane, 1,2-	78-87-5	E611C	0.5	µg/L	100 µg/L	99.4	70.0	130	----
dichloropropylene, cis-1,3-	10061-01-5	E611C	0.5	µg/L	100 µg/L	86.6	70.0	130	----



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Project : 210629400

Sub-Matrix: **Water**

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



Sub-Matrix: **Water**

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



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 $\geq 1 \times$ spike level.

Sub-Matrix: **Water**

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



Sub-Matrix: Water

Sub-Matrix: Water					Matrix Spike (MS) Report					
					Spike		Recovery (%)		Recovery Limits (%)	
Laboratory sample ID	Client sample ID	Analyte	CAS Number	Method	Concentration	Target	MS	Low	High	Qualifier
Anions and Nutrients (QCLot: 731609)										
VA22C6784-009	Noohalk Creek Downstream	sulfate (as SO4)	14808-79-8	E235.SO4	107 mg/L	100 mg/L	107	75.0	125	-----
Anions and Nutrients (QCLot: 731610)										
VA22C6784-009	Noohalk Creek Downstream	nitrate (as N)	14797-55-8	E235.NO3-L	2.67 mg/L	2.5 mg/L	107	75.0	125	-----
Anions and Nutrients (QCLot: 731611)										
VA22C6784-009	Noohalk Creek Downstream	nitrite (as N)	14797-65-0	E235.NO2-L	0.531 mg/L	0.5 mg/L	106	75.0	125	-----
Anions and Nutrients (QCLot: 731612)										
VA22C6784-009	Noohalk Creek Downstream	fluoride	16984-48-8	E235.F	1.04 mg/L	1 mg/L	104	75.0	125	-----
Anions and Nutrients (QCLot: 731613)										
VA22C6784-009	Noohalk Creek Downstream	chloride	16887-00-6	E235.Cl	106 mg/L	100 mg/L	106	75.0	125	-----
Anions and Nutrients (QCLot: 731614)										
VA22C6784-009	Noohalk Creek Downstream	bromide	24959-67-9	E235.Br-L	0.523 mg/L	0.5 mg/L	105	75.0	125	-----
Anions and Nutrients (QCLot: 731620)										
VA22C6784-009	Noohalk Creek Downstream	phosphate, ortho-, dissolved (as P)	14265-44-2	E378-U	0.0268 mg/L	0.03 mg/L	89.2	70.0	130	-----
Anions and Nutrients (QCLot: 745895)										
VA22C6784-002	MW22-02	ammonia, total (as N)	7664-41-7	E298	ND mg/L	0.1 mg/L	ND	75.0	125	MS-B
Organic / Inorganic Carbon (QCLot: 732901)										
VA22C6784-002	MW22-02	carbon, total organic [TOC]	----	E355-L	ND mg/L	5 mg/L	ND	70.0	130	-----
Total Metals (QCLot: 733391)										
KS2204251-001	Anonymous	mercury, total	7439-97-6	E508	0.0000966 mg/L	0.0001 mg/L	96.6	70.0	130	-----
Total Metals (QCLot: 735839)										
VA22C6711-002	Anonymous	aluminum, total	7429-90-5	E420	ND mg/L	0.2 mg/L	ND	70.0	130	-----
		antimony, total	7440-36-0	E420	0.0400 mg/L	0.04 mg/L	99.9	70.0	130	-----
		arsenic, total	7440-38-2	E420	0.0421 mg/L	0.04 mg/L	105	70.0	130	-----
		barium, total	7440-39-3	E420	0.0383 mg/L	0.04 mg/L	95.8	70.0	130	-----
		beryllium, total	7440-41-7	E420	0.0790 mg/L	0.08 mg/L	98.8	70.0	130	-----
		bismuth, total	7440-69-9	E420	0.0194 mg/L	0.02 mg/L	97.0	70.0	130	-----
		boron, total	7440-42-8	E420	ND mg/L	0.1 mg/L	ND	70.0	130	-----
		cadmium, total	7440-43-9	E420	0.00812 mg/L	0.008 mg/L	102	70.0	130	-----
		calcium, total	7440-70-2	E420	ND mg/L	4 mg/L	ND	70.0	130	-----
		cesium, total	7440-46-2	E420	0.0198 mg/L	0.02 mg/L	99.0	70.0	130	-----
		chromium, total	7440-47-3	E420	0.0783 mg/L	0.08 mg/L	97.8	70.0	130	-----
		cobalt, total	7440-48-4	E420	0.0403 mg/L	0.04 mg/L	101	70.0	130	-----

Total Metals (QCLot: 735839) - continued

Sub-Matrix: Water												
						Matrix Spike (MS) Report						
Laboratory sample ID		Client sample ID	Analyte	CAS Number	Method	Spike		Recovery (%)		Recovery Limits (%)		Qualifier
						Concentration	Target	MS	Low	High		
Total Metals (QCLot: 735839) - continued												
VA22C6711-002		Anonymous	copper, total	7440-50-8	E420	ND mg/L	0.02 mg/L	ND	70.0	130	-----	
			iron, total	7439-89-6	E420	4.15 mg/L	4 mg/L	104	70.0	130	-----	
			lead, total	7439-92-1	E420	0.0395 mg/L	0.04 mg/L	98.8	70.0	130	-----	
			lithium, total	7439-93-2	E420	0.203 mg/L	0.2 mg/L	101	70.0	130	-----	
			magnesium, total	7439-95-4	E420	ND mg/L	1 mg/L	ND	70.0	130	-----	
			manganese, total	7439-96-5	E420	ND mg/L	0.02 mg/L	ND	70.0	130	-----	
			molybdenum, total	7439-98-7	E420	0.0407 mg/L	0.04 mg/L	102	70.0	130	-----	
			nickel, total	7440-02-0	E420	0.0783 mg/L	0.08 mg/L	97.9	70.0	130	-----	
			phosphorus, total	7723-14-0	E420	19.4 mg/L	20 mg/L	97.1	70.0	130	-----	
			potassium, total	7440-09-7	E420	8.23 mg/L	8 mg/L	103	70.0	130	-----	
			rubidium, total	7440-17-7	E420	0.0404 mg/L	0.04 mg/L	101	70.0	130	-----	
			selenium, total	7782-49-2	E420	0.0920 mg/L	0.08 mg/L	115	70.0	130	-----	
			silicon, total	7440-21-3	E420	19.2 mg/L	20 mg/L	96.1	70.0	130	-----	
			silver, total	7440-22-4	E420	0.00754 mg/L	0.008 mg/L	94.2	70.0	130	-----	
			sodium, total	7440-23-5	E420	ND mg/L	2 mg/L	ND	70.0	130	-----	
			strontium, total	7440-24-6	E420	ND mg/L	0.02 mg/L	ND	70.0	130	-----	
			sulfur, total	7704-34-9	E420	ND mg/L	20 mg/L	ND	70.0	130	-----	
			tellurium, total	13494-80-9	E420	0.0842 mg/L	0.08 mg/L	105	70.0	130	-----	
			thallium, total	7440-28-0	E420	0.00809 mg/L	0.008 mg/L	101	70.0	130	-----	
			thorium, total	7440-29-1	E420	0.0429 mg/L	0.04 mg/L	107	70.0	130	-----	
			tin, total	7440-31-5	E420	0.0408 mg/L	0.04 mg/L	102	70.0	130	-----	
			titanium, total	7440-32-6	E420	0.0773 mg/L	0.08 mg/L	96.6	70.0	130	-----	
			tungsten, total	7440-33-7	E420	0.0432 mg/L	0.04 mg/L	108	70.0	130	-----	
			uranium, total	7440-61-1	E420	0.00844 mg/L	0.008 mg/L	105	70.0	130	-----	
			vanadium, total	7440-62-2	E420	0.205 mg/L	0.2 mg/L	103	70.0	130	-----	
			zinc, total	7440-66-6	E420	0.807 mg/L	0.8 mg/L	101	70.0	130	-----	
			zirconium, total	7440-67-7	E420	0.0826 mg/L	0.08 mg/L	103	70.0	130	-----	
Dissolved Metals (QCLot: 731623)												
VA22C6700-001		Anonymous	mercury, dissolved	7439-97-6	E509	0.0000912 mg/L	0.0001 mg/L	91.2	70.0	130	-----	
Dissolved Metals (QCLot: 736358)												
TY2203715-002		Anonymous	aluminum, dissolved	7429-90-5	E421	0.202 mg/L	0.2 mg/L	101	70.0	130	-----	
			antimony, dissolved	7440-36-0	E421	0.0212 mg/L	0.02 mg/L	106	70.0	130	-----	
			arsenic, dissolved	7440-38-2	E421	0.0212 mg/L	0.02 mg/L	106	70.0	130	-----	
			barium, dissolved	7440-39-3	E421	ND mg/L	0.02 mg/L	ND	70.0	130	-----	
			beryllium, dissolved	7440-41-7	E421	0.0412 mg/L	0.04 mg/L	103	70.0	130	-----	



Sub-Matrix: Water

Sub-Matrix: Water					Matrix Spike (MS) Report					
Laboratory sample		Client sample ID	Analyte	CAS Number	Method	Spike		Recovery Limits (%)		Qualifier
ID						Concentration	Target	MS	Low	High
Dissolved Metals (QCLot: 736358) - continued										
TV2203715-002	Anonymous	bismuth, dissolved	7440-69-9	E421	0.00924 mg/L	0.01 mg/L	92.4	70.0	130	100.0000
		boron, dissolved	7440-42-8	E421	ND mg/L	0.1 mg/L	ND	70.0	130	100.0000
		cadmium, dissolved	7440-43-9	E421	0.00416 mg/L	0.004 mg/L	104	70.0	130	100.0000
		calcium, dissolved	7440-70-2	E421	ND mg/L	4 mg/L	ND	70.0	130	100.0000
		cesium, dissolved	7440-46-2	E421	0.0104 mg/L	0.01 mg/L	104	70.0	130	100.0000
		chromium, dissolved	7440-47-3	E421	0.0403 mg/L	0.04 mg/L	101	70.0	130	100.0000
		cobalt, dissolved	7440-48-4	E421	0.0198 mg/L	0.02 mg/L	99.1	70.0	130	100.0000
		copper, dissolved	7440-50-8	E421	0.0193 mg/L	0.02 mg/L	96.4	70.0	130	100.0000
		iron, dissolved	7439-89-6	E421	1.93 mg/L	2 mg/L	96.6	70.0	130	100.0000
		lead, dissolved	7439-92-1	E421	0.0194 mg/L	0.02 mg/L	97.1	70.0	130	100.0000
		lithium, dissolved	7439-93-2	E421	0.100 mg/L	0.1 mg/L	100	70.0	130	100.0000
		magnesium, dissolved	7439-95-4	E421	ND mg/L	1 mg/L	ND	70.0	130	100.0000
		manganese, dissolved	7439-96-5	E421	ND mg/L	0.02 mg/L	ND	70.0	130	100.0000
		molybdenum, dissolved	7439-98-7	E421	0.0215 mg/L	0.02 mg/L	108	70.0	130	100.0000
		nickel, dissolved	7440-02-0	E421	0.0408 mg/L	0.04 mg/L	102	70.0	130	100.0000
		phosphorus, dissolved	7723-14-0	E421	11.0 mg/L	10 mg/L	110	70.0	130	100.0000
		potassium, dissolved	7440-09-7	E421	ND mg/L	4 mg/L	ND	70.0	130	100.0000
		rubidium, dissolved	7440-17-7	E421	0.0205 mg/L	0.02 mg/L	102	70.0	130	100.0000
		selenium, dissolved	7782-49-2	E421	0.0320 mg/L	0.04 mg/L	79.9	70.0	130	100.0000
		silicon, dissolved	7440-21-3	E421	ND mg/L	10 mg/L	ND	70.0	130	100.0000
		silver, dissolved	7440-22-4	E421	0.00263 mg/L	0.004 mg/L	65.8	70.0	130	MES
		sodium, dissolved	7440-23-5	E421	ND mg/L	2 mg/L	ND	70.0	130	100.0000
		strontium, dissolved	7440-24-6	E421	ND mg/L	0.02 mg/L	ND	70.0	130	100.0000
		sulfur, dissolved	7704-34-9	E421	21.8 mg/L	20 mg/L	109	70.0	130	100.0000
		tellurium, dissolved	13494-80-9	E421	0.0340 mg/L	0.04 mg/L	85.1	70.0	130	100.0000
		thallium, dissolved	7440-28-0	E421	0.00393 mg/L	0.004 mg/L	98.2	70.0	130	100.0000
		thorium, dissolved	7440-29-1	E421	0.0205 mg/L	0.02 mg/L	102	70.0	130	100.0000
		tin, dissolved	7440-31-5	E421	0.0204 mg/L	0.02 mg/L	102	70.0	130	100.0000
		titanium, dissolved	7440-32-6	E421	0.0404 mg/L	0.04 mg/L	101	70.0	130	100.0000
		tungsten, dissolved	7440-33-7	E421	0.0210 mg/L	0.02 mg/L	105	70.0	130	100.0000
		uranium, dissolved	7440-61-1	E421	0.00416 mg/L	0.004 mg/L	104	70.0	130	100.0000
		vanadium, dissolved	7440-62-2	E421	0.105 mg/L	0.1 mg/L	105	70.0	130	100.0000
		zinc, dissolved	7440-66-6	E421	0.406 mg/L	0.4 mg/L	102	70.0	130	100.0000
		zirconium, dissolved	7440-67-7	E421	0.0430 mg/L	0.04 mg/L	107	70.0	130	100.0000
Aggregate Organics (QCLot: 740658)										



Sub-Matrix: Water

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



Sub-Matrix: **Water**

Sub-Matrix: Water					Matrix Spike (MS) Report					
					Spike		Recovery (%)	Recovery Limits (%)		
Laboratory sample ID	Client sample ID	Analyte	CAS Number	Method	Concentration	Target	MS	Low	High	Qualifier
Volatile Organic Compounds (QCLot: 734790) - continued										
VA22C6784-001	MW22-01	xylene, m+p-	179601-23-1	E611C	210 µg/L	200 µg/L	105	70.0	130	-----
		xylene, o-	95-47-6	E611C	106 µg/L	100 µg/L	106	70.0	130	-----

Qualifiers

Qualifier

Description

MES

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

MS-B

Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.



www.alsglobal.com

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

COC Number: 20-1016075

Page 1 of 1

Contact and company name below will appear on the final report

Company: Morrison Hershfield

Contact: Emily Read

Phone: (360) 280-0190

Company address below will appear on the final report

Street: 310-4321 Still Creek Drive

City/Province: Burnaby BC

Postal Code: V5C 6S4

Invoice To: Same as Report To ☒ YES ☐ NO

Company: Morrison Hershfield ☒ YES ☐ NO

Contact: emr@mhershfield.com

Project Information

ALS Account # / Quote #: MHG100

Job #: 2106 24400

PO / AFE:

LSD:

ALS Lab Work Order # (ALS use only):

Sample Identification and/or Coordinates (This description will appear on the report)

ALS Sample # (ALS use only)

MMW22-01

MMW22-02

MMW22-03

MMW22-04

MMW22-05

Field Blank

DUP

Noohalk Creek Upstream

Noohalk Creek Downstream

Reports / Recipients

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

Merge QC/QC 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: emr@mhershfield.com

Email 2: emr@mhershfield.com

Email 3:

Invoice Recipients

Select Invoice Distribution: ☒ EMAIL ☐ MAIL ☐ FAX

Email 1 or Fax: supplies@mhershfield.com

Email 2:

Oil and Gas Required Fields (client use)

A/E/Cost Center:

Major/Minor Code:

Routing Code:

Requisitioner:

Location:

ALS Contact: lan Chen

Date (dd-mm-yy)

Time (hh:mm)

Sample Type

MMW22-01

MMW22-02

MMW22-03

MMW22-04

MMW22-05

Field Blank

DUP

Noohalk Creek Upstream

Noohalk Creek Downstream

Turnaround Time (TAT) Requested

☒ Routine (R) if received by 3pm M-F - no surcharges apply

☐ 4 day (F4) if received by 3pm M-F - 20% rush surcharge minimum

☐ 3 day (F3) if received by 3pm M-F - 25% rush surcharge minimum

☐ 2 day (F2) if received by 3pm M-F - 50% rush surcharge minimum

☐ 1 day (F1) if received by 3pm M-F - 100% rush surcharge minimum

☐ Same day (F0) if received by 10am M-F - 200% rush surcharge. Additional fees may apply for rush requests on weekends, statutory holidays and non-routine tests

Date and Time Required for all EAP TATs:

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

dd-mm-yy hh:mm

Analysis Request

Indicate Filled (F), Preserved (P) or Filtered and Preserved (FP) below

Fluoride

Mercury

Total metals

Total mercury

VOCs

LEPH/HEPH/EPH/PAH

Routine (General Parameters)

Nutrients, Anions

COD, BOD, TOC

Specific Conductance

dd-mm-yy hh:mm

APPLY ALS BARCODE LABEL HERE (ALS use only)

SAMPLES ON HOLD

EXTENDED STORAGE REQUIRED

SUSPECTED HAZARD (see notes)

APPLY ALS BARCODE LABEL HERE (ALS use only)

APPENDIX B: Fire Safety & Emergency Response Plan

Fire Safety & Emergency Response Plan (STAFF)

Thorsen Creek Waste and Recycling Centre Landfill



Date: November 15, 2024

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FIGURES

Figure 1: Muster Points #1 and #2	4
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APPENDICES

APPENDIX A: Emergency Checklist Sheet

APPENDIX B: Emergency Preparedness Checklist



1. INTRODUCTION

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

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

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

This document will cover the following:

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

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

2. DEFINITIONS AND TERMS

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

Emergency responses include the following:

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

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

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

and

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

3. FIRE MANAGEMENT

3.1 Fire Response Procedures

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

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

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

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

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

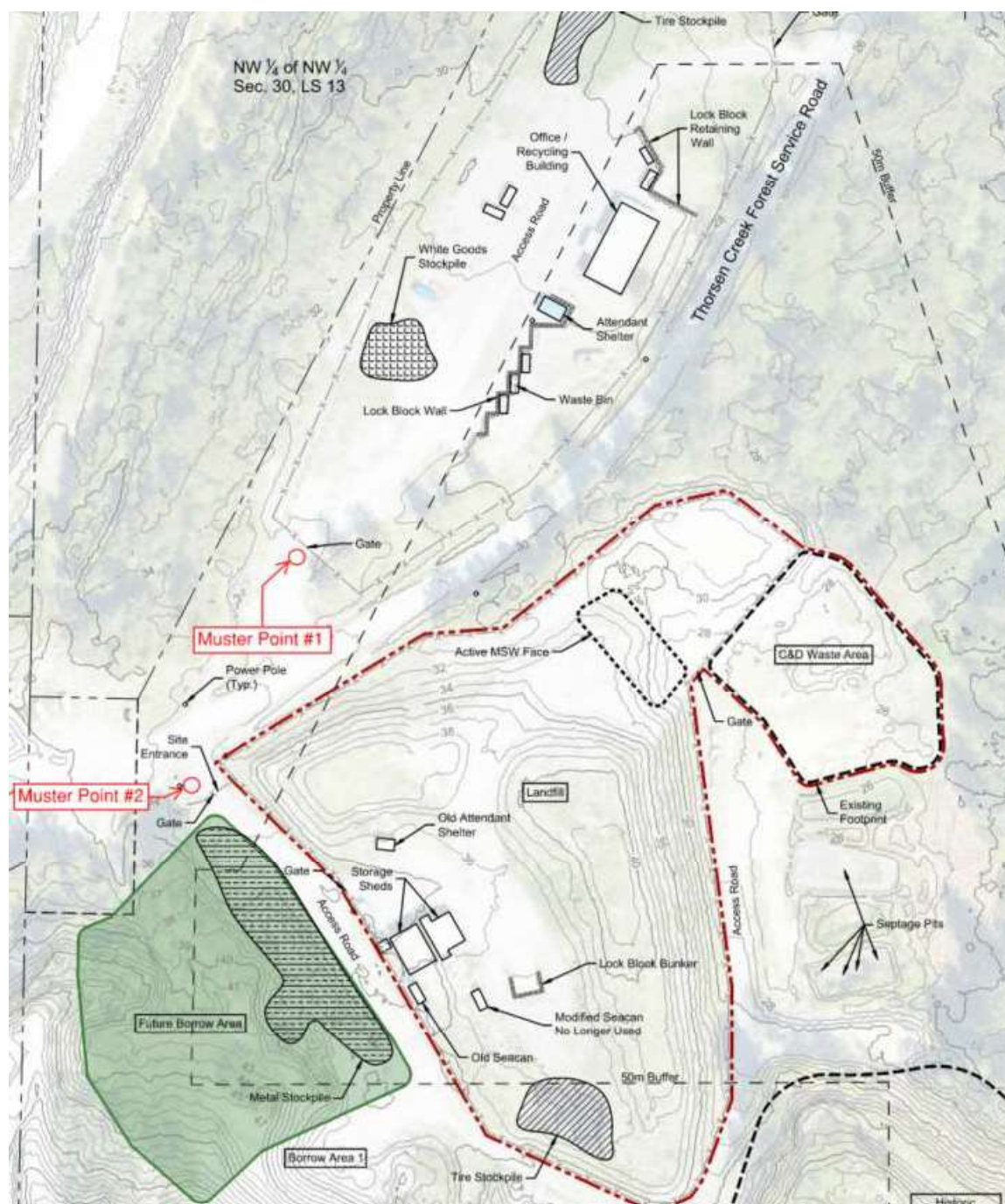


Figure 1: Muster Points #1 and #2

3.2 General Fire Fighting Guidelines

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

3.3 Fire Prevention on Landfill

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

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

Fire prevention techniques will include:

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

3.4 Wind-Blown Litter & Debris

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

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

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

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

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

4. FIRE PROCEDURE CHECKLIST

THE FIRST PERSON ON THE SCENE MUST:

- 1 **PROTECT** human health and safety. Eliminate possible dangerous sources. Warn/remove bystanders.
- 2 **EVACUATE** the building when safe to do so.
- 3 **DIRECT** self and bystanders to a muster point when it is safe to do so.
- CALL** and wait for emergency response personnel to arrive.
- 4 Bella Coola Fire Department: **(250) 799-5321**
Direct personnel to Civic Address:
751 Thorsen Creek, Bella Coola
- 5 **CONTACT** the Supervisor and Owner to update the situation.
- 6 **REPORT** in writing on the emergency response as needed when help arrives.

5. EMERGENCY RESPONSE

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

Staff at the Landfill will require to have the following:

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

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

5.1 Medical Emergencies:

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

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

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

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

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

5.2 Vehicular or Equipment Accidents:

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

6. EMERGENCY PROCEDURE CHECKLIST

THE FIRST PERSON ON THE SCENE MUST:

- 1 **PROTECT** human health and safety. Eliminate possible dangerous sources. Warn/remove bystanders.
- 2 **ATTEND** to the injured person and apply First Aid.
- 3 **CALL** and wait for emergency response personnel to arrive.
BC Ambulance: **(800) 461-9911**
Direct personnel to Civic Address:
751 Thorsen Creek, Bella Coola
- 4 **STAY** with injured person until medical assistance arrives.
- 5 **CONTACT** the Supervisor and Owner to update the situation.
- 6 **REPORT** in writing on the emergency response as needed when help arrives.

7. EMERGENCY RELATED RESOURCES AND CONTACT NUMBERS

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

APPENDIX A: Emergency Checklist Sheet

EMERGENCY RECORD SHEET

Date of Emergency: _____ Time: _____ am / pm

Location: _____

(Facility and exact location at facility)

Type of Emergency:

☐ Fire

☐ Vehicle or equipment accidents

☐ Medical (minor or major)

☐ Others: _____

What caused the emergency?

Actions Taken: _____

Who was the Emergency Reported to: _____

Emergency Impacts (Injuries, accidents, damage to property)

Report Completed by: _____ Date: _____

Signature: _____

Thorsen Creek Waste & Recycling Centre Landfill – Incident Report

Reported by: _____

Reported to: _____

Department: _____

Date of Report: _____

INCIDENT INFORMATION

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

Location (please be specific): _____

Nature of Incident:

☐ Injury/Illness

☐ Fire

☐ Vehicle Collision

☐ Property Damage

☐ Spill

☐ Other: _____

Incident Description (use additional form if necessary): _____

Nature of Injury (if applicable):

☐ First Aid

☐ Medical Aid

☐ Modified Work

☐ Lost Time

☐ Fatal

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

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

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

Reporting Officer: _____ Phone: _____

Contributing Factors (if any): _____

Corrective Actions: _____

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

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

Reporting Employee Name/Position: _____

Employee Signature: _____ Date: _____

Supervisor Name: _____

Supervisor Signature: _____ Date: _____

Manager Name: _____

Manager Signature: _____ Date: _____

Comments/Recommendations: _____

WITNESS STATEMENT #1

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

This image shows a blank sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

Witness Name: _____

Witness Signature: _____

Date: _____

WITNESS STATEMENT #2

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

This image shows a blank sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

Witness Name: _____

Witness Signature: _____

Date: _____

APPENDIX B: Emergency Preparedness Checklist

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

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

RECEIVED

JUL 23 2013

Central Coast Regional District

File: MR-4223

April 12, 2006

REGISTERED MAIL – RT 779 645 741 CA

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

Dear Operational Certificate Holder,

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

This Operational Certificate does not authorise entry upon, crossing over, or use for any purpose of private or Crown lands or works, unless and except as authorised by the owner of such lands or works. The responsibility for obtaining such authority shall rest with the Operational Certificate holder. Failure to comply with the requirements of this Operational Certificate is an offence pursuant to Section 120 of the *Environmental Management Act*. It is also the responsibility of the Operational Certificate holder to ensure that all activities conducted under this authorisation are carried out with regard to the rights of third parties, and comply with other applicable legislation that may be in force.

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

...2/

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

Yours truly,

A handwritten signature in black ink, appearing to read "Douglas J. Hill".

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

Enclosure

**Operational Certificate
MR-4223**

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

Central Coast Regional District

P.O. Box 186

Bella Coola BC V0T 1C0

is authorised to discharge refuse to land and air contaminants to air from municipal solid waste sources located near Bella Coola, British Columbia, subject to the conditions listed below. Contravention of any of these conditions is a violation of the *Environmental Management Act* and may result in prosecution.

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

1. AUTHORISED DISCHARGES

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

1.1.1. Rate of Discharge

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

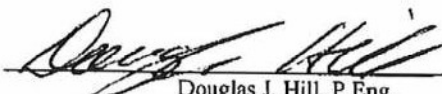
1.1.2. Characteristics of the Discharge

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

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

Date Issued: **APR 12 2006**

Page: 1 of 8



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

Operational Certificate: MR 4223

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

1.1.3. Authorised Works

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

1.1.4. Location of the Point of Discharge

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

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

1.2.1. Rate of Discharge

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

1.2.2. Characteristics of the Discharge

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

1.2.3. Location of the Point of Discharge

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

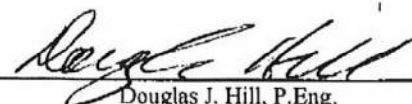
2. GENERAL REQUIREMENTS

2.1. Maintenance of Works and Emergency Procedures

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

Date Issued: **APR 12 2006**

Page: 2 of 8



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

Operational Certificate: MR 4223

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

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

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

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

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

2.2. Process Modifications

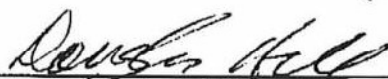
The Operational Certificate Holder shall have written approval from the Director prior to implementing changes to the authorised works that may result in discharges exceeding the characteristics authorised under this Operational Certificate.

2.3. Site Access

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

Date Issued: **APR 12 2006**

Page: 3 of 8



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

Operational Certificate: MR 4223

2.4. Landfill Operation

- 2.4.1. The Operational Certificate Holder shall develop the landfill in a strip shaped cell pattern. The width of each strip cell shall not exceed 6 metres and the height shall not exceed 2 metres.
- 2.4.2. Refuse placed in the active putrescible waste cell shall be compacted at the end of each operating day. The top surface and the working face of the active putrescible waste cell shall be covered with a minimum of 15 cm of clean fill no less than once per week. Suitable alternatives to cover material on the surface of the working face may be used if approved by the Director
- 2.4.3. Final cover of the landfill surface shall be with a layer of compacted soil no less than 1 metre deep plus a minimum of 0.15 metres of topsoil with appropriate vegetation established. The final surface of the landfill shall be crowned to promote runoff of surface waters and to prevent ponding
- 2.4.4. Provision of surface water diversion works and site restoration as required, shall be carried out to the satisfaction of the Director.
- 2.4.5. Vegetation shall be removed from the surface of the entire site annually.

2.5. Litter Control

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

2.6. Segregation of Recyclable Materials

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

2.7. Electric Fencing

2.7.1. Bear Proof Containment of Putrescibles

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

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

2.7.2. Electric Fence Design, Construction and Maintenance

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

2.7.3. Period of Operation

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

2.7.4. Minimum Voltage

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

2.7.5. Gate Operation

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

2.7.6. Fence Inspections

The entire perimeter of the electric fencing shall be inspected at least once every seven days and the voltage of the fencing measured at several points along the fencing and at each gate using a proper electric fence voltmeter compatible with the brand of the fence charging unit. Any results less than the minimum 6,000 volts or any problems which affect operation of the fence shall be immediately investigated and corrected. In addition, the Director shall be notified as per section 2.1 in the event that the voltage is not maintained above 6,000 volts.

In cases of low voltage or signs of penetration attempts, inspections shall be increased from once per week to once per day until proper voltage is

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

2.7.7. Record Keeping and Reporting

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

2.8. Operational Requirements for Regulated Open Burning of Wood Residue

2.8.1. Timing

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

2.8.2. Nature of Wastes

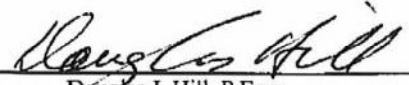
Only cardboard and clean woody debris from demolition, land clearing or construction operations may be incinerated. Tires, treated lumber, asphalt products or hazardous waste shall not be burned. No material other than dry wood, paper, cardboard, propane, diesel fuel oil, or commercially prepared fire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

2.8.3. Smoke Control

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

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3. MONITORING AND REPORTING REQUIREMENTS

3.1. Water Sampling and Analysis

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

3.2. Sampling Procedure

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

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

3.3. Analytical Procedures

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

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

3.4. Quality Assurance

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

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

3.5. Reporting

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

TABLE 1 - Monitoring Sites and Frequencies

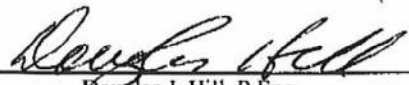
Site Code	Site Name	Water Quality Sample Frequency
E239642	Noohalk Creek upstream of highway 20	field parameters only: once in late winter all parameters: once in early summer
E245136	Noohalk Creek upstream of landfill	field parameters only: once in late winter all parameters: once in early summer

TABLE 2 - Water Quality Parameters

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

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SITE PLAN



N.W. 1/4 of N.W. 1/4

SEC. 30

Tr. 1

0313730

Location of Discharge

DD: 201791
PAGE OF 51
FORFEITED TO CROWN

0.745 ha.

URES

dump

DELETED

LAGOON

DATE

BASE OF SLOPE

of Bay

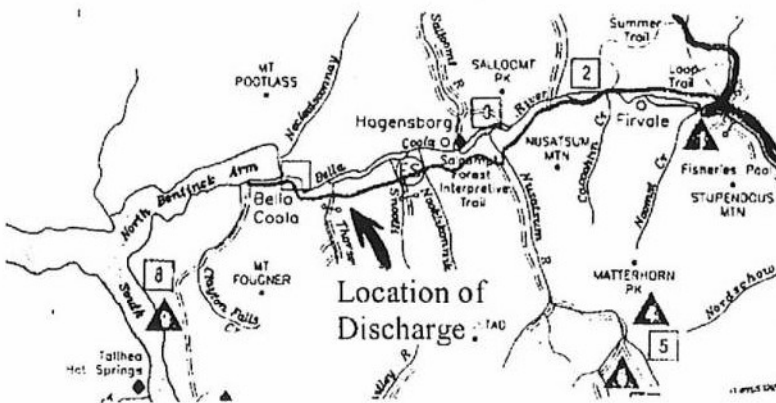
N. $1/2$ of S.W. $1/4$ of N.W. $1/4$

SE 30

DL 452

BOUNDARY OF UNDERHILL PIT

Location Map



Not to Scale

Operational Certificate MR-4223

Date: **APR 12 2006**

Douglas J. Hill
Douglas J. Hill, P. Eng.

For Director, *Environmental Management Act*
Cariboo Region

**APPENDIX “D” BYLAW 551 SOLID WASTE DISPOSAL RATES AND
CHARGES;**

CENTRAL COAST REGIONAL DISTRICT
BYLAW NO. 551
SOLID WASTE DISPOSAL RATES AND CHARGES

A bylaw to amend Central Coast Regional District Refused Disposal Regulatory Bylaw, No. 348, 2002

WHEREAS the “Central Coast Regional District Solid Waste Management and Recycling Conversion and Service Establishment Bylaw No. 402, 2011” established a Service for the purpose of establishing, developing, operating, managing and maintaining a solid waste and recycling centre, with Electoral Areas C, D & E participating;

AND WHEREAS the Board of Directors of the Central Coast Regional District by “Central Coast Regional District Refuse Disposal Regulatory Bylaw, No. 348, 2022” regulates the management and disposal of solid waste and recyclable materials and imposes rates and charges payable in respect of the Service;

AND WHEREAS the Central Coast Regional District Board of Directors has deemed it necessary and is empowered to update the rate structure and develop new rates and charges for solid waste and other disposal;

NOW THEREFORE, the Board of Directors for the Central Coast Regional District, in open meeting assembled, enacts as follows:

1. Citation

This bylaw may be cited as “Central Coast Regional District Solid Waste Disposal Amendment Bylaw No. 551, 2025”.

2. Amendment

By deleting Schedule ‘A’ in its entirety and replacing it with Schedule ‘A’ attached to and forming part of this bylaw.

3. Effective Date

This Bylaw comes into effect on July 1, 2025.

READ A FIRST TIME as amended this 17th day of April, 2025.

READ A SECOND TIME this 22nd day of May, 2025.

READ A THIRD TIME this 22nd day of May, 2025.

RECONSIDERED AND FINALLY ADOPTED this 22nd day of May, 2025.

Chair

Corporate Officer

Central Coast Regional District

Bylaw No. 348

SCHEDULE 'A'

1. Definitions

"Biomedical Waste" means solid waste such as soiled sheets, garments and other similar solid waste. Excluded is waste material from pathology, operating rooms, laboratories and other hospital operations, which produce potentially infectious waste considered to be special waste;

"Controlled Waste" means certain hazardous waste, liquid waste and Municipal Solid Waste which is approved for disposal at the Thorsen Creek landfill site but which, because of its inherent nature and quantity, may require special handling and disposal techniques to avoid creating health hazards, nuisances, or environmental pollution. Controlled Waste includes, but is not limited to:

- a. Demolition waste including:
 - i. Roofing materials;
 - ii. Clean construction materials
 - iii. Drywall/gypsum board;
 - iv. Stumps, land clearing debris;
 - v. Yard and garden waste (branches 2" and under)
- b. Contaminated soils:
 - i. Traces of petroleum products;
 - ii. Catch basin and manhole material
- c. Fish shrimp shells, animal carcasses;
- d. Steel cable;
- e. Biomedical waste;
- f. Loads containing fish feed totes

"Corrugated Cardboard" means recyclable waste from industrial, commercial, institutional sources which includes, but is not limited to containers or materials used in containers consisting of 3 or more layers of Kraft paper material and having smooth exterior liners and a corrugated or rippled core, but excluding containers which are impregnated with blood, grease, oil, chemicals, food residue, was; or have polyethylene, foil or other non-paper liners; or are contaminated with a material which will render the corrugated cardboard not marketable;

"Construction/Demolition Waste" means waste produced from the construction, renovation, and demolition of building, bridges, wharfs, rail lines and other structures, but does not include waste containing or contaminated with asbestos, creosote, PCB treatments, paints or chemicals of any kind;

"Hazardous Waste" means gaseous, liquid and solid waste which, because of its inherent nature and quantity, requires special disposal techniques to avoid creating health hazards, nuisances, or environmental pollution. Hazardous Wastes are toxins or poisons, corrosives, irritants, strong sensitizers, flammables, explosives, infectious waste, condemned food, etc., flammable wastes excluding plastics, paper products and the like;

"Ignitable" means having the properties of:

- a. Flammable gas,
- b. Flammable liquid, or
- c. Flammable solids, or substances susceptible to spontaneous combustion or substances that on contact with water emit flammable gasses as defined in the Special Waste Regulations of the Environmental Management Act;

"Metal" means recyclable ferrous and non-ferrous metallic materials which include, but are not limited to: sheet metal, siding, roofing, rebar, flashings, pipes, window frames, doors, furnaces, duct work, wire, cable, bathtubs, fencing, bicycle frames, automotive parts, machinery, appliances, garbage cans, metal furniture, tire rims and metal cans. It does not include metal that is incorporated into a product or packaging, such as a couch, that does not compose more than 50% of produce weight and that cannot be readily separated from the non-metallic components;

"Radioactive Waste" means waste containing a prescribed substance as defined in the Atomic Energy Control Act in sufficient quantity or concentration to require a licence for possession or use under the Act and regulations made under that Act;

"Reactive Waste" means waste which is:

- a. Explosive, oxidizing, or so unstable that it readily undergoes violent change in the presence of air or water;
- b. Generates toxic gasses, vapours, or fumes by itself or when mixed with water; and
- c. Polymerizes in whole or in part by chemical action and causes damage by generating heat or increasing volume; as defined in the Special Waste Regulations of the Environmental Management Act;

"Refuse" means discarded or abandoned materials, substances or objects; but does not include Controlled Waste and Prohibited Waste;

"Residential Household Refuse" means non-hazardous solid waste generated by normal, non-commercial households.

"Stewardship Materials" means any waste or recyclable materials in an approved stewardship plan as defined in the Recycling Regulation of the BC Environmental Management Act.

Schedule of Rates and Charges

Solid Waste, excluding Controlled Waste	Tipping Fee	Other Charges	Notes
Residential household refuse-bagged	\$5 per bag (standard residential garbage bag of up to 67 litres)		
Residential Refuse – Loose (unbagged)	\$52 per cubic meter	Minimum Charge \$10	Includes large household items such as furniture, swimming pools
Commercial, institutional or industrial general refuse – <u>Includes bagged waste</u>	\$52 per cubic meter	Minimum Charge \$10	
Commercially or Institutionally generated corrugated cardboard	\$52 per cubic meter	Minimum Charge \$10	Uncompacted cardboard is charged at ½ rate
Note 1: In the event that an incoming load contains multiple categories of waste, the higher of the applicable minimum charges will be applied.			
Note 2: Metals, clean wood waste and cardboard must be sorted and disposed of in the appropriate bins at the transfer station or in landfill area as directed by attendant.			

Controlled Waste	Tipping Fee	Other Charges	Notes
Construction & Demolition Waste	\$68 per cubic meter	Minimum Charge \$10	See Note 1 below.
Construction & Demolition Waste – Unsorted	\$135 per cubic meter	Minimum Charge \$10	See Note 1 below.
Clean Wood Waste	\$52 per cubic meter	Minimum Charge \$10	
Yard & Garden Waste	\$52 per cubic meter	Minimum Charge \$10	
Stumps, land clearing debris	\$68 per cubic meter	Minimum Charge \$68	
Steel Cable	\$335 per cubic meter	Minimum Charge \$10	Maximum 10' lengths
Fishing Nets	\$168 per cubic meter	Minimum Charge \$10	
Cooking Oil	Free		Accepted at attendant's discretion
Animal Carcasses	\$84 per cubic meter	Minimum Charge \$10	No charge for critters disposed of by a government agency
Asbestos	\$84 per cubic meter	Minimum Charge \$84	Requires CCRD approval
Creosoted/Treated wood	\$252 per cubic meter	Minimum Charge \$10	Accepted at CCRD discretion

Hydrocarbon Contaminated Soil	\$335 per cubic meter	Minimum Charge \$335 plus any estimated out of pocket treatment costs	Must be Ministry of Environment Approved and receive CCRD approval
Other Waste such as large items requiring special handling, or items that are not suitable for landfilling such as concrete, asphalt	As determined by CCRD		Accepted at CCRD discretion
Note 1: Loads of construction and demolition debris must have metals and clean wood waste separated and be disposed of in the designated bins at the transfer station. Deposition of unsorted waste must receive CCRD permission. Note 2: In the event that an incoming load contains multiple categories of waste, the higher of the applicable minimum charges will be applied. Note 3: Volumes of incoming waste will be determined by the Landfill Attendant or other person(s) designated by the Central Coast Regional District as the regional district representative. If a customer wishes to dispute the assessed volume, this must be done in writing to the CCRD Operations Manager or designate prior to deposition of the waste at the transfer station/landfill. The CCRD Operations Manager or designate will issue a determination that is final.			

Recyclable Materials	Tipping Fee	Other Charges	Notes
Fridges/Freezers/ODS Containing Appliances	68 each		Doors must be removed and no food inside
Large Appliances (stoves, washers, dryers, dishwashers)	\$32 each		
Recyclable Metal	\$52 per cubic meter	Minimum Charge \$10	All motors must have fluids removed. Metal tanks must be empty prior to disposal.
Mattresses and box springs	\$52 per item		
Tires (Light Vehicle and bicycle) with Rims Removed	Free		
Tires with Rims (light vehicle)	Not accepted		Not Accepted
Commercial, farm and off-road tires	Charged according Tire Stewardship BC pricing plus \$19 handling fee per tire		Rims must be removed

Vehicle Hulks (light Duty passenger vehicles)	\$503 each		All fluids, batteries and tires must be removed by a licenced inspection facility unless otherwise authorized by CCRD
Commercial Vehicle Hulks	As determined by CCRD		Accepted at CCRD discretion
1 lb propane tanks	Free		
Propane tanks >1lb to 100 lb	\$19		
Stewardship program materials such as household generated packaging, cardboard, light bulbs, light fixtures, paint, household hazardous waste, batteries, used oil & Antifreeze, oil filters and containers, small appliances, and electronics.	FREE		Certain stewardship programs prohibit the collection of commercially generated items. In such instances a tipping fee will be assessed.

Other Rates & Charges	Amount (\$)		Notes
Dumping of 4-yard bins with CCRD Packer Truck	\$7 per bin		This charge is in addition to tipping fees
Storage of 4-yard bins at transfer station	\$3/bin per day		Bins lids must be properly secured to prevent access by bears or other wildlife
Special Opening of Landfill	At cost plus 20%		Subject to approval by CCRD. A 4 hour minimum will apply.

Prohibited Waste – The following wastes are not accepted for landfilling

Liquid waste - with the exception of cooking oil which must be disposed of in accordance with the transfer station attendant's direction

Hazardous waste with the exception of asbestos and hydrocarbon contaminated soils

Ignitable wastes

Reactive Wastes

Radioactive waste
Biomedical/Medical Waste
Pool Chemicals
Solid waste that is on fire or smouldering
Metal that is recyclable
Clean wood waste
Stewardship materials

APPENDIX “E” – EQUIPMENT AND SUPPLIES

THORSEN CREEK WASTE & RECYCLING CENTRE OPERATION CONTRACT

Proposal Submitted By:

	)	Name and address of Proponent
	)	
	)	
	)	
	)	

To:

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

PART 1 - PRICING.

I/We, propose the following pricing (in Canadian Dollars) to perform the duties as described in the RFP Package for Operation of Thorsen Creek Waste and Recycling Centre and for Force Account Work (Hourly work requested by CCRD over and above contractual obligations) for the period commencing January 1, 2027 and extending until December 31, 2032.

ITEM NO	DESCRIPTION OF WORKS /SERVICES	TENDERED RATE/PRICE (GST EXCLUDED)
1.	Monthly fee for operation of Thorsen Creek Landfill and Transfer Station (in accordance with sample contract)	\$ / month
2.	Special levy / additional operating day designated by the CCRD - per day, all found price	\$ / day
3.	Force Account Rate _____ Dozer – all found price	\$ / hour
4.	Force Account Rate _____ Front End Loader - all found price	\$ / hour
5.	Force Account Rate _____ Excavator – all found price	\$ / hour
6.	Force Account Rate _____ Dump Truck – all found price	\$ / hour
7.	Force Account Rate - Superintendent – all found price	\$ / hour
8.	Force Account Rate - General Labourer – all found price	\$ / hour
9.	Authorized supplies and expenses – Material costs/expenses on individual items valued at more than \$100 to be substantiated with copies of receipts . Cost is deemed to be the net pre-tax amount.	At cost

PART 2 – CONTRACTOR EXPERIENCE

Contractor Personnel	Number of Years of Relevant Experience (landfill, quarry, or comparable heavy construction)	Details (include relevant experience and location of key personnel)
Contractor/Business		
Superintendent Name: _____ _____		
Attendant Name: _____ _____		
Attendant Name: _____ _____		
Subcontractor Name: _____ _____		

PART 3 – CONTRACTOR EQUIPMENT DEDICATED TO LANDFILL SITE

Type of Proposed Equipment	Details (Make, Model, Year, Hours, Condition, Leased or Owned, Current Location)

PART 4 – SUB-CONTRACTORS (IF ANY)

Name of Sub-contractor	Description of Sub-contractor Role

I acknowledge that I have read and understood the requirements and specifications within the sample contract included with the RFP Package, and that the information included in my proposal is accurate and free of any misrepresentation.

DATED: _____

Signature _____

Name (Printed) _____

Position _____

WorkSafe BC No. _____ (I/We certify I/we are a member in good standing)

GST Registration No. _____

SCHEDULE “A” – LANDFILL OPERATOR SERVICES

Site Contact: Nicola Koroluk, Solid Waste Coordinator (250-982-0081)

Required scope of work and specifications for the Thorsen Creek Landfill are as follows:

File: CCRD/XXXXX

Attachment to the Agreement with **name** for **supply of labour, equipment and materials required for the operation of Thorsen Creek Waste and Recycling Centre.**

1. General

- 1.01 These specifications describe the operation of the Thorsen Creek Waste and Recycling Centre or “the Site”, which includes both the Landfill Area and the Transfer Station/Recycling Facility and Areas as shown on Appendix A.
- 1.02 Except as herein agreed to, the Contractor shall provide all necessary equipment, materials, labour, supervision and perform all work, and fulfil everything as set forth and in strict accordance with the Contract Documents.
- 1.03 The Site shall be operated in accordance with the Environmental Management Act, its successor legislation, Operational Certificate No. MR-4223, attached as Appendix B, Design, Operations and Closure Plan, attached as Appendix C.
- 1.04 The Contractor shall accept for disposal at the Site all Solid Waste as defined herein, except those items specifically prohibited by Schedule A 4 (a), these Operational Specifications as currently written or amended from time to time by the Central Coast Regional (CCRD), attached as Appendix D.
- 1.05 The Landfill and Recycling Areas are available to all residents, businesses, corporations, and institutions located within Electoral areas C, D and E of the CCRD.
- 1.06 The Contractor shall operate the Site in accordance with WorkSafe BC/Workers Compensation Board regulations, existing and amended CCRD bylaws, the Health Act and other applicable policies of the CCRD.

If any task or service is not expressly described in this Contract but is reasonably incidental to, and necessary for, the proper performance of the Work and the operation of the Site in accordance with Operational Certificate MR-4223, such task or service shall be deemed included in the Work and in the Contract price, except where it constitutes Force Account work expressly directed by the CCRD.

Transition and Commencement of Services

Upon award, the CCRD and the successful Proponent will confirm a transition plan and commencement date. The Contractor shall have all required Equipment on Site and fully operational, and shall be prepared to assume full operation of the Site, on or before January 1, 2027.

The CCRD may, at its discretion, arrange a period of overlap or coordination with the outgoing contractor to allow for orderly handover, site familiarization and continuity of service, and the Contractor shall cooperate in good faith with any such handover.

The Contractor shall ensure there is no interruption or loss of coverage of Services during the transition, and the Site shall remain in compliance with Operational Certificate MR-4223 at all times.

2. Work By Contractor

- 2.01 The Work of this Contract to be performed by the Contractor shall include:
 - (a) Operation of the landfill in accordance with Operational Certificate MR-4223 (Appendix B);
 - (b) coordinating with the transfer station on the transfer of waste from the Transfer Station to appropriate sites at the landfill;
 - (c) constructing and maintaining access roads and parking areas within the landfill and transfer station property;
 - (d) removal of recyclable materials such as automotive/marine batteries, tires, and scrap metal from the General Refuse, and transportation of same to designated on-site stockpile areas;
 - (e) removal of clean wood waste from the waste stream and moving it to a designated clean wood waste storage area or burning it in accordance with the BC Open Burning Regulation on an as-needed basis;

- (f) coordinate with the landfill attendant and/or transfer station attendant the transfer of putrescible waste, construction & demolition waste, metals, wood waste, commercial cardboard from the Transfer Station Area to the Active Face and other designated areas at the landfill/transfer station site;
- (g) spreading, leveling and compacting of Refuse in accordance with the CCRD filling plan and *The Landfill Criteria for Municipal Solid Waste, 2nd Edition, British Columbia, BC Ministry of Environment; June 2016*. Wastes are to be spread in thin layers (0.6 m or less) on the active face and compacted. 5 passes of the compacting equipment over the wastes are usually sufficient to achieve adequate compaction.
- (h) receiving, handling and depositing of waste asbestos or asbestos-containing waste in the designated asbestos disposal area and in accordance with *The Landfill Criteria for Municipal Solid Waste, 2nd Edition, British Columbia, BC Ministry of Environment; June 2016*;
- (i) covering of the compacted waste with ADCS or 15cm of clean cover material deemed acceptable by the CCRD, or an alternate cover material, at the end of each working day;
- (j) development of landfill cells in accordance with Operational Certificate MR-4223 and the Filling Plan;
- (k) excavating, transporting and applying daily cover on the active face as required;
- (l) excavating, transporting and applying intermediate cover on the top of each lift;
- (m) excavation, transportation, placement and compaction of soils to provide daily and intermediate cover to Cells, to construct embankments and to construct new roads;
- (n) maintain drainage patterns and structures;
- (o) maintain log book with cover soil application summaries as requested;
- (p) monitor electric bear fence and complete minor repairs to the electric bear fence, incl: vegetation management, tightening wires, fixing insulators, gates as needed;
- (q) periodic clean-out of all run-off control ditches to maintain functionality;
- (r) snow removal operations, as necessary, on all roads and operational areas, including the transfer station and recycling areas;
- (s) litter control at the landfill as required, expect major clean after snow melts; and
- (t) other machine work as needed to maintain the landfill;
- (u) other force account work as directed by the CCRD.

3. Work By Others

3.01 The CCRD will undertake the following work by its own forces or by Other Contractors:

- (a) operation of the recycling depot and transfer station
- (b) maintenance of CCRD equipment and infrastructure;
- (c) installing perimeter fencing
- (d) making final rulings on acceptable and unacceptable wastes;
- (e) making final rulings on tipping fee charges;
- (f) establishing survey location and control points, surveying and periodic grade control;
- (g) compaction testing or earthworks and refuse density;
- (h) seeding;
- (i) litter control at the Transfer Station and along Thorsen Road;
- (j) provision of information signs at entrance to site;
- (k) provision of utilities for existing works and buildings; and
- (l) final cover construction and other major capital projects.
- (m) daily Monitoring and repairing electric fencing at both locations.

3.02 Notwithstanding the Contractor's responsibilities, the CCRD shall maintain overall authority for management and control of the Site. Nothing in this Contract grants the Contractor any interest in the Site, and the CCRD may, at its discretion, retain others to carry out work on and around the site.

4. Hours and Days of Operation

4.01 Disposal of Solid Waste will be allowed and the Site shall be open during the following times: 8:30 a.m. to 5:30 p.m. each Wednesday and Saturday for a total of two days per week, 52 weeks per year. In instances when an opening day falls upon a statutory holiday, provision will be made for a different opening day that week in lieu of the statutory holiday. This day will be agreed upon by the CCRD and Contractor a minimum of 30 days in advance of the statutory holiday in order to allow for notice to the public and scheduling of staff. Each day the Site is open, the Contractor shall remain at the Site a suitable period of time, after the

closing of the Site to the public, in order to properly compact and cover the Solid Waste on the active face and ensure site safety. In addition to regular operating days, the CCRD may designate special levy days, community clean-up days, or other additional operating days from time to time, on a minimum of 14 days' written notice to the Contractor. Additional operating days will be compensated at the per-day rate set out in the Proposal Form, unless otherwise agreed in writing.

5. Materials Accepted

- 5.01 All Solid Waste generated in and collected from the prescribed areas shall be accepted for disposal at the Transfer Station, except for the following prohibited items:
- (a) all liquid wastes;
 - (b) biomedical wastes;
 - (c) radioactive wastes;
 - (d) household generated cardboard (commercially generated cardboard is accepted in the clean wood waste bin);
 - (e) unless otherwise authorized in Operational Certificate MR-4223, hazardous waste, as defined in the Hazardous Waste Regulation and the B.C. Environmental Management Act;
 - (f) recyclables such as household cardboard; vehicle batteries, defined electronic waste, household paint, used oil/antifreeze and unused medication, as covered by specific provincial Product Stewardship programs;
 - (g) materials containing asbestos in concentrations greater than 0.5%, and contaminated soil or noxious weed/infested vegetation, except as accompanied by written authorization from the CCRD;
 - (h) extra large items, such as campers, recreational vehicles and trailers, bunkhouse trailers or boats, except as accompanied by written authorization from the CCRD;
 - (i) vehicle hulks, except as accompanied by written confirmation from a licensed vehicle inspection facility confirming removal of battery(s), tires and fluids.
 - (j) any other items so designated from time to time by the CCRD as prohibited from entering the Site.

6. Transfer Station & Landfill Operation

- 6.01 The transfer station will be maintained by CCRD Staff.
- 6.02 The Contractor will remove snow from the transfer station.
- 6.03 The Contractor will transfer materials to the landfill site when requested.
- 6.04 The contractor shall coordinate with the landfill attendant the transporting, emptying and replacing the three 30 yard bins (metal, construction and demolition debris and wood waste/commercial cardboard). This must be done regularly to ensure the bins do not overflow. This must take place during non-operational hours.
- 6.05 At the end of each operating day, the Contractor will ensure all material placed in the landfill are compressed and covered in accordance to the operating certificate.
- 6.06 The Contractor shall obtain Cover Material from areas of the Site as designated by the CCRD Representative. The CCRD shall retain responsibility for terracing of borrow pit areas to maintain the area in a safe manner.
- 6.07 From time to time, the CCRD will authorize the receipt of asbestos containing waste. The contractor will prepare a pit and immediately bury asbestos waste in accordance with *The Landfill Criteria for Municipal Solid Waste, 2nd Edition, British Columbia, BC Ministry of Environment; June 2016* and applicable WorkSafe BC procedures.
- 6.08 Given reasonable notice, the Contractor's Superintendent will make themselves available to meet with the CCRD's representative to review landfilling.

7. Landfilling Method

- 7.01 The Landfill will be constructed primarily using cells as described in the *BC Landfill Criteria*. The filling plan described in the Design, Operation and Closure Plan ("DOCP") will be followed.
- 7.02 A 150 mm thick daily cover layer or an alternate cover approved by the CCRD shall be placed over compacted landfill waste at the end of each operating day. This cover shall extend from the previous day's cover to the top of the Active Face.
- 7.03 For daily spreading, covering and compaction of Refuse, the landfill equipment shall be capable of compacting the deposited material to a density of 500 kg/m³ or greater. The Contractor shall operate their landfill compacting equipment for sufficient time, and in such a manner as is required to level and compact the deposited material to a minimum density of 500 kg/m³. Best operating practice recommends five passes on each track width over the waste.
- 7.04 The Waste to Cover Ratio shall be a minimum of 3.0:1 in terms of volume.
- 7.05 Placement of Waste material shall be controlled by spreading the Waste with Landfill equipment to establish compaction in layers not exceeding 300 mm with each layer placed and compacted to achieve a maximum of 2.7 metres in height before applying an intermediate cover layer 300 mm thick.
- 7.06 A 1000 to 1300 mm high berm should be constructed on the outer edge of each cell so that filling can proceed against an inclined berm at all times. The outer face of the berm shall have a finished grade of 3H:1V after cut back. The inner face of the berm should be at the natural angle of repose.

8. Recycling and Other Operations

- 8.01 The Contractor will maintain the following designated areas separate from the Landfill Area for the receipt of materials as specified in Appendix A:
- (a) Burn pile
 - (b) Metal area for refrigerators, freezers, air conditioners and propane tanks
 - (c) Mixed Metal area for metals other than those identified in (b) above
 - (d) Automobile area
 - (e) Fishing net pile
 - (f) Concrete, Asphalt area
- 8.02 Refrigerators, freezers, air conditioners and propane tanks shall be maintained in a designated area in an upright position pending removal of fluids and valves.
- 8.03 Those waste materials destined for the burn pile as specified in Appendix B shall be burned on a regular basis, except as prohibited by fire season, in a safe manner and in accordance with the Operational Certificate.
- 8.04 The Contractor will compact and stack the metal pile in a way that maximizes the storage capacity of the designated area.
- 8.05 Fishing nets will be maintained in a compact pile and, if necessary, covered with tarps or other material to avoid scattering by or danger to birds.

9. Wildlife Control and Electric Bear Exclusion Fence

- 9.01 The Contractor is responsible to prevent the attraction of birds and wildlife by using good housekeeping procedures, including ensuring adequate daily cover of the Active Face of the landfill. Any dead wildlife found on the Site shall be reported to the B.C. Conservation Service and disposed of in accordance with their directions.
- 9.02 Any attempts to penetrate the electric fence by bears shall be immediately reported to the CCRD.

10. Reporting

- 10.01 The Contractor shall provide the CCRD with a brief monthly operating summary, in a format acceptable to the CCRD, noting at minimum: operating days completed, any equipment breakdowns or service interruptions, any safety or environmental incidents, electric fence or wildlife issues, and any matters requiring CCRD attention. The Contractor shall also provide such additional operational information as the CCRD Representative may reasonably request to assist the CCRD in the preparation of financial, annual or other reports and Operational Certificate compliance.

11. Personnel

- 11.02 The contractor shall ensure that sufficient and properly trained personnel are available and who, in the absence of the Contractor, possess sufficient skills, qualifications and experience to operate the Equipment and carry out the full scope of Work as required.
- 11.03 Wages and hours of labour employed shall be in accordance with Federal, Provincial or Territorial enactments.
- 11.04 The Contractor shall, at all times, enforce discipline and good order among their employees and/or subcontractors and shall not employ on the Work Site any unfit person or anyone not skilled in the Work assigned to him. Any persons employed on the Work Site, who become intoxicated, intemperate, disorderly, incompetent or willfully negligent, shall, at the written request of the CCRD, be removed from the work Site and shall not be employed again in any portion of the Work without the approval of the CCRD.
- 11.05 The Contractor will designate a Superintendent.

12. Superintendence

- 12.01 The Contractor shall employ a competent superintendent and/or necessary assistants who shall be in attendance at the Work Sites at all times while Work is being performed.
- 12.02 In the interest of supplying the CCRD and public with consistent and reliable service, the Contractor superintendent must live within one-hour drive of TCWRC and be available to be on Site during any given operating day, unless otherwise authorized by the CCRD. The superintendent or designate must be available to respond in a timely manner to any emergency event at the landfill/transfer station and operate equipment as needed to deal with an emergency.

13. Equipment

- 13.01 Except as specified herein, the Contractor shall provide all other Equipment required for the execution of the Work. Equipment may be owned, leased, or secured through documented third-party arrangements, provided it is available on Site as required by these specifications.
- 13.02 The Contractor shall provide the following set of equipment, at minimum, which shall be available on Site during days of operation:
- (a) A tracked excavator with a weight classification of at least 25 tonnes and equipped with a digging bucket, clean up bucket and hydraulic thumb; a front-end wheel loader with bucket, a dump truck capable of moving cover material and metals and snow removal equipment; OR
 - (b) A tracked excavator with a weight classification of at least 25 tonnes and equipped with a digging bucket, clean up bucket and hydraulic thumb and a combination of equipment capable of achieving compaction of waste, transport/spreading of cover material, burning or wood and cardboard piles, organization/mounding of metal pile and snow removal.
- 13.03 The equipment provided by the Contractor shall be capable of performing the following tasks:
- (a) spreading and compacting waste;

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- (b) excavation for berm and cover materials;
 - (c) hauling excavated materials to points of use;
 - (d) compaction of earth fills and roadways;
 - (e) construction and grading of access roads;
 - (f) face berm construction;
 - (g) fire control;
 - (h) road and ditch maintenance;
 - (i) snow removal;
 - (j) compacting and loading scrap metal; and
 - (k) moving large components of the waste stream, such as timbers, vehicle hulks and other large materials to designated areas of the site.
 - (l) Removing vegetation from the site
- 13.04 The CCRD agrees to allow the Contractor to store Equipment required to perform the Work at the Site during non-operating days and hours but accepts no responsibility for damage or vandalism.
- 13.05 The Contractor shall maintain all Equipment in good operating condition. In the event that any Equipment required to perform the Work becomes inoperable, the Contractor shall notify the CCRD as soon as reasonably possible and shall take all reasonable steps to maintain daily cover and Site compliance in the interim. The Contractor shall repair the Equipment or provide a suitable replacement such that full Services resume within seven (7) business days, and shall maintain a written contingency plan identifying sources of backup equipment, whether owned, leased, or available through a third-party arrangement.
- 13.06 Where a breakdown affects the Contractor's ability to compact and cover waste on a scheduled operating day, the Contractor shall coordinate with the CCRD on alternate arrangements to ensure the active face is covered in accordance with the Operational Certificate.
- 13.07 The Contractor will ensure their employees are trained on the safe use of equipment.
- 14. Site and Facilities Maintenance**
- 14.01 The CCRD will provide the following facilities: Transfer Station Area, and Site Attendant's Office. The following conditions shall apply:
- (a) The Contractor shall not construct any buildings, structures or improvements without prior approval of the CCRD.
- 14.02 The Contractor shall be responsible for the maintenance of all active roads and parking areas within Transfer Station and Landfill sites. Maintenance shall include snow removal, grading, graveling, salting and sanding as required.
- 14.03 Drainage ditches and surface water controls shall be developed and maintained as specified in consultation with the CCRD.
- 14.04 The Contractor shall install and maintain such barricades and directional signs as provided by the CCRD including, but not limited to, information signs at the entrance to the Site; signs directing traffic to the Drop Off Area and the Recycling Facility and Areas; and internal signs identifying specific Solid Waste/recycling disposal areas.
- 14.05 At the beginning of each day the Site is open to the public, the Contractor shall be available to assist with the removal of any Solid Waste that has been deposited incorrectly since the last operational day.
- 15. Fire Control**
- 15.01 The Contractor shall perform all work in a fire-safe manner. He shall comply with all applicable governmental requirements and, without limiting the generality of the foregoing, shall supply and maintain at the Site adequate and proper fire-fighting equipment.

- 15.02 The Contractor shall be responsible for protecting the Site from fire, as well as preventing the spread of fire to adjacent properties should a fire occur at the Site.
- 15.03 The Contractor shall, in the event of fire at the Site, operate their equipment to control and extinguish the fire, and call upon the fire department to respond.

16. Safety Program

- 16.01 The Thorsen Creek Waste and Recycling Centre is a multi-employer work site and governed by WorkSafe BC's Occupational Health and Safety Regulations and Policies. The Contractor will assume the Prime Contractor role for the site.
- 16.02 The Contractor is advised that the Work is being performed in and adjacent to buried waste and refuse. During normal operations, the potential exists to puncture containers that could become explosive, release pockets of landfill gas under pressure, release fluids that could be contaminated, create surface subsidence by shifting refuse, and other types of hazards. Exposure to decaying waste is possible during this work. Exposure may also include possible contact with leachate, asbestos, inhalation of landfill gas, explosion, pathogenic bacteria, and others.
- 16.03 The Contractor shall develop, maintain and supervise for the duration of the Work a comprehensive safety program that will effectively incorporate and implement all required safety precautions. The program shall, as a minimum, respond fully to the requirements of all applicable laws, ordinances, rules, regulations and orders and general operations practices for the safety of persons or property, including without limitation any general safety rules and regulations of the CCRD and any Workers' Compensation or Occupational Health and Safety legislation or regulations that may be applicable (e.g. WHMIS).
- 16.04 The Contractor shall inform all workers, sub-trades and their workers, and the public attending the job Site through the course of the Work of the potential for the presence of methane, landfill gases, and other potentially hazardous waste and the importance of safety precautions to ensure the safety of all workers and the public.
- 16.05 The Contractor shall be solely and completely responsible for ensuring safety of all persons and property, (including CCRD staff, employees, sub-trades and the public) on the Landfill property during the performance of the Work. This requirement shall apply continuously and not be limited to normal working hours. Safety provisions shall conform to all applicable federal, provincial, and regional laws, Owner's policies and procedures developed for the Landfill, ordinances, codes, and regulations. Where any of these are in conflict the more stringent shall be followed.
- 16.06 The Contractor shall send a designate to any CCRD Safety Meetings as required.
- If the Contractor performs any part of the Work in an unsafe manner, or fails to follow its safety program or the requirements of this Contract, the CCRD may direct the Contractor to suspend the affected Services until the matter is corrected to the CCRD's satisfaction. The Contractor shall not be entitled to any additional compensation as a result of any such suspension.
- 16.07 The Contractor shall supply and maintain, at their own expense, at their office or other well-known place at the Site, safety equipment necessary to protect the workers and general public against accident or injury as prescribed by the governing authorities.

17. Security

- 17.01 TCWRC is in an isolated location and the Contractor shall take reasonable measures to ensure that vandalism is deterred.
- (a) The CCRD will be responsible for unlocking the entry gate at the beginning and end of each day's operation, and the Contractor will be responsible to ensure the land fill gate is locked on leaving the site. The Contractor will not issue any gate or CCRD Equipment keys to any third party unless authorized to do so by the CCRD.
- (b) No scavenging is permitted on the Site.
- (c) The Contractor shall report to the CCRD any acts of vandalism or other criminal activities occurring at the Landfill Site and assist with any CCRD and/or RCMP investigation of such acts.

18. Public Relations

- 18.01 The Contractor acknowledges that its employees, agents and Sub-Contractors will be dealing with the public in the execution of this Contract and that the CCRD requires and expects that all persons under the control of the Contractor will conduct themselves in a courteous and respectful manner conducive to good public relations.
- 18.02 The CCRD may request that the Contractor remove and replace any person who does not maintain a professional standard of conduct. Unacceptable conduct includes, but is not limited to, use of foul language, disorderly conduct, neglect of duty and failure to act in accordance with the Operational Specifications or expressed solid waste management and recycling objectives of the CCRD.

Appendices to Schedule A - Operation Specifications:

Appendix A - Landfill Site Plan
Appendix B - Operating Certificate MR 4223
Appendix C – Design Operations and Closure Plan (DOCP)
Appendix D - User Fee Schedule